Accident
Investigation Board
Norway

Bundesstelle für Seeunfalluntersuchung
Federal Bureau of Maritime Casualty Investigation

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REPORT Sjø 2013/01

MARINE INCIDENT REPORT M/S TIDEROSE LEGL/9510242 PASSENGER OVERBOARD NEAR VESTNES ON 16 SEPTEMBER 2012

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.

Accident Investigation Board Norway • P.O. Box 213, N-2001 Lillestrøm, Norway • Phone: + 47 63 89 63 00 • Fax: + 47 63 89 63 01
www.aibn.no • post@aibn.no

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

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NOTIFICATION OF THE ACCIDENT

On Sunday 16 September 2012, the Norwegian Accident Investigation Board (AIBN) was notified by the Norwegian Maritime Authority that a passenger had fallen overboard from the high-speed craft Tiderose. The marine accident happened when the high-speed craft was on its way from Molde to Vestnes. On Monday 17 September 2012 the AIBN decided to launch an investigation into the marine accident. Two accident investigators boarded the vessel and conducted interviews and technical investigations on 18 September.

On Friday 21 September it was decided that the investigation would be carried out in cooperation with Bundesstelle für Seeunfalluntersuchung (BSU), the German investigation board for marine accidents. It was also decided that the AIBN would lead the investigation work.

Figure 1: Map section showing the Romsdalsfjord. The accident site is marked by a red x.

Figure 2: The high-speed craft Tiderose. Photo: AIBN.

SUMMARY

On the afternoon of Sunday 16 September 2012, the high-speed craft Tiderose sailed its ordinary route between Molde and Vestnes. During the crossing, a passenger fell overboard through the side gate (gangway) on the starboard aft deck. The passenger was rescued by the vessel's crew and taken to hospital. The passenger did not suffer any serious physical injuries.

The purpose of the investigation was to describe and analyse the chain of events in order to uncover underlying safety problems.

Two significant safety problems are pursued in safety recommendations to the shipping company and the Norwegian Maritime Authority, respectively.

The first safety problem concerns the securing of the gangway on the aft deck. It serves as a side gate during crossings. To prevent passengers from falling overboard, the shipping company had chosen a solution that meant that the ordinary seaman by routine had to lock the gangway in place. In the opinion of AIBN the shipping company had established a weak barrier against this risk, since many circumstances could result in such a task not being carried out as envisaged in an ideal situation. It is also possible that previous maintenance of the gangway had made it easier for the locking mechanism to be released. The shipping company's locking procedures and existing locking mechanism for the gangway did not provide sufficient safety for the passengers on board.

The other safety problem concerns the rescue arrangements for man overboard emergency situations. In principle, the high-speed craft should be equipped with at least one rescue boat to recover persons from the water (MOB boat). For Tiderose and other small high-speed craft, the Norwegian Maritime Authority grants exemptions from this requirement on certain conditions. Instead of a MOB boat, the high-speed craft was equipped with a rescue frame system, davit and a manual winch on the forecastle. This rescue arrangement was not a sufficiently effective means of recovering the passenger from the sea. The limitations of this rescue arrangement are primarily related to vessels with a (relatively) high freeboard, and to the fact that it is not realistic to expect persons in the water to remain still.

1. DETAILS ABOUT THE VESSEL AND THE MARINE ACCIDENT

1.1 Vessel details

Owner	Norled AS
Responsible for ISM	Norled AS
Home port	Bergen
Country of registration	Norway (NOR)
Type	Catamaran, passenger vessel
Persons on board	Maximum 147 passengers, a total of 150 persons on board
Trade area	5 – Small coasting within radio coverage area A1
Build year	2009
Place of build/build no	Brødrene Aa / 257
Construction material	Composite
Maximum length	24.500 m
Waterline length, Lbp	22.60 metres
Gross tonnage	179.00
Engine power	Main engine: Two main engines, type MAN D2842 LE410 EDC with 809kW each, derated to 749 kW/2100 rpm (1498 kW in total) Auxiliary engines: Two Kohler 27 EFOZ, each with 27 kW, 1500 rpm
Service speed	32 knots
Other relevant information	Propellers: Two controllable pitch propellers Rudders: Two balanced rudders

1.2 Details of the accident

Date and time	16 September 2012, at approximately 16:36 (local time)
Accident location	Vestnes, the Romsdalsfjord. The passenger fell overboard at the following position: N 62° 37.678 E 007° 06.245.
Persons on board	13 passengers, 3 crew members
Injured persons/fatalities	No physical injuries
Material damage/ environmental harm	None

2. THE COURSE OF EVENTS

At 16:00 (local time[1]) on Sunday 16 September 2012, the crew of the Tiderose started the high-speed craft. The crew comprised the captain, an engine room attendant and an ordinary seaman. The high-speed craft was moored at the express boat quay in Molde.

Passengers boarded via the aft gangway on the starboard side. Thirteen passengers embarked for this crossing, including a German married couple and their adult son. The passengers then proceeded to the passenger lounge, where there was a ticket station.

The weather was good; sunny with a westerly breeze and an air temperature of 14 °C. The sea was calm, and the sea temperature was estimated to be 11 °C.

Before the high-speed craft left the quay, the captain told the engine room attendant that he could put off alone. At the time, the captain was sitting in the day room with necessary documentation relating to the vessel's maintenance system. The captain had had a day or two of sickness absence earlier that week, and a stand-in had taken over in his absence. As a result, the captain had fallen behind with follow-up of the stipulated maintenance plan and reporting. By agreement with the captain, the engine room attendant was alone on the bridge when the vessel left the quay. The engine room attendant probably steered the vessel using manual controls.

After having raised the gangway and released the mooring ropes, the ordinary seaman went to sell tickets.

The high-speed craft left the quay as normal according to its timetable. The high-speed craft then sailed for Helland at Vestnes. The engine room attendant continued probably steered the vessel using manual controls.

After buying tickets, the three German passengers went up on deck to admire the view, while the other passengers remained in the passenger lounge. After a while, the German woman and her son descended the stairs and stood on the port side of the aft deck.

The passenger and her son then moved from the port to the starboard side of the aft deck because they wanted to photograph Feøy island. She was standing close to the gangway. The gangway was in the vertical position and functioned as a gate in the side of the vessel, see Figure 3.

[1] All times are given in local time, i.e. UTC +2.

Figure 3: Illustration photo. Starboard gangway on the aft deck. In this position, the gangway serves as a gate in the side of the vessel. Photo: AIBN.

The captain entered the bridge before 16:32. This was about four minutes before the passenger fell overboard.

As they approached Feøy, the engine room attendant asked the captain to take over control of the vessel during docking. The captain sat down in the starboard navigator's seat.

The high-speed craft suddenly and unexpectedly changed course when the captain took over control of the navigation[2]. This was quickly corrected by the captain, and the vessel continued on its planned course. The speed was around 26 knots.

The sudden change of course may have caused the passenger to loose her balance and try to steady herself against the gangway. The gangway fell down, and the passenger fell overboard. The incident happened just before 16:36.

The passenger's son ran upstairs to the bridge and raised the man overboard alarm. In the first 10 seconds after the crew became aware of the situation, the ordinary seaman and engine room attendant started preparations for the rescue, while the captain initiated a hard U-turn.

