MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

ACCIDENT REPORT

SERIOUS MARINE CASUALTY | REPORT NO 24/2013 | NOVEMBER 2013

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This investigation has been conducted with the co-operation and assistance of the Safety Investigation Authority Finland.

MV *FINNARROW*

Contact with berth and subsequent flooding
Holyhead, UK
16 February 2013

SUMMARY

At 0556 UTC[1] on 16 February 2013, the port fin stabiliser of the passenger / ro-ro cargo ferry *Finnarrow* **(Figure 1)** made contact with the berth as she arrived at Holyhead, UK. The fin stabiliser subsequently punctured the hull, which led to the pump room flooding. All passengers were disembarked, cargo was unloaded and the vessel's onboard services crew were sent ashore. Once divers had plugged the hole in the hull and the shore fire service had employed a high-volume pump, the water level in the pump room was reduced to below the floor plates and a cement box was constructed to seal the leak.

The investigation found that the procedures for pre-arrival checks were inadequate. It also concluded that the crew lacked sufficient familiarity with the vessel's equipment and emergency procedures; issues that had been raised during a recent port state control inspection. Finnlines Ship Management reported it has implemented several improvements to its safety management system. However, the MAIB has made recommendations to the company aimed at improving awareness of the status of the vessel's fin stabilisers and ensuring its crews are properly prepared to deal effectively with emergencies.

[1] Universal time co-ordinated

Image courtesy of Roger Sandström

Figure 1: *Finnarrow*

FACTUAL INFORMATION

Background and environmental conditions

Finnarrow was chartered from 16 January 2013 by Stena Line Ltd to operate on the Holyhead to Dublin route while the usual ferry, *Stena Nordica*, was employed as a relief ship for other Stena Line Ltd routes. *Finnarrow* normally operated in the Baltic Sea and had previously run between Kapellskar and Naantali.

In September 2012, the vessel's Flag State was changed from Sweden to Finland, at which time the majority of the crew was also changed. At the time of the accident, all of the officers were Finnish apart from the first engineer, who was Estonian. Documentation on board was predominantly in English, but Swedish and Finnish was also used. The vessel had two masters and two chief engineers who alternated 12-hour duties. The masters nominally switched at 0700 and 1900 while in port, and the chief engineers changed at 0500 and 1700. The deck officers consisted of a chief officer and two second officers who between them covered all bridge watches and the loading and unloading of cargo. The remaining engineer officers consisted of a first engineer and two second engineers who between them covered the engine room watches.

On 16 February, at the time of the accident, visibility was good and, inside Holyhead breakwater, sea conditions were slight. There was a south-south-east force 4-6 breeze and it was dark with sunrise due at 0733. Low water was at 0800.

Narrative

During the evening of 15 February 2013, the day master attained a pilotage exemption certificate (PEC) for Holyhead, which included an oral exam and a pilot witnessing *Finnarrow*'s departure from the port. After the departure, the day master retired to his cabin, falling asleep at about 2300. With the night master in command, *Finnarrow* arrived in Dublin at 0025 on 16 February and departed at 0215. Once clear of the port, the night master handed the con to the duty second officer and retired to his cabin. At about 0400, the second officer decided to reduce the vessel's rolling motion by deploying the port fin stabiliser.

At 0510, the second officer called the day master 30 minutes prior to the vessel's expected time of arrival 1.5nm from the end of Holyhead breakwater. At 0526, the day master arrived on the bridge. After discussing the status of the fin stabilisers, the weather, and the berth at Holyhead with the second officer, the master took the con. At 0532, the chief officer arrived on the bridge and, shortly afterwards, the second officer left the bridge and made her way towards the forward mooring station.

At 0543, with additional steering motors and the bow thrusters running, and control transferred to the port bridge wing console, the day master manually steered the vessel around the end of the breakwater towards berth 3 **(Figure 2)**. The chief officer stood half-way between the port bridge wing console and the centre console holding a UHF[2] radio, ready to communicate with the mooring teams.

As the vessel slowed, the day master had to apply differential propeller thrust to keep the vessel's heading on course for the berth. At 0556, and about 30m from the intended berthed position, *Finnarrow* stopped. The day master applied more propeller thrust and the vessel moved slowly ahead. Shortly afterwards, an alarm sounded and the day master and chief officer both realised that the port fin stabiliser was still deployed.