[2] As the captain took over the manual controls at 16:35:40, the steering machinery received a rudder command of 30° starboard. This command gave an actual rudder angle of approx. 15° and resulted in a rate of turn of approximately 192° per minute. This caused the high-speed craft to change its course by 8° to port for 2.5 seconds. During this time, the vessel moved 33 metres forward and less than 4.7 metres to the side (compared with its original course). The captain then corrected the course by reversing the rudder angle 15° to starboard at 16:35:42.5.

The ordinary seaman and engine room attendant proceeded immediately to the forecastle. While the engine room attendant put on a survival suit, the ordinary seaman rigged the man overboard (MOB) rescue equipment.

The high-speed craft was back with the passenger less than two minutes after she had fallen overboard.

An attempt was made to hoist the passenger onto the deck using a rescue frame. But the passenger grabbed hold of the rescue frame, which made it difficult for the ordinary seaman to place the rescue frame around her. The passenger did not remain still in the water. Language problems arose between the passenger and the crew because they did not speak the same language. The ordinary seaman was unable to place the rescue frame around the passenger.

The engine room attendant jumped into the sea to help to correctly place the rescue frame. During manoeuvring towards the persons in the water, the passenger and engine room attendant drifted under the bow of the vessel.

When the captain backed the high-speed craft, it caused a strong current, and the engine room attendant was forced to let go in order not to pull the passenger along with him. This took place at 16:42.

The ordinary seaman was still trying to secure the rescue frame around the passenger.

At 16:46, the captain called Florø coast radio station to request immediate assistance. In the meantime, the passenger's husband and son had made their way to the forecastle to help. The passenger had been in the water for about nine minutes.

The ordinary seaman fetched a hawser with a large eye. He lowered this to the passenger, who put it in the correct position under her arms.

The ordinary seaman, the husband and son tried to hoist the passenger aboard in a gentle manner. It was very heavy work, since the distance from the waterline up to the forecastle was approx. 1.8 metres. The rubbing band also made it difficult to hoist the passenger up the last part of the vessel's side. The ordinary seaman noticed that the passenger was about to loose consciousness, and managed to lift her onto the deck with a great effort. The time was then 16:47.

The passenger immediately went into the passenger lounge, where she took off her outer clothing and was wrapped in blankets.

At approximately 16:51, the ordinary seaman used the rescue frame, davit and winch to hoist the engine room attendant from the water.

The high-speed craft immediately sailed to Vestnes, where an ambulance was waiting.

Ambulance personnel came aboard at approximately 17:00 and attended to the passenger. She walked ashore herself and was soon after taken to Molde Hospital by ambulance helicopter accompanied by her husband.

The passenger was treated at Molde hospital. She had no serious physical injuries, and was discharged from the hospital on Wednesday 19 September 2012.

3. FACTUAL INFORMATION

The factual information is based on a technical inspection of the vessel, data collected from the vessel, interviews with crew members and passengers, and information obtained from the shipping company, other parties and the supervisory authorities.

3.1 General information about the high-speed craft, the shipping company and the shipyard

The high-speed craft Tiderose sailed on the Romsdalsfjord between Molde, Helland at Vestnes, Vikebukt and Sekken. This was within trade area 5, small coasting. On weekdays, the vessel departs from quay 43 times. On Sundays, the first departure from Molde was at 16:15.

The vessel is a fast catamaran intended for passenger transport. The vessel's maximum speed is 32 knots. The maximum number of passengers is 147.

In its Notification of Newbuilding, the shipyard stated that the vessel was built in accordance with the International Code of Safety for High-Speed Craft (the HSC 2000 Code). This code has not been implemented in Norwegian regulations, but the Norwegian Maritime Authority accepts its use. If used, the code must be complied with in full, and the Norwegian Maritime Authority cannot accept deviations from it.

In areas not covered by the HSC 2000 Code, the rules and regulations in the directorate's publication 'Excerpts from the Norwegian Passenger and Cargo Ship Legislation etc.' that apply to high-speed passenger vessels must be complied with. The Norwegian Ship Safety and Security Act and several regulations will be relevant here.

Norled AS is a wholly owned subsidiary of Det Stavangerske Dampskibsselskap. At the beginning of 2012, Tide Sjø AS was renamed Norled AS. Norled has approximately 1,150 employees and an annual turnover of about NOK 1.6 billion. The company currently operates many car ferry and high-speed craft services along the Norwegian coast. As of November 2012, the company operated 26 high-speed craft and 47 car ferries. Most of their routes are in the counties of Møre and Romsdal, Hordaland and Rogaland, but also in the Oslofjord and the northern part of Troms county.

The high-speed craft was built at Brødrene Aa AS shipyard and handed over to Tide Sjø in April 2009. The Tiderose has two sister ships, the Tide Cruise and the Tidevind[3]. It was the eighth high-speed craft made from composite materials delivered to Tide Sjø by Brødrene Aa. From 2002 to November 2012, Brødrene Aa has delivered 26 high-speed craft made from composite materials.

Pursuant to the Ship Safety and Security Act, the shipping company has an overall duty to ensure that the construction and operation of the ship are in accordance with the rules[4].

[3] Construction no 253, call sign LARN, IMO no 9438963 and construction no 256, call sign LDHI, IMO no 9473494, respectively.
[4] Act of 16 February 2007 No 9 relating to Ship Safety and Security, Section 6.

3.2 Crewing

The vessel was crewed with two shifts in accordance with the basic safety manning requirement. Each shift worked one week and had one week off. According to the Norwegian Maritime Authority, the basic safety manning required for the Tiderose is three people – a master, an engine room attendant and an ordinary seaman.

Qualification requirements only apply to the master. The master must hold a D4 qualification (II/3.5) and have high-speed craft qualifications. The engine room attendant is part of the bridge crew and must also have high-speed craft qualifications.

The main engines were derated to 749 kW/2100 rpm, and the vessel is therefore exempt from the qualification requirement for a certified engineer, cf. Section 4.3.2 of the Regulations concerning the Manning of Norwegian Ships.

The crew on board at the time of the accident had previously completed the shipping company's training for the vessel. The captain had the required qualifications. Both the captain and the engine room attendant had the qualifications required for masters of high-speed craft and other bridge crew. The ordinary seaman was in excellent physical shape.

The police carried out a routine test for alcohol on the crew members on the evening of the accident. There was no indication that any of the crew were under the influence of alcohol.

3.3 Passengers' access to open decks

The high-speed vessel has a total of three open decks – the forecastle, the aft deck and the upper deck. In connection with most departures, passengers board via the aft deck. At one quay, the vessel docks bow first and passengers board via the forecastle.

During the crossing, passengers are in principle free to use the aft deck and upper deck. In summer and when the weather is good, chairs will be provided for passengers on the upper deck. The crew does not allow passengers to use the forecastle under any circumstances.

It is up to the crew to assess whether it is acceptable for passengers to use the aft deck and upper deck. This assessment is primarily based on sea conditions, and whether there are school pupils on board. The crew does not want school pupils to be on the aft deck.

Just before arriving at the quay, it is standard procedure for the captain to ask all passengers via the PA system to remain seated until the vessel has moored. The ordinary seaman would like passengers to stand inside the passenger lounge, and no further forward than the exit door, until the vessel has moored. In the crew's experience, there can be passengers on the aft deck when the vessel moors due to delays, bus connections etc.

In cases of poor weather conditions, difficult quay conditions and crew in training, the vessel's handbook states that it should be considered whether passengers should be asked to remain seated until the vessel has come to a stop.

3.4 Description of gangways, relevant operating procedures and official requirements

3.4.1 Technical gangway arrangements

The high-speed vessel has a total of three gangways, two of which are located on the aft deck. They are hinged to the deck and are lowered and lifted manually by the ordinary seaman. Only the starboard gangway is in use, see Figure 4 and Figure 5. When the gangway is in use, it rests on the quay surface as shown in the figure. The third gangway is at the bow of the vessel, and it is hydraulically operated from the bridge.

Figure 4: Gangway on the starboard side of the aft deck, seen from the quay. The gangway rests on the quay's surface. The black block on the side of the gangway is there to secure the gangway when in the vertical position. Photo: AIBN.

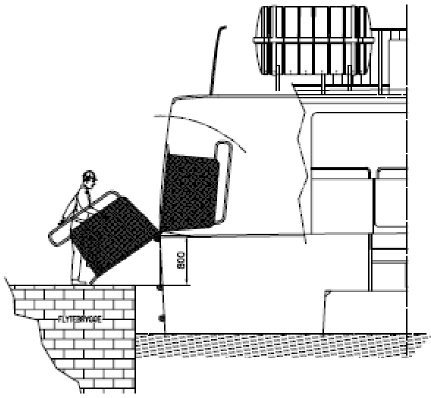


Figure 5: Arrangement sketch of the port aft gangway. The gangway on the starboard side is the same. Source: Norled AS.

During crossings, the gangways function as gates in the side of the vessel, see Figure 3. A bolt at the front of the gangway is used to secure the gangway in the vertical position, see Figure 6 and Figure 7. The ordinary seaman must stand in front of the gangway when securing it. From this position, it will also be possible to see whether or not the gangway has been secured. It is not possible to see whether the gangway has been secured from other positions.

Figure 6: The locking bolt for the starboard gangway on the aft deck is not *secured. Photo: AIBN.*

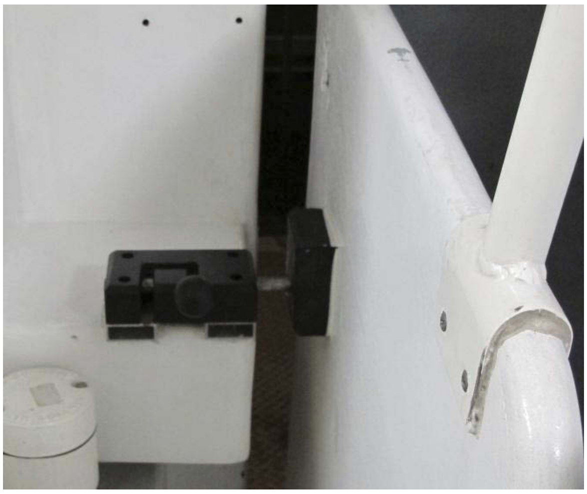


Figure 7: The locking bolt for the starboard gangway on the aft deck is secured. Photo: AIBN.

3.4.2 Description of relevant procedures in the vessel's safety management system

The shipping company's safety management system shows that the company has prepared an overall risk assessment and preventive measures for risk factors that have been uncovered.

In the overall risk assessment, it is pointed out that organisational and symbolic barriers will always entail a risk of human error. The company handbook gives examples of such organisational and symbolic barriers, including labelling, information, procedures and competence.

In addition, the overall risk assessment points out that physical and technical barriers can help to reduce the risk of human error. It is also pointed out that the risk of an undesirable incident can be reduced by implementing several independent barriers.

The vessel's handbook contains the following statement of passenger policy:

> *'We provide efficient and safe passenger and car transport by sea along the coast of Norway. We undertake to have expedient vessels, sufficient qualified personnel and robust procedures for day-to-day operations and maintenance and for dealing with emergency and contingency situations.'*

The shipping company's risk assessment has identified hazards relating to passenger safety, crew safety and environmental harm, respectively. On the basis of the identified hazards, the company has carried out a quantitative assessment of the risk (as the product of probability and consequence) to passenger safety as described in **Annex A: Risk assessment for the Tiderose**. This presentation does not include the man overboard hazard. The company has implemented measures for the hazards with the highest risk, for example by establishing procedures, to reduce the risk to an acceptable level.

Among other things, the vessel's handbook contains a procedure for operation of the aft gangway. There was no description of the operations to be carried out in connection with the most common ports of call where the aft gangway is used.

The vessel's handbook contains a departure procedure, which describes the tasks to be carried out and communication between the captain and the rest of the crew. Among other things, the sequential procedure describes the following:

> *'The captain receives information from mooring stations that they are ready for departure.*
>
> *The captain reduces the pitch so that tension on any moorings is reduced and they can be pulled in.*
>
> *The moorings are pulled in, and the person in charge of the mooring station checks that there is no obstacle to departure.*
>
> *The person in charge of the mooring station communicates this to the captain.*
>
> *The captain manoeuvres the vessel away from the quay while checking any dead angles (particularly when reversing).'*

Other parts of the vessel's handbook mention the gangway in connection with starting up and shutting down for the day (preparing for and concluding scheduled services). These procedures state that the ordinary seaman shall check/carry out securing of the gangway.

The training and checking-out of the ordinary seaman, engine room attendant and captain has included a general reference to vessel data, systems and on-board equipment, and to navigation equipment. These chapters deal with the gangways and the manoeuvring equipment on the bridge.

3.4.3 Official requirements concerning gangways

Chapter 2 of the Regulations of 15 June 1987 No 507 concerning Safety Measures etc. on Passenger Ships, Cargo Ships and Lighters contains requirements for means of access. It stipulates requirements that fixed and portable means of access shall be properly maintained (Section 7.1) and that they shall meet the requirements stated in the appendix to these Regulations or ISO standard No 7061 (Section 9.6).

Section 4 of Annex 1 to the Regulations sets out requirements for gangways. These requirements involve specification of the static load, minimum dimensions, load requirements and arrangements for railings, foothold and maximum inclination, and test loads.

3.4.4 The shipping company's observation of a missing guide sheave intended to hold the gangway in place

After the accident, the shipping company has observed that a guide sheave that held the starboard gangway in place in the longitudinal direction was missing.

The shipping company believes that this guide sheave was not fitted after gangway maintenance carried out during a yard stay in March 2012. This is because the crew felt that it created too much friction, which made it difficult to operate the gangway. The shipping company's explanation is that the personnel who removed the guide sheave did not see the potential consequences of this modification.

3.5 Technical manoeuvring arrangements

The vessel has two independent propulsion lines (starboard and port) that power a propeller under each hull. The propeller has adjustable blade pitch. The vessel has a remotely controlled manoeuvring system that consists of an operating panel and manoeuvring handles to adjust the blade pitch or rpm. A fixed rpm is used when manoeuvring.