After hearing a loud noise, the second engineer on watch made his way to the separator room where he found the port fin stabiliser head severely damaged **(Figure 3)**. The second engineer then returned to the engine control room (ECR), where he reported the damage to the day chief engineer. At 0606, the bilge alarm for the pump room sounded. By the time the second engineer had made his way to the pump room, the water level had risen to just below the floor plates, and he was unable to locate the source of the leak.

[2] Ultra High Frequency

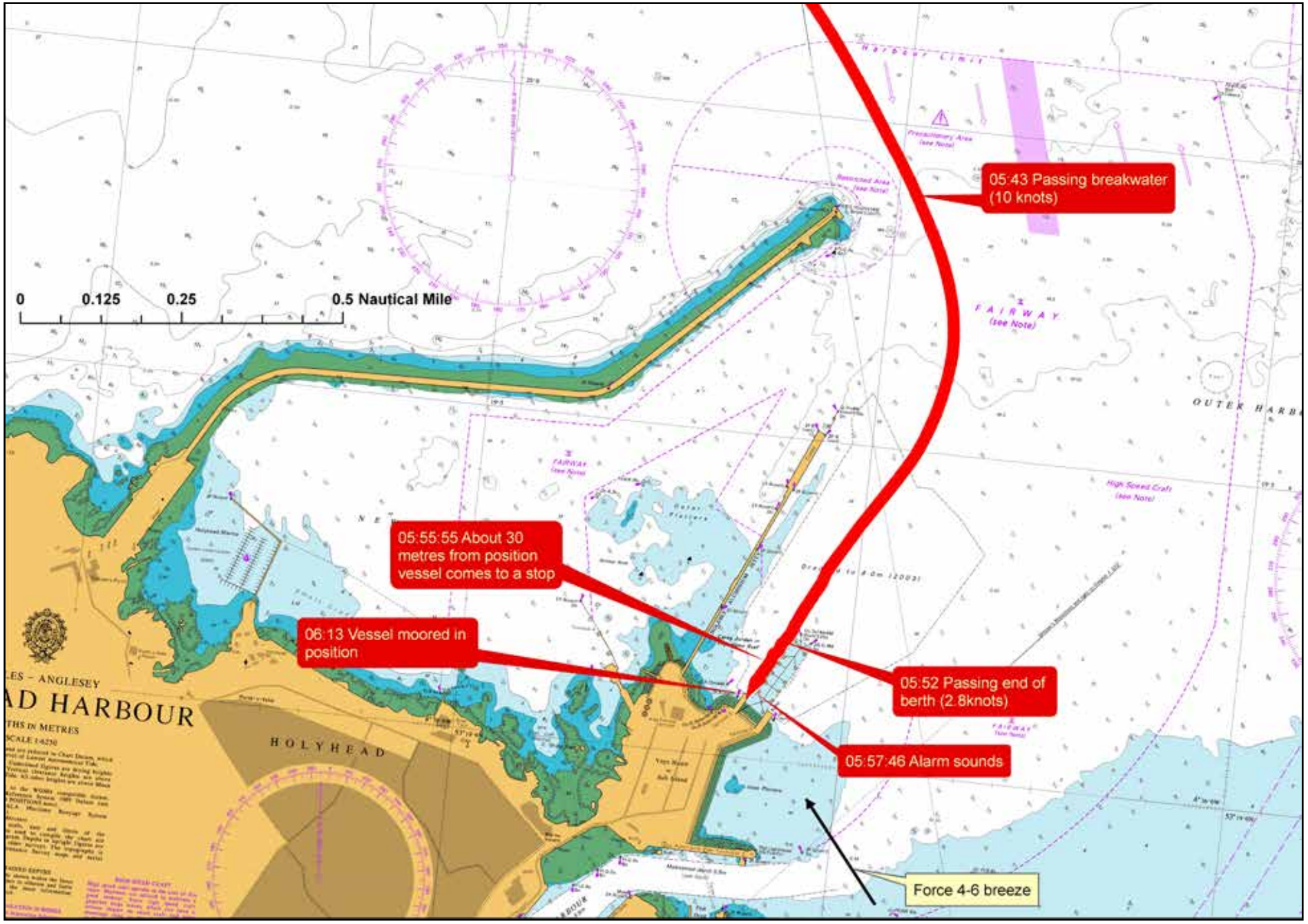

Figure 2: *Finnarrow*'s track

Figure 3: Port fin stabiliser head damage in separator room

He evacuated the pump room and secured the watertight doors. He then started the piston bilge pump in the separator room, Fire & Bilge pump No. 1 in the pump room, and Fire & Bilge pump No. 2 in the auxiliary diesel generator room, and configured the bridge system valves to try to discharge the flood water overboard from the pump room.