The vessel was equipped with a steering system consisting of an autopilot located in the middle of the central console, a manual steering wheel on the armrests of the starboard and port seats, and an emergency system in front of the central console, see Figure 8. The starboard seat was defined as the captain's position. This seat’s manual steering wheel did not have a spring arrangement that would return it to the middle position after it was turned. Since there was virtually no resistance in the manual steering wheel's axle, it was easy to turn it to the side.

The transfer of control from one seat to the other is done by pressing an 'In command' button on the armrest console.

Figure 8: Illustration photo. Overview of the starboard navigator's seat. The armrest is fitted with a manual steering wheel and buttons for the takeover of control of manoeuvring. Photo: AIBN

3.6 Rescue equipment for man overboard emergency situations

From the bridge, the captain has an overview of the rescue operation and the crew on the forecastle. The high-speed craft's rescue equipment includes a rescue frame system, a davit and a manual winch on the foreship, see Figure 9. The rescue equipment was supplied by Sula Bedriftsteneste AS.

The rescue frame system was of the SB Rescue Sling type, where the rescue sling is flush with the frame, see Figure 10. The line from the rescue sling runs through the pulley to the davit.

Once the crew has placed the rescue sling under the arms of the person in the water, the sling is released from the frame. The person is manually hoisted aboard using the winch, see Figure 11.

The manufacturer describes the equipment as being simple to operate and having a good range. It is argued that this equipment makes it far easier to recover people and get them back on board in critical situations.

The manufacturer has set an upper limit of 4 metres freeboard for use of the rescue frame. It is a condition for use of the rescue frame that the person is floating and remains still when the frame is placed around him/her. If a person does not remain still, it could be necessary for one of the rescue personnel to jump into the water to help to put the sling under the person's arms, but the manufacturer does not recommend this, since it will endanger the rescuer's life.

In the 1990s, the rescue frame system was tested in rough seas on a dummy floating in the water, and it proved to be an effective piece of rescue equipment.

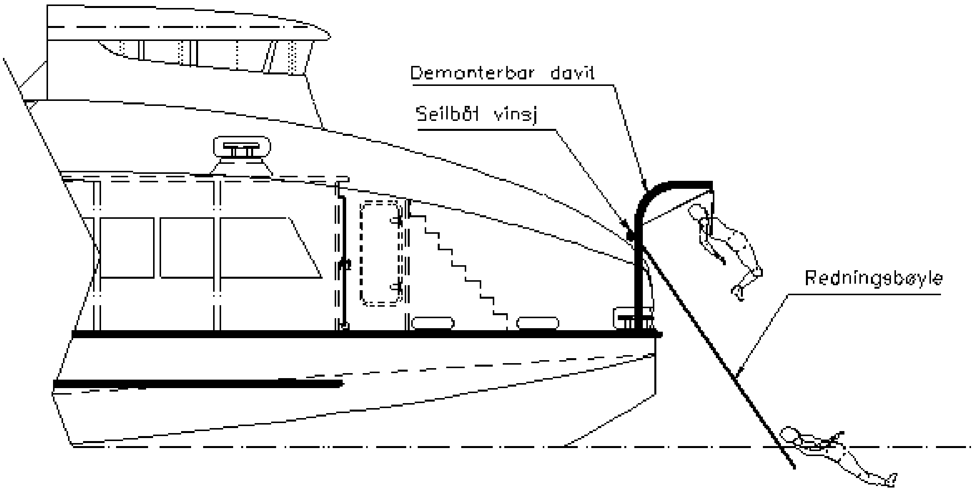


Figure 9: The drawing shows rescue equipment used to hoist a person from the sea. Translation from the figure: Redningsbøyle = Rescue frame system, Demonterbar davit: dismountable davit, Seilbåt vinsj = sailing boat (manual) winch. Source: Norled AS

Figure 10: Photo of a rescue frame. The rescue sling (yellow and white line) lies flush with the frame. The line from the rescue sling runs through the pulley to the davit. Photo: Norled AS

Figure 11: Illustration photos. Use of the SB Rescue Sling to recover a person and hoist him/her aboard. Photo: www.sula.as.

3.6.1 The shipping company's emergency procedure for man overboard situations and drills carried out by the crew

The safety management system contains procedures that describe evacuation drills, fire and smoke diving drills and drills for 15 emergency procedures, including man overboard/missing person.

The vessel's handbook requires the crew to practice all the emergency procedures. The training must be evaluated, documented and entered in the vessel's maintenance system with a work order and specification of the interval.

Before the time of the accident, both crew shifts had carried out monthly evacuation, fire and smoke diving drills. In addition, the two shifts had carried out 28 and 31 emergency procedure drills, respectively, during the first eight and a half months of 2012. Both shifts had practised the 'man overboard' emergency procedure twice in 2012. The last time that shift no 2 (i.e. the shift that was on board at the time of the accident) practised this procedure was in July 2012.

3.6.2 Requirement for man overboard boat (MOB boat)

Regulations No 700 of 15 September 1992 concerning Life-Saving Appliances on Passenger Ships requires non-convention ships engaged in small coasting to carry one or more rescue boats (Chapter 4, Section 18.3 subparagraph 4). The Regulations also require the crew to carry out rescue and fire drills (Chapter 4 Section 24). Chapter 5 Section 40 sets out a requirement for man overboard boats. It has been accepted that the Tiderose complies with the HSC 2000 Code instead of the above-mentioned Regulations.

Chapters 8.10.1.4 and 8.10.1.5 of the HSC 2000 Code set out requirements for equipment for recovering people from the water. In principle, the high-speed craft shall be equipped with at least one rescue boat to recover persons from the water (MOB boat). High-speed craft of less than 30 metres in length may be exempted from carrying a rescue boat, provided that:

- *'the craft is arranged to allow a helpless person to be recovered from the water;*
- *recovery of the helpless person can be observed from the navigation bridge; and*
- *the craft is sufficiently manoeuvrable to close in and recover persons in the worst intended conditions.'*

Pursuant to the Ship Safety and Security Act[5], the shipping company has the primary responsibility for the choice of rescue equipment and for uncovering any operational limitations the chosen equipment has in relation to specific vessels. Operational limitations can relate to freeboard, the equipment's range, its location in relation to visibility, crane dimensions, etc.

Applications for dispensation from the MOB boat requirement are submitted to the Norwegian Maritime Authority. There were no established international or national acceptance criteria for minimum requirements for alternative equipment instead of MOB boats. There were no acceptance criteria relating to the vessel's trade areas and other operating conditions.

The Norwegian Maritime Authority normally takes part in function testing of rescue equipment in which it verifies that the conditions for granting exemption are met.

The Norwegian Maritime Authority has granted exemptions from the MOB boat requirement to many of the high-speed craft that sail along the coast of Norway.

3.6.3 The Norwegian Maritime Authority's consideration of the application for exemption from the MOB boat requirement

In connection with the building of the high-speed craft, the shipyard Brødrene Aa AS applied to the Norwegian Maritime Authority for exemption from the MOB boat and evacuation drill requirements.

The shipyard referred to the fact that the Tiderose's arrangements were identical to those of her sister ships, which had already been granted exemptions. The shipyard described the view from the navigator's seat, and stated that the vessel would be equipped with a rescue frame system, rescue davit on the aft deck and a PA system. It was pointed out that the rescue arrangements at the bow of the vessel can be operated by one person alone. The shipyard had previously demonstrated that this rescue arrangement can be used to hoist a helpless person from the sea.