By 0613, the day master had managed to manoeuvre *Finnarrow* port side alongside berth 3, and the link span was lowered onto the vessel's bow. The passengers and cargo were discharged quickly, with all passengers disembarked within 20 minutes. At 0620, the vessel's four main engines shut down due to the lack of cooling water. The day master gave instructions for the crew to report to the bridge, the night master already having been summoned. At 0627, the day master reported the incident to port control and requested assistance; a short time later he specifically requested that divers attend the vessel. At one stage, at the request of the second engineer, the fire hydrants were opened to help discharge the flood water, but no water was emitted from them.

The chief officer checked the stability of *Finnarrow* for a condition with her pump room flooded using the NAPA onboard loading computer, which confirmed the vessel was safe and still satisfied damage stability requirements.

The first local fire service appliance arrived on board the vessel at 0646. The fire crew were able to access the pump room via the emergency escape trunk from vehicle deck 3, and they saw that the water level was steadily rising. At 0700, the day master ordered the onboard services crew to disembark ashore and, a few minutes later, he informed the coastguard of the situation. At about 0720, the fire alarm sounded in the ECR and the space was evacuated. However, after a fire team had been mustered and the situation checked, it was determined that there was no fire. It was believed the alarm had activated following an electrical short circuit.

Finnarrow's bilge pumping system was unable to stem the rate of flooding, with Fire & Bilge pump No. 1 having failed as the water level rose in the pump room. By 0800, it was estimated that the pump room water level had equalised with the sea level outside. To increase the fire service's pumping capacity, it was requested that a high-volume pump (HVP) be delivered to the vessel. By 0830, some leakage of water from the pump room was detected entering the main engine room via pipe and cable glands, but this was reduced using rags to plug any visible gaps.

Figure 4: Hull shell penetration in pump room

Finnarrow's diesel generators continued to supply power until about 0900, when they shut down due to a lack of cooling water. The emergency generator then started automatically, supplying the emergency switchboard only.

At 0950, an HVP arrived on board, but it had to be dismantled and reassembled in order to access the pump space. An hour later, the HVP was discharging flood water overboard at approximately 360m3/ hour.

At 1300, divers arrived and during the afternoon they managed to plug the leak into the pump room using rags. The water level in the pump room was then steadily reduced to below the floor plates, at which point the damaged area became visible **(Figure 4)**. It took until the evening of 17 February to construct an effective cement box around the damaged area. This allowed the vessel to sail for repairs at Greenock.

Damage

The port fin stabiliser was extensively damaged as it was driven against the berth and forced backwards **(Figure 5)**. In the process, the inboard/trailing edge of the fin punctured the hull, causing a 0.5m by 0.2m hole, approximately 3m below the waterline. As a result of the subsequent flooding in the pump room, numerous electric motors and other electrical equipment were also damaged.

Figure 5: Port fin stabiliser and hull damage

Crew

The night master, who was 43 years old and previously had served as master for 3 years, was recently recruited and had joined *Finnarrow* 3 weeks earlier. He had obtained his PEC for Dublin and Holyhead 1½ weeks before the accident.

The day master, who was 55 years old, had obtained a master's qualification in 1986. He had worked on various Finnlines vessels since 1997 and had served as master on *Finnlady*, the passenger/ro-ro cargo ferry, during 2012. He joined *Finnarrow* on 7 February and had a 3-day handover with the previous master. From 11 February, the night master had to conduct all entries and exits from port while the day master studied for his own PECs for Dublin and Holyhead.

The chief officer, who was 35 years old and had served at sea for 19 years, had started work with Finnlines in November 2012 on board *Finnarrow* . Prior to this, he had held the position of chief officer for about 4 years. He had also served as master.

The second officer on watch prior to the vessel's arrival at Holyhead was 42 years old and had worked for Finnlines for 1½ years. She had joined *Finnarrow* when the vessel was changed to the Finnish Flag in September 2012.

All the deck officers held Master (Unlimited) Certificates of Competency (STCW[3] II/2) issued by Finland.

[3] International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, as amended in 1995 and 1997 (STCW Convention)

The day chief engineer, who was 62 years old, had retired in 2011 but had since worked as a chief engineer on an occasional basis. He held a Chief Engineer Certificate of Competency (STCW III/2) issued by Finland. He had previously served on board *Finnarrow* for a number of years and had assisted for 10 days with *Finnarrow*'s transition to the Finnish flag. He had rejoined the vessel on 1 February 2013 on a 4-week contract. He had also served previously on the passenger/ro-ro cargo ferries *Finnstar* and *Finnlady*.

The second engineer on watch was 28 years old. He had started as a motorman on Finnlines vessels in 2008 and was promoted to second engineer in 2010. He joined *Finnarrow* in September 2012. He held an Engineer Certificate of Competency (STCW III/1) issued by Finland.

Vessel background

Finnarrow was constructed in Jakarta, Indonesia in 1996. The vessel was propelled by two controllable pitch propellers, driven by four Sulzer 4320kW diesel engines. Each of the two 1200kW bow thrusters was powered by a shaft generator connected to each shaft gearbox. Auxiliary power was supplied by three Sulzer 1170kW diesel generators, with two in operation at any one time. The emergency generator was situated on deck 3. The cooling water systems were all driven by pumps situated in the pump room.

The vessel was fitted with a Norcontrol system, which allowed the bilge and ballast system to be operated from the ECR **(Figure 6)**. Most of the system's valves and pumps could be controlled remotely using this system. The piston bilge pump, which had a nominal 130m^3/hr capacity, was situated in the separator room. It was normally used to pump bilge water into a bilge tank from where it could be pumped either ashore or overboard via oily water separators. The overboard discharge from the piston bilge pump in the separator room had been blanked off to prevent the inadvertent discharge of oily water overboard.