In connection with the building of the high-speed craft, the Norwegian Maritime Authority considered the shipyard's application and granted an exemption from the MOB boat requirement, cf. the HSC 2000 Code 8.10.1.5, and full-scale evacuation test, cf. the HSC 2000 Code 4.8.10.

3.6.4 Demonstration of the rescue equipment before handover from the shipyard

In connection with the shipyard's technical testing of the vessel's systems (before handover to the shipping company) it was found that the rescue frame system could be

[5] Act of 16 February 2007 No 9 relating to Ship Safety and Security, Section 9.

operated by one person alone. This conclusion was based on a demonstration of the rescue equipment, but without a person in the water. The reason why the arrangement was not tested with a person in the water was that the water temperature was low. The test had already been carried out on a corresponding vessel, and, on the basis of the equal treatment principle, the Norwegian Maritime Authority accepted the arrangements.

3.6.5 Other vessels that use the rescue frame and their experience

The Norwegian Maritime Authority cannot refer to experience of the effectiveness of the rescue frame from actual operations. Searches of the directorate's accident database find no relevant accidents where the rescue frame has been used.

Other high-speed ferries owned by the shipping company were also equipped with a rescue frame system, davit and winch supplied by the same manufacturer.

Another high-speed craft operated by Norled was also equipped with a basket. The basket is used to lower a crew member to the water surface to better help to put on the rescue sling.

Many of the Norwegian Society for Sea Rescue's (NSSR) vessels have a rescue frame on board. The NSSR's experience of the rescue frame was that it can be used effectively to control the person in the water, but they use other equipment to hoist the person from the sea. The NSSR has also found that rescue from a vessel with higher freeboard is less effective than from an MOB boat or a vessel with low freeboard. For more information, see Annex B.

The Norwegian Coastal Administration's pilot vessels are also equipped with rescue frames. The pilot vessels usually have a platform at the aft where the person in the water can be helped aboard.

3.6.6 Theoretical background to immediate reactions when a person in the water is in distress

This section aims to provide theoretical background for the discussion in section 4.4.

The book *Livredning for folk flest*[6] describes how a person in the water in distress can grasp anything within reach and cling to it. In other cases, the person can be so cold and exhausted that it is difficult to hold on to anything. It can be very difficult for the rescuers to read the situation in advance. The book therefore emphasises the importance of at least using something that extends the arm. It can be a rescue buoy, rescue line, oar, ladder, board, rope etc. The point is to use an aid that floats and that the person (in distress) can grab hold of, while the rescuers' own safety is preserved.

According to the book *Katastrofepsykologi*,[7] in a disaster situation, most people will find that they absorb, process and store information in a different way from what they normally do. This is an important immediate reaction that helps people to face danger. A shock reaction is expedient and has great survival value for people.

Initially, the book emphasises that a disaster need not be a major accident with many victims. It takes as its point of departure whether the person in question perceives the

[6] Norges Livredningsselskap, Melbye, Veglederen Forlag, 2011, second edition, second print run.
[7] Atle Dyregrov, Fagbokforlaget Vigmostad & Bjørke AS, second edition, 2002

situation as a disaster. Falling into the sea and being at risk of drowning can therefore be a case in point.

The book wants to emphasise the human ability to react adaptively to dangerous situations. The most common reactions in such situations include more rapid information processing with altered time perception, previous experience becoming available, heightened senses, focused attention, 'super memory', absence of emotions, physical reactions and inexpedient behaviour.

The book also emphasises that although most people behave in an expedient manner, there are examples of both individuals and groups displaying inexpedient behaviour. Depending on the situation, between 10% and 25% of disaster victims show inexpedient reactions during a disaster. Inexpedient behaviour can be roughly divided into overreaction and underreaction.

Overreaction manifests itself as hysteria and panic. The following is said about panic on pages 18 and 19 of the book:

'Rapid evacuation of a dangerous area is not panic, but expedient behaviour. It can be described as panic when the behaviour of one individual prevents or diminishes other people's chance of saving themselves from a life-threatening situation. ... The mass media often describe actions as panicky because they see them from the outside, without knowing why the people in question acted as they did. If you speak to the people who carried out these actions, you will often find that the actions were highly rational based on their understanding of the situation. ... Much of what is described as panic has been rational behaviour on the part of the disaster victims. Great confusion can of course arise in a disaster situation, and fear can have a bearing on what people choose to do. However, that some people act in an inexpedient manner appear to be more a result of their attempts to cope with an ambiguous situation in which the absence of or rapidly changing information makes it difficult to choose the appropriate behaviour.'

When panic does occur, two factors are usually present in the situation. The first factor is that the disaster victims feel that their lives are in immediate danger. The other is that they see a possibility of escaping from the danger immediately, but believe that this possibility is rapidly shrinking. Fighting for survival in such situations is known from fires, famines and evacuation from sinking ships.

Underreaction in the form of apathy or inability to act can also occur in disaster victims. This means that people become paralysed and show no signs of attempting to make their way out of the dangerous area.

3.7 Measures implemented after the marine accident

The Norwegian Maritime Authority inspected the high-speed vessel the day after the accident. The directorate communicated two observations to the shipping company, observations that have subsequently been followed up. One observation concerned the risk assessment of the operation and securing of the gangways. The other observation concerned the gangways, which had to be secured better so that they cannot be opened unintentionally.

After the accident, Norled has carried out an internal investigation into the accident. On the basis of this investigation, the shipping company decided to implement the following measures:

- The gangways on the aft deck of the Tiderose have been fitted with a different type of locking mechanism. The intention with the new one is that it will lock automatically when the gangway is placed in the vertical position.

- Since the shipping company, after the accident, observed that a guide sheave (intended to prevent the gangway from moving in the longitudinal direction) was missing, this sheave has been refitted.

- Based on this experience, the shipping company have made plans to fit the new type of locking mechanism on other high-speed craft that the company operates.

- The shipping company has revised a procedure to specify that the ordinary seaman must ensure that the gangway is locked before the vessel leaves the quay.

- Based on the problems the crew experienced recovering the passenger from the sea, the shipping company has decided to improve the rescue arrangements or otherwise compensate for the vesssel’s (relatively) high freeboard.

4. ANALYSIS

4.1 Introduction

The analysis discusses three issues: The first is the sudden and unexpected change of course. This is discussed in section 4.2.

The second issue concerns the securing of the gangway. This is discussed in section 4.3.

The third issue concerns the effectiveness of using the rescue frame system, davit and winch to hoist persons from the sea. This is discussed in section 4.4.

The AIBN's delimitation of the safety investigation is summarised as follows:

4.1.1 Delimitation in relation to the shipping company's safety management system

The AIBN has limited its investigation to not include details of the company's safety management system, just a general review of the documentation.

The AIBN's impression, based on the regular evacuation, fire and other emergency drills carried out by crews, was that the crew and shipping company emphasise carrying out these drills in a satisfactory manner.

The analysis will therefore not deal with the shipping company's safety management system other than those aspects that pertain to activities relating to the securing of gangways and to rescue equipment.

4.1.2 Delimitation in relation to crewing

During a large part of the crossing, there was only one person on the bridge. This is understood to be a consequence of the captain giving priority to catching up on reporting, since he had been off sick earlier in the week. In the AIBN's opinion, this cannot be linked directly to the chain of events, but it could be worth keeping it in mind in the event of a future safety investigation by AIBN of crewing.

4.1.3 Other delimitations of the safety investigation

The AIBN has found no indications of technical problems with the high-speed craft's propulsion or manoeuvring system immediately before or at the time of the accident.

There were no indications of technical problems with the life-saving equipment immediately before or at the time of the accident.

Weather and sea conditions were good on the day of the accident. The AIBN has therefore ruled out the possibility that the weather and sea conditions affected the movements of the vessel at the time of the accident.

The crew demonstrated their ability to deal effectively with a man overboard situation. When the engine room attendant was hoisted aboard using the rescue frame system, davit and winch immediately afterwards, this demonstrated that the rescue equipment was in working order and that the crew were capable of using it. However, the circumstances were different compared with recovering a passenger from the sea.

The safety investigation does not cover how other high-speed craft have solved the problems relating to the securing of the gangway and the use of rescue equipment in man overboard situations.

4.2 Sudden and unexpected change of course

The sudden change of course just before 16:36 (local time) was not intentional on the part of the bridge crew.

The sudden change of course to port coincides with the captain (the starboard seat) taking over navigational command.

Before the sudden change of course, the engine room attendant probably navigated the high-speed craft using manual controls. The manual steering wheel on the starboard seat was probably in the hard port position before the transfer of command.

The manual steering wheel on the starboard seat was most likely in the hard port position already before the vessel left the quay. It is also possible that somebody has brushed against the wheel during the crossing. There was virtually no resistance in the manual steering wheel's axle, and it was thus easy to turn it to the side. Nor did the manual steering wheel have a spring arrangement to return it to the middle position after turning.

These assumptions could explain why a hard port command was given when the captain pressed the 'In command' button on the armrest console.

In the AIBN's assessment, the sudden and unexpected change of course caused horizontal acceleration of the vessel, but only within the limitations for normal operation set out in the HSC 2000 Code.

It is therefore the AIBN's opinion that, although the sudden and unexpected change of course was one of the circumstances that triggered the events, we do not see relevant safety problems that can be linked to this marine accident.

4.3 Securing of gangways and passenger safety

In the AIBN's assessment, there are two probable explanations for how the passenger could fall out of the side gate (gangway):

- The ordinary seaman was distracted and forgot to secure the gangway before he went into the passenger lounge. This could leave the gangway unsecured during the crossing. This possibility is discussed further in 4.3.1.

- The ordinary seaman secured the gangway, but the locking bolt did not enter far enough into the groove in the black block. In such case, sufficient force applied to the gangway could make it fall down. This possibility assumes that the gangway was further aft, so that the locking bolt was not very deep in the groove in the black block. This possibility is discussed further in 4.3.2.

4.3.1 <u>Discussion based on the assumption that the gangway was unsecured during the crossing</u>

Securing of the gangway is based on its having to be locked using a bolt. The work procedure was based on one person, the ordinary seaman, always ensuring that the gangway was secured. If this was not done, there were no visible reminders to show that the gangway was left unsecured.

By this we mean that, in order to see whether or not the gangway was secured, it was necessary to go close up to the locking mechanism. This will only be done if the ordinary seaman finds it necessary to check whether it was locked. The technical arrangements were such that it was not possible for the captain or engine room attendant to notice whether or not the gangway was secured unless they went down to the aft deck and all the way over to the locking bolt. This would come into conflict with other essential duties. Thus there were in reality no other crew members who could detect if the gangway was unsecured. The AIBN's assessment is therefore that there was no way for the crew to immediately see or be reminded that the gangway was probably left unsecured during the crossing. The planning of work on board the vessel has failed to take into account the possibility that the gangway could be left unsecured by oversight. On board the high-speed craft there was therefore a real possibility that the gangway was not secured, and this resulted in a risk that passengers or crew members could fall overboard.

The shipping company's choice of technical solution and description of the work process for securing the gangway was based on one person having to remember to do it. There was no way for the crew to immediately see or be reminded that the gangway remained unsecured during a crossing. Nor were there other technical solutions to prevent the gangway from falling down once it was left unsecured.

The technical solution and the work duties therefore only involved one operational barrier intended to ensure that the gangway was secured during the crossing, see Figure 12.

This barrier is deemed to be a weak one, since it is common knowledge that people easily forget, become distracted or otherwise fail to carry out their duties as envisaged in an ideal situation. The technical solution and work procedure for securing the gangway on departure from the quay have thus not taken into account that to err is human.

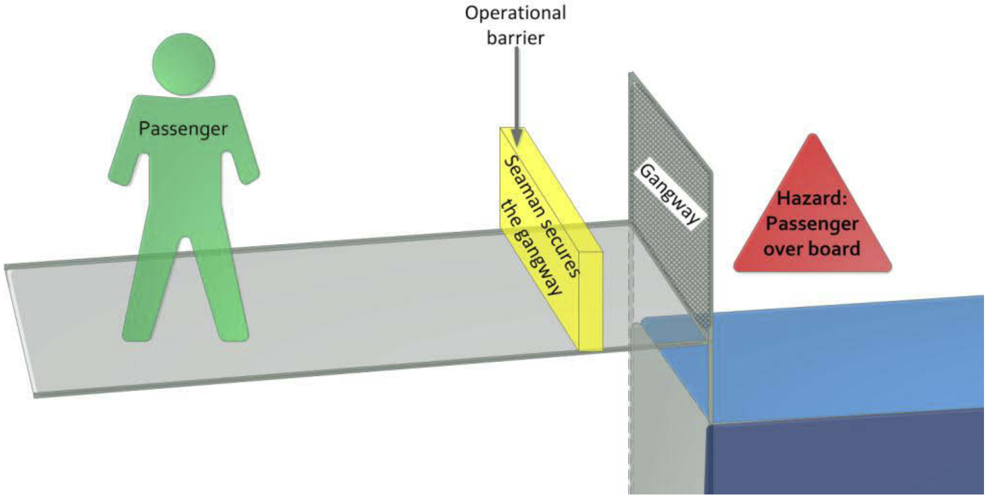


Figure 12: Illustration of the operational barrier intended to prevent passengers from falling overboard. This is deemed to be a weak barrier, since it is common knowledge that people easily forget, become distracted or otherwise fail to carry out their duties as envisaged in an ideal situation. Illustration: AIBN

Based on this one weak barrier, the shipping company had failed to consider whether it would represent an acceptable level of risk if the barrier were to fail and the gangway be left unsecured. Even though the company's overall risk assessment pointed out that operational barriers were regarded as weak barriers, was this not reflected in the procedures set out in the vessel's handbook or the way in which work on board is carried out.

This is understandable, considering that the risk of a passenger falling overboard has not been among the risks identified as most important, cf. **Annex A: Risk assessment for the Tiderose**. This risk has therefore not been given the same weight in the preventive safety work as other more important risks such as a foundering, collision, fire, etc.

It is assumed that this type of locking mechanism has been installed on many of the high-speed craft delivered by the shipyard in question. A variety of different locking mechanisms exist among the shipping company's high-speed craft and in the high-speed craft fleet in general. The regulations in this area are limited to requirements that it shall be possible to secure the gangway. It has been up to the shipyard, the shipping company and representatives of the supervisory authority to assess what constitutes adequate securing of the gangway.