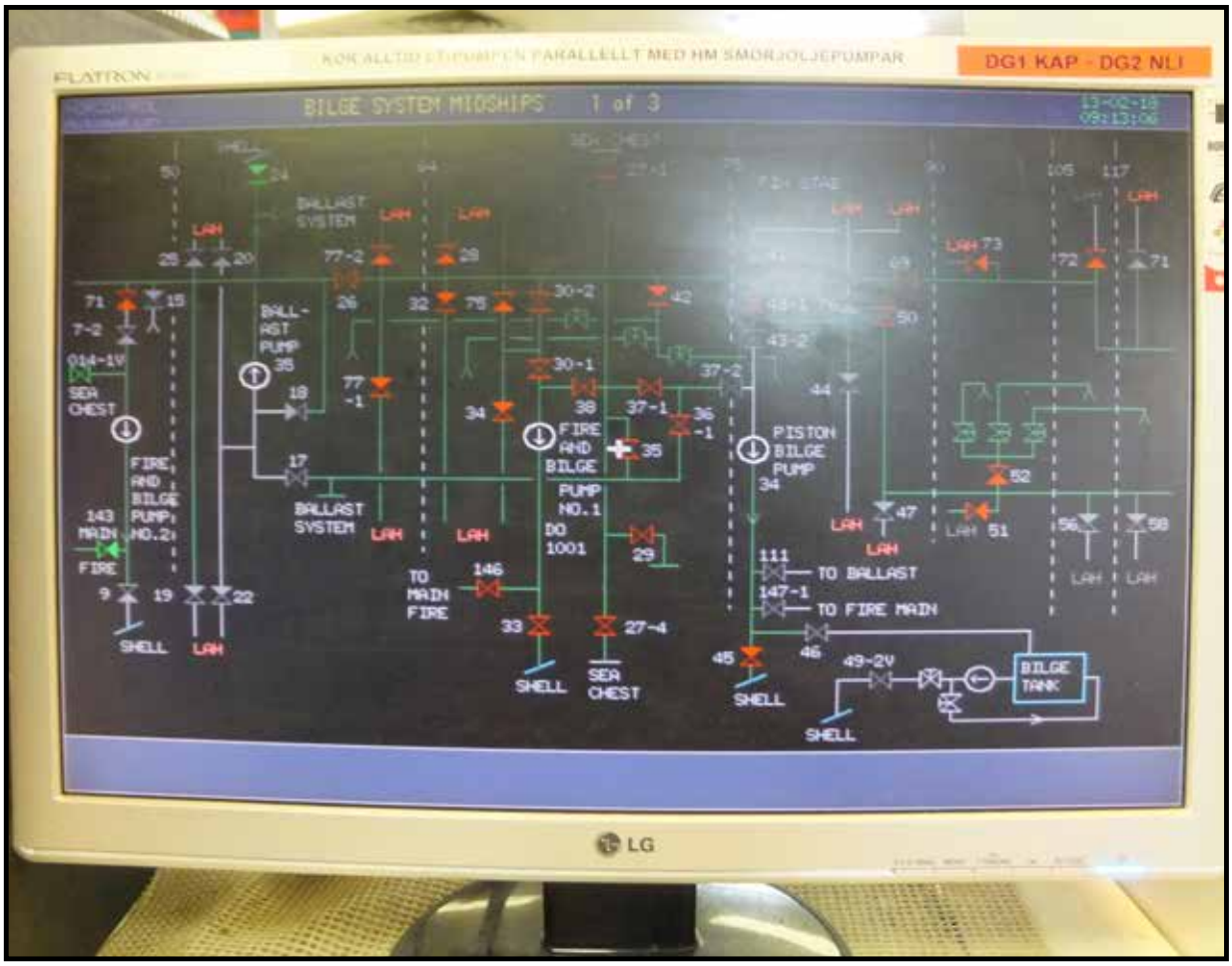

Figure 6: Bilge and ballast system Norcontrol screen

Finnarrow was fitted with two emergency Fire & Bilge pumps. Fire & Bilge pump No.1 was positioned in the pump room along with its overboard discharge. Fire & Bilge pump No. 2 was located in the auxiliary diesel generator room with its overboard discharge located in the boiler room. Each of these electric pumps had a capacity of 130m^3/hr and could be powered from the emergency switchboard. There was also a higher capacity, 300m^3/hr, ballast pump in the main engine room that could be used to discharge water. The bilge pumping system pipework had a diameter of 150mm, while that of the ballast system pipework was 200mm.

The vessel was fitted with a Brown Brothers Ltd (now Rolls Royce) folding-fin ship stabiliser system. Each fin had an area of 10m^2 and took 2 minutes to deploy or house. The stabilisers could be operated in manual or automatic mode from a panel on the bridge centre console **(Figure 7)**. In the automatic mode, the fin stabilisers housed automatically when the vessel's log speed dropped below 6 knots. In manual mode, the fin stabilisers housed automatically only if the input speed was less than 6 knots. On board *Finnarrow*, prior to the accident, the fin stabilisers were operated in manual mode with an input speed of 19 knots.

Figure 7: Fin stabiliser panel on the bridge centre console

Safety management, audits and inspections

Finnlines' safety management system (SMS) was written mainly in English and included crew responsibilities, daily routines and checklists. The daily routines provided an outline of responsibilities during the vessel's arrival and departure to/from port. The voyage checklist was predominantly written in English and was tailored for a voyage in the Baltic Sea. Ship's staff had created a revised voyage checklist for the Dublin to Holyhead route. The crisis and alarm plan contained emergency procedure checklists for various scenarios, including grounding or stranding, collision and black-out.

An internal SMS audit was conducted in November 2012, which highlighted two non-conformities regarding procedures and documentation. The Finnish Transport Agency issued a new Safety Management Certificate on 7 February 2013 based on an initial survey conducted on 10 January 2013 in Naantali, during which no deficiencies were found.

On 17/18 January 2013, *Finnarrow* underwent a joint port state control (PSC) inspection by the Irish and UK maritime authorities. The inspection found 22 deficiencies, half of which were rectified before the end of the inspection. The inspection was critical of emergency preparedness, finding crew unfamiliar with their respective duties and the vessel's safety equipment. Several of the deficiencies were highlighted as '*Objective evidence of serious failure or lack of effectiveness of implementation of the ISM Code*'. One of the deficiencies was a requirement for an internal safety audit and corrective action to be conducted within 3 months. This requirement was still outstanding when other deficiencies were closed following an inspection in Dublin on 31 January.