The AIBN would like to point out the connection between the fact that the shipping company had only planned a weak organisational barrier for the locking of the gangway and that, at the same time, the company deemed it safe for passengers to be on the open deck.

4.3.2 Discussion based on the assumption that the gangway was secured during the crossing

As mentioned in the introduction, it is also possible that the gangway was secured during the crossing.

Assuming that the gangway's guide sheave had not been re-fitted after the yard stay, it would be possible for the gangway to move on an axle in the longitudinal direction. If the gangway was in the far aft position, it would not be possible for the locking bolt to enter very far into the groove in the black block. Thus, force applied to the gangway could disengage the locking mechanism.

Based on this theory, the problem arose when maintenance work was carried out on the gangway during a yard stay in March 2012. When the maintenance work was carried out, the shipping company had not ensured that the gangway could be adequately secured.

4.4 The effectiveness of and requirements concerning man overboard rescue arrangements

The description of the chain of events shows that the passenger was in the water for just less than 12 minutes. The rescue operation can be broken down as follows:

- It took 8-10 seconds from the passenger fell overboard until the captain was aware of it.

- After the passenger fell overboard, it took less than two minutes for the vessel to turn around and return to the site of the accident. In the AIBN's opinion, the crew reacted efficiently in locating the passenger in the water.

- The crew struggled to place the rescue frame around the passenger for nine minutes (from 16:37 to 16:46). During this time the engine room attendant, who had jumped into the water to help the passenger, drifted away because of the current. This took place at 16:42, only five minutes after the vessel had returned to the site of the accident.

- When the crew realised that it would take too long to hoist the passenger aboard using the rescue frame, they considered using a hawser. In the AIBN's opinion, this shows that the crew demonstrated that they had the ability and resources to consider alternative solutions. The rubbing band made it difficult to use a hawser, but, most of all, it required a huge effort to lift a person out of the water in this way. Once this solution had been chosen, and because of the good physical fitness of the ordinary seaman, the passenger was brought aboard quickly.

The longest phase of the rescue operation, nine out of the total twelve minutes, was spent trying to recover the passenger from the water using the rescue frame, davit and winch.

The main reason why this took so long was that the ordinary seaman was unable to (using the rescue frame) place the rescue sling correctly around the passenger. This was because the passenger did not keep still, but tried to get out of the water by grabbing hold of the rescue frame. Communication between the passenger and the ordinary seaman was also difficult, since they did not speak the same language.

In the AIBN's opinion, the crew was well trained for this emergency situation and acted in an effective manner once the situation had arisen.

As stated in the application for exemption from the MOB boat requirement that the shipyard submitted to the Norwegian Maritime Authority, using a rescue frame requires the person in the water to remain still. The manufacturer of the rescue frame also points out the necessity of the person in the water keeping still. The rescue operation involving the Tiderose shows that this precondition was not met in the case in question.

In the AIBN's opinion, it is not a realistic precondition for a rescue operation that the person in the water must remain still. As shown in section 3.6.6, it is normal for 10–25% of disaster victims to display inexpedient reactions. In addition, outsiders can sometimes perceive the victim as acting in panic even when the victim's actions are highly rational based on his/her assessment of the situation. The fact that the passenger in the water grabbed the rescue frame and held on to it can be understood as a rational act. The reason may be that she did not want to drift away from the vessel. Her clothes and bag were heavy with water, which made her float low in the water. It can therefore be understood as a rational act to grasp the rescue frame and attempt to lift herself from the sea. The specialist literature (see section 3.6.6) substantiates that it should be expected that a person in the water in distress may act in this way.

Although the specialist literature points out that, as humans, we often react adaptively and adjust our actions based on previous experience, it is not realistic to base the design of rescue arrangements and planning/training on rescue operations on the expectation that passengers have experience of being at sea and of the use of rescue equipment. Nor is it uncommon for communication problems to occur in a difficult situation, whether this is due to the parties involved having no common language, too much noise or other factors.

The experience of the Norwegian Society for Sea Rescue, see section 3.6.5, also indicates that the rescue frame system with a manual winch has certain limitations when it comes to recovering persons from the sea.

Since the accident, the shipping company has, among other things, decided to improve the rescue arrangements by enabling rescue personnel to get closer to the water surface or otherwise compensate for the vessel's (relatively) high freeboard. This reflects the fact that one of the challenges arise when there is a certain distance between where the rescue personnel are standing and the water, i.e. the problem relates to difficulties in rescue work for vessels with a (relatively) high freeboard.

To summarise: the limitations of this rescue arrangement are primarily related to vessels with a (relatively) high freeboard, and to the fact that it is not realistic to expect persons in the water to remain still.

In the AIBN's opinion, it is necessary that the Norwegian Maritime Authority, in consultation with the industry, improves the criteria for exemption from the MOB boat requirement in a way that addresses these limitationsl. A safety recommendation is submitted in this connection.

5. CONCLUSION

5.1 Securing of the gangway

As a prerequisite, it should have been safe for passengers to be in the areas to which they were permitted access. Aboard the high-speed vessel, passengers were permitted to be on the aft deck during crossings. Another condition was that the gangway should have been secured during crossings.

In the AIBN's opinion, a combination of three circumstances created a risk of a passenger falling overboard:

1. The shipping company had chosen an arrangement that meant that the ordinary seaman had to remember to lock the gangway. In the AIBN's opinion, this was a weak barrier, since it is common knowledge that people easily forget, become distracted or otherwise fail to carry out their duties as envisaged in an ideal situation. There was no way that the crew could immediately see or be reminded that the gangway was left unsecured during the crossing. Nor were there other technical solutions to prevent the gangway from falling down once it was left unsecured.

2. The gangway had previously been modified, which may have resulted in the locking bolt not entering as far into the groove, thus making it easier to release the gangway from the locked position.

3. The shipping company had not considered the two above-mentioned circumstances in relation to whether it was safe for passengers to be on the aft deck.

The AIBN therefore submits a safety recommendation to the shipping company in this connection.

5.2 Effective rescue arrangements for man overboard situations

A total of ten minutes elapsed from the high-speed craft had returned to the site of the accident until the passenger had been brought aboard. Nine of the ten minutes were spent trying, unsuccessfully, to place the rescue sling around the passenger. The crew was well trained for this emergency situation and acted effectively once the situation had arisen.

In principle, a high-speed craft should be equipped with at least one rescue boat to recover persons from the water (MOB boat), but the Norwegian Maritime Authority granted exemptions from this requirement provided that certain criteria were met. As stated in the HSC 2000 Code, one of these criteria was that the high-speed craft must be fitted with equipment to allow a helpless person to be recovered from the water.

The Norwegian Maritime Authority's granting of exemptions from the MOB boat requirement was based on the rescue arrangements being deemed to be an effective means of recovering lifeless persons in the water. The rescue arrangement consisted of a rescue frame system, davit and manual winch.

A review of this accident shows that this was not a sufficiently effective method of recovering the passenger from the sea.

This rescue arrangement has limitations, primarily in relation to vessels with a (relatively) high freeboard, and to the fact that it is not realistic to expect persons in the water to remain still.