Similar accidents

Since 1991, four other incidents involving passenger ferries berthing with fin stabilisers still deployed have been reported to the MAIB. In all cases the port arrival procedures had failed to remind bridge teams that their fin stabilisers had not been housed, but only minor or no damage resulted in these cases.

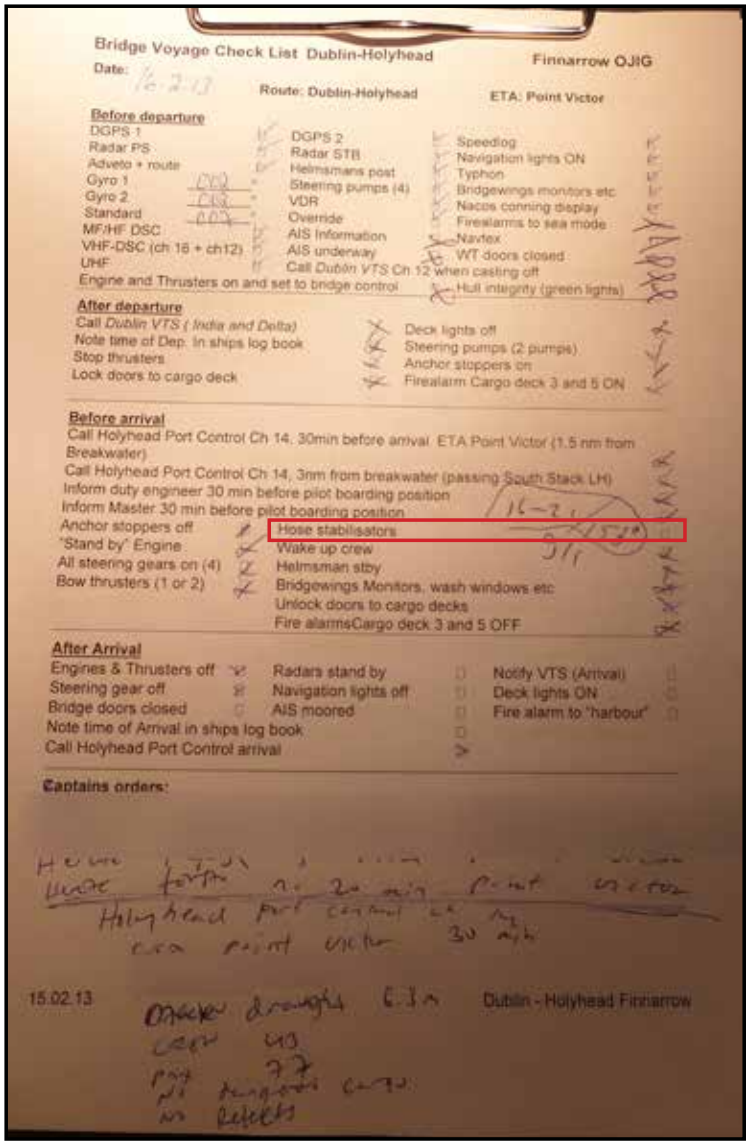

Figure 8: Completed bridge voyage checklist

ANALYSIS

Overview

The accident occurred because the port fin stabiliser was left deployed during *Finnarrow's* final approach to the berth. Although the flooding that resulted from the consequential hull damage was restricted largely to the pump room, the rate and extent of flooding might have been reduced if better damage control actions had taken place.

Fin stabiliser housing

The bridge procedures in place for conducting end of passage/pre-arrival checks were ineffective, resulting in several potential defence opportunities being missed to ensure the fin stabilisers were housed. The procedures should have ensured early identification that the port fin stabiliser was deployed, that it was then retracted correctly and, finally, that it was properly housed.

The first defence opportunity was the con and watch handovers between the second officer, master and chief officer, where good practice would have required the status of the fin stabilisers to be reported. Although the second officer informed the day master that the port fin stabiliser was deployed, she did not pass this information to the chief officer.

Secondly, a tick box on the voyage checklist to confirm that the fin stabilisers were housed, was not completed **(Figure 8)**. This failed to act as a prompt to either the day master or chief officer to check that the fin stabilisers were housed. The SMS did not include any reference as to when specific aspects of the day voyage checklist should be completed. The voyage checklist for the Dublin-Holyhead route had been created by ship's staff and was similar to another checklist in the SMS, but it was an informal document and not part of the approved SMS documentation.

Thirdly, the only visual indication that the port fin stabiliser was deployed was a small indicator light on the fin stabiliser panel situated on the centre console **(Figure 7)** and another small indicator light on the damage control console. As soon as the day master and chief officer had moved away from the centre console, these warning lights ceased to be effective. No thought had been given to providing a more obvious reminder that fin stabilisers were deployed.

Fatigue

Both the day master and chief officer had forgotten that the port fin stabiliser was deployed. The master's action in applying more propeller thrust when *Finnarrow* unexpectedly stopped short of the berth lacked caution and possibly led to the vessel's hull being punctured. Theses types of error and the day master's and chief officer's recent work patterns leading up to the accident suggest a moderate risk that both men might have been suffering from fatigue.

There were several factors that might have prevented the masters, chief officer and second officer from achieving adequate rest. The night master had been required to conduct all arrival and departures since 11 February, thereby preventing him from resting for at least one 6-hour period each day as stipulated in STCW. Likewise, the day master for the first 4 days on board, although only gaining experience for his PEC, was on the bridge for all arrivals and departures. Once in command, he then had to study for his PEC exams.

The chief officer was nominally scheduled to be on duty between 0500 and 1700. During the week prior to the accident, he had managed 1-2 hours less than the nominally required 10 hours rest per day on three occasions and fewer than 77 hours of rest during the week. His working hours had been extended for the 2 days prior to the accident as he was required to oversee the vessel's loading and unloading in Holyhead, as the internal loading ramp had to be used because the port's upper link span was out of action.

In general, it had been difficult for *Finnarrow* to maintain the sailing schedule, which led to watches being extended by 30 minutes to 1 hour, eroding the deck officers' hours of rest. Discussions on the bridge prior to the accident had included the topic of tiredness, further supporting the conclusion that fatigue might have been a contributing factor.

Emergency preparedness

While *Finnarrow*'s bilge pumping system had some level of redundancy, as required by SOLAS[4], the crew's response to the flooding could have been more effective. The crew were insufficiently familiar with the vessel's equipment, and lack of effective flooding drills hampered the damage control effort as demonstrated by the attempt to discharge flood water overboard using the piston bilge pump, whose discharge line had been blanked off. No checks were made locally to see if the bilge pumps were functioning. It would have been feasible, while the auxiliary diesel generators were running, to employ the higher capacity ballast pump to assist with pumping. However, there was no emergency response procedure in the vessel's SMS to deal specifically with flooding. Although a major damage drill was scheduled three times a year in the SMS drill schedule, there was no requirement for a routine drill relating specifically to flooding.

While every effort was taken to ensure all passengers and non-essential crew were disembarked ashore, the situation was generally not well managed on board. It was fortunate that the vessel was fitted with an onboard loading computer and that the ship's crew were able to establish the vessel would still be stable with the pump room flooded as this negated the need to stem the rate of flooding. The crisis and alarm plan in the vessel's SMS was not relevant to the emergency in this case, and the crew's overall lack of familiarity with the vessel's systems hampered the damage control effort.

This accident also highlights the design limitation of locating a vessel's total cooling water pumping capacity in one space. For example, if the harbour cooling pumps for a diesel generator had been situated in a separate space, the early reliance on the emergency generator, and the limitations this imposed, could have been avoided. The SOLAS 'safe return to port' requirements should ensure this issue is addressed in future for new vessels, and some recent cruise ship disablement accidents have led to greater levels of redundancy being considered by some operators of passenger vessels.

Safety management system

The issues discussed above, in common with the PSC inspection conducted on 17/18 January 2013, highlight failings in the vessel's SMS and its application on board *Finnarrow*.

Bridge procedures were not well documented or well thought through. Port arrival and departure routines were ineffective and the SMS simply required the chief officer to 'assist the master on the bridge' during

[4] International Convention for the Safety of Life at Sea 1974, as amended

arrival. The voyage checklist included items such as ‘VDR’ but the bridge team did not know what this required them to do. Overall, the vessel lacked the thorough, meaningful and robust arrival and departure procedures that would be expected of a passenger ferry operator.