The AIBN therefore submits a safety recommendation to the Norwegian Maritime Authority in this connection.

Since this accident, the shipping company has decided to improve the rescue equipment arrangements.

6. SAFETY RECOMMENDATIONS

The investigation of this marine accident has identified two areas in which the AIBN deems it necessary to submit safety recommendations for the purpose of improving safety at sea[8].

Safety recommendation MARINE no. 2013/01T

In order to secure the gangway the shipping company had chosen an arrangement that meant that the ordinary seaman had to lock it in place. The AIBN considers this to be a weak organisational barrier. It is also possible that previous maintenance of the gangway had made it easier for the locking mechanism to be released. The shipping company's locking procedures and existing locking mechanism for the gangway have thus not provided adequate safety for passengers on board the high-speed craft.

The Accident Investigation Board Norway recommends that the shipping company Norled AS carry out the necessary assessments and measures to prevent similar man overboard situations.

Safety recommendation MARINE no. 2013/02T

The rescue frame system, davit and winch installed on board the high-speed craft were not a sufficiently effective means of recovering the passenger from the sea. This rescue arrangement has limitations, primarily in relation to vessels with a (relatively) high freeboard, and to the fact that it is not realistic to expect persons in the water to remain still. In the AIBN's opinion, the Norwegian Maritime Authority's assessments in connection with the granting of exemptions from the MOB boat requirement have not been sufficiently based on realistic emergency situations and experience of the use of such equipment.

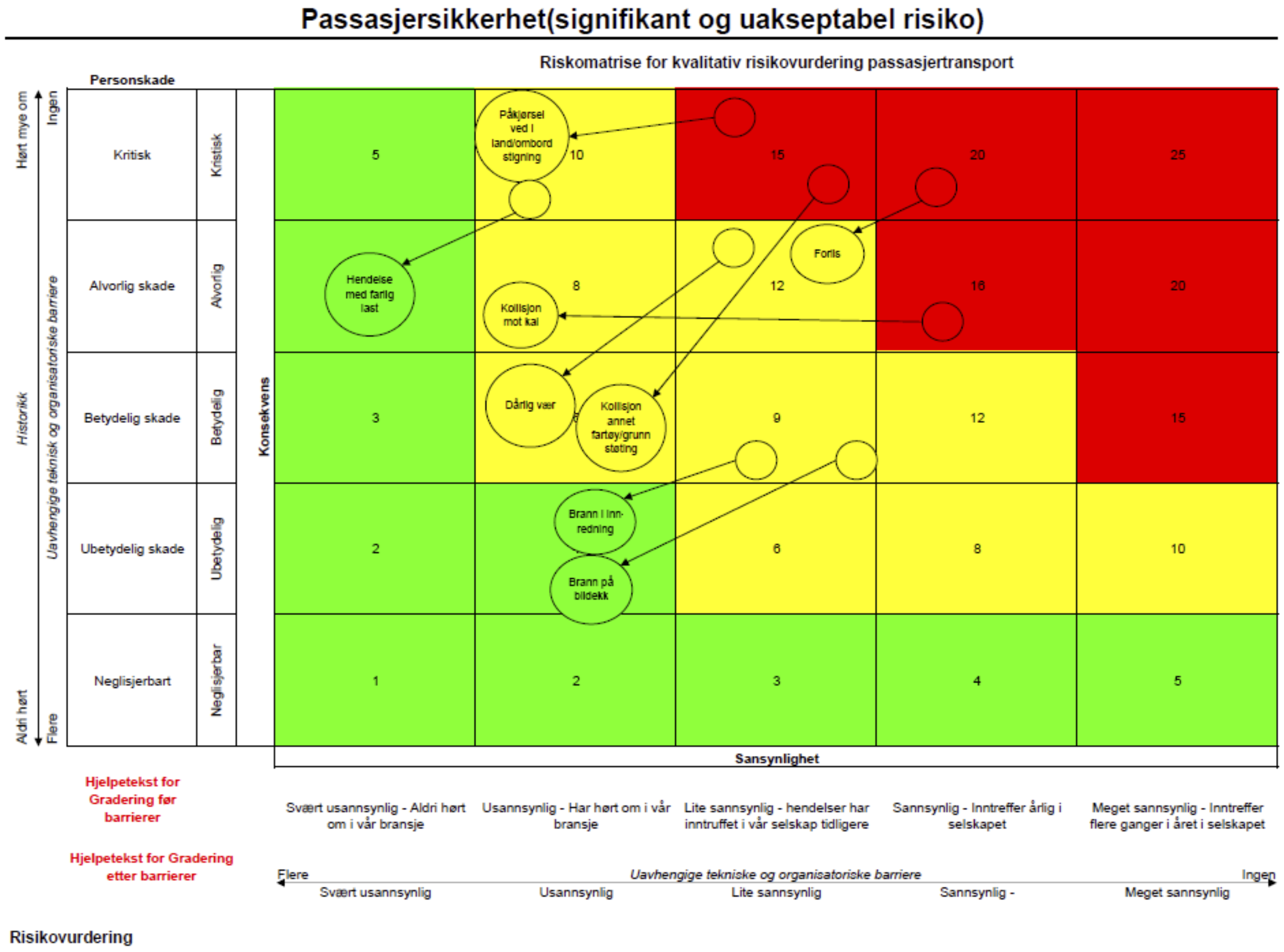
The Accident Investigation Board Norway recommends that the Norwegian Maritime Authority, in consultation with the industry, revises the criteria for exemption from the MOB boat requirement in order to ensure effective recovery of persons from the sea and to address the challenges relating to freeboard.

Accident Investigation Board Norway
Lillestrøm, 6 May 2013

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

ANNEX

Annex A: Risk assessment for the Tiderose



This risk assessment was part of the shipping company's safety management system.

Annex B: Overview of the Norwegian Society for Sea Rescue's man overboard recovery equipment

Many of the Norwegian Society for Sea Rescue's (NSSR) vessels have a rescue frame on board, see Figure 14. It can be part of the rescue equipment on all vessels with a length of up to 100 feet. Larger SAR vessels (longer than about 65 feet) also have a rescue cage and crane, see Figure 13. The freeboard of these vessels is around 1.7–2.5 metres.

The NSSR's experience of using the rescue frame from these vessels is that it can be used effectively to control a person in the water, but they then use the rescue cage and crane to hoist the person from the sea. The NNSR's experience is that the rescue frame can be quickly re-armed. It can be used at a distance of 3-4 metres from the vessel's railing. The challenge in relation to these vessels is that the freeboard is so high that the rescue personnel are not near the surface and the person in the water.

Figure 13: Måløy rescue cages with cranes have been installed on the large SAR vessels. The rescue cage is effective and simple to use, and recovery is quick. It can be used up to moderate weather conditions. Source: the Norwegian Society for Sea Rescue.

Figure 14: SB Rescue Sling. Source: the Norwegian Society for Sea Rescue.

Small NSSR SAR vessels (with lower freeboard) were also equipped with rescue nets, see Figure 15. The SAR vessels also have different MOB boat concepts. The SAR vessels also use surface divers in such operations.

Figure 15: SAR vessel with a Dacon rescue net. These are used on board SAR vessels with low freeboard. Source: the Norwegian Society for Sea Rescue.