Use of the fin stabiliser system was also not covered in the SMS, although the operation and maintenance manual was carried on board. The decision concerning when to deploy fin stabilisers, appropriately, was left to the officer of the watch’s discretion but procedural details, limitations and instructions on the use of the fin stabilisers were not documented in the SMS.

The SMS lacked effective guidance and the crew lacked familiarity with the vessel’s systems that would have helped them deal with the emergency that unfolded.

With the significant number of crew changing following the vessel’s transition to the Finnish Flag, it was apparent that many of the ship’s staff were still familiarising themselves with the vessel and, generally, *Finnarrow* appeared to have lacked sufficient preparation for her charter to Stena Line Ltd.

CONCLUSIONS

- Neither the bridge handover and arrival procedures, together with their associated documentation, nor the indication equipment were effective at alerting the bridge team to the status of the fin stabilisers.
- Fatigue might have contributed to the accident given the types of error made by the day master and chief officer and their work patterns leading up to the accident.
- The crew’s response to the flooding could have been more effective and it was fortunate that the vessel sustained flooding to only one compartment.
- The SMS lacked effective guidance that would have helped the crew deal with the emergency.
- The crew were insufficiently familiar with the vessel’s equipment, and lack of effective flooding drills hampered the damage control effort.
- The accident has demonstrated that the SMS was in need of an internal safety audit and corrective action as identified in the vessel’s recent PSC inspection.

ACTION TAKEN

Finnlines Ship Management has conducted its own investigation, and has reported that the following actions have been taken:

- Operation of the fin stabilisers has been checked by the manufacturer and found to be in order. The system is now used in automatic mode.
- All Finnlines’ vessels’ fin stabilisers have been checked and modified to ensure they have a similar logic regarding alarms and automatic housing.
- The bridge resource management (BRM) methodology and implementation has been clarified in the SMS with special focus on bridge procedures.
- The role and the importance of checklists has been emphasised in the SMS and a reminder of their implementation will be sent to all vessels.

- The importance of using “closed loop communications” and the “checklist complete procedure” has been emphasised and implemented on all vessels.
- The DPA[5] has verified the implementation of the bridge procedures.
- The *Finnarrow* accident and lessons learned have been circulated to all vessels.
- A more detailed job specific familiarisation procedure has been developed in the SMS for the handover period on board.
- The existing instructions for how to assess the length of the handover period have been verified.

The company also intends that BRM and bridge procedures shall be a topic at the next internal masters’ day.

RECOMMENDATIONS

Finnlines Ship Management is recommended for *Finnarrow,* and other vessels in its fleet, to:

2013/242 As part of the process of developing robust arrival procedures, ensure the status of the fin stabilisers has sufficient procedural and visual checks to prevent them being left deployed when the vessel enters port.

2013/243 Review and amend emergency response procedures to ensure ship’s staff are adequately supported during emergencies, and to require regular flooding drills to be conducted on board to enhance crew familiarisation.

2013/244 Ensure robust project management procedures are used when changing flag and/or routes to capture the need for providing crews with:

- Adequate vessel familiarisation.
- Sufficient rest periods in accordance with the requirements of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW).

Marine Accident Investigation Branch
November 2013

[5] Designated Person Ashore

SHIP PARTICULARS

Vessel's name	*Finnarrow*
Flag	Finland
Classification society	Registro Italiano Navale
IMO number	9010814
Type	Passenger/ro-ro cargo vessel
Registered owner	RoPax IV Arrow AB
Manager(s)	Finnlines Ship Management
Construction	Steel
Length overall	168m
Length between perpendiculars	151.2m
Gross tonnage	25966
Minimum safe manning	24
Authorised cargo	Passengers and vehicles

VOYAGE PARTICULARS

Port of departure	Dublin
Port of arrival	Holyhead
Type of voyage	International
Cargo information	1,175 vehicle lane metres and 77 passengers
Manning	43

MARINE CASUALTY INFORMATION

Date and time	16 February 2013 05:56
Type of marine casualty or incident	Serious marine casualty
Location of incident	Holyhead Port, berth 3
Place on board	Pump room
Injuries/fatalities	None
Damage/environmental impact	Port fin stabiliser severely damaged, hull plating damaged, pump room flooded and circulating water pumps damaged by flood water
Ship operation	Berthing
Voyage segment	Arrival
External & internal environment	Wind: SSE F4-6 Sea state: Smooth/slight Visibility: Good
Persons on board	120