ACCIDENT REPORT

MAIB

MARINE ACCIDENT INVESTIGATION BRANCH

Report on the investigation of

the capsize and foundering of the fishing vessel

Njord (SH 90)

resulting in one fatality

150 miles north-east of Peterhead, Scotland

on 6 March 2022

VERY SERIOUS MARINE CASUALTY REPORT NO 2/2025 FEBRUARY 2025

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2012 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

NOTE

This report is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

Front cover image courtesy of SAR helicopter.

All MAIB publications can be found on our website: www.gov.uk/maib

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

°	-	degrees
°C	-	degrees Celsius
AIS	-	automatic identification system
AP	-	aft perpendicular
BL	-	base line
CL	-	centre line
CoC	-	certificate of competency
DSC	-	digital selective calling
EPIRB	-	Emergency Position Indicating Radio Beacon
FP	-	forward perpendicular
FRC	-	fast rescue craft
FSM Code	-	Fishing Safety Management Code
GPS	-	global positioning system
HRU	-	hydrostatic release unit
ILO 188	-	International Labour Organization Work in Fishing Convention No.188
JRCC	-	Joint Rescue Coordination Centre
kg	-	kilogram
LCG	-	longitudinal centre of gravity
LOA	-	Length Overall
m	-	metres
m^3	-	cubic metres
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note
MHz	-	megahertz
MIN	-	Marine Information Note

mm	-	millimetre
MSIS	-	Marine Survey Instructions for the Guidance of Surveyors
MSN	-	Merchant Shipping Notice
nm	-	nautical miles
PFD	-	personal flotation device
RL	-	Registered Length
SAR	-	search and rescue
SMS	-	safety management system
SOLAS	-	International Convention for the Safety of Life at Sea, 1974 as amended
t	-	tonnes
UKSR	-	United Kingdom Ship Register
UTC	-	universal time coordinated
VHF	-	very high frequency

TIMES: all times used in this report are UTC unless otherwise stated.

Image courtesy of Pete Harwood (vesselfinder.com)

Njord

SYNOPSIS

On 6 March 2022, the 26.56m UK registered stern trawler *Njord* (SH 90) capsized 150 nautical miles north-east of Peterhead, Scotland while processing a large haul of fish. All eight crew members entered the water and one drowned before he could be rescued.

The investigation found that the net had been secured to the starboard trawl winch and the weight of the catch then acted on a handrail high up on the vessel's starboard side. As the remaining fish in the net started to sink, along with the vessel's hopper being overloaded, a substantial list developed to the point that downflooding could occur.

A valve in a drain cut into the weathertight bulkhead on the vessel's starboard working deck had been left open, which allowed downflooding into the internal spaces of *Njord*. The downflooding caused the starboard list to increase further, leading to the vessel capsizing. All eight crew abandoned to the upturned hull where they waited for almost 45 minutes before a rescue helicopter arrived. None of the crew were able to don personal flotation devices or lifejackets. Shortly after the rescue helicopter arrived on scene *Njord* sank and the crew entered the water.

The investigation concluded that modifications made to *Njord* in 2021 reduced the safety margin of the vessel's transverse stability and that this, coupled with the way the vessel was operated on the day, directly led to *Njord* capsizing. The deceased deckhand entered the cold water without the aid of a personal flotation device and drowned before he could be rescued.

The MAIB has issued a safety flyer to the fishing industry to highlight the importance of operating fishing vessels in line with the assumptions made in vessel stability books and remind owners and operators of fishing vessels to consult with the Maritime and Coastguard Agency before undertaking any significant modifications to their vessels.

Given the existing guidance on vessel modifications and wearing of personal flotation devices no recommendations have been made in this report.

SECTION 1 – FACTUAL INFORMATION

1.1 PARTICULARS OF *NJORD* AND ACCIDENT

SHIP PARTICULARS	
Vessel's name	*Njord*
Flag	UK
Classification society	Not applicable
IMO number/fishing numbers	SH 90
Type	Stern trawler
Registered owner	SH 90 Limited
Manager(s)	SH 90 Limited
Construction	Steel
Year of build	1992
Length overall	26.56m
Registered length	24.40m
Gross tonnage	257
Minimum safe manning	Not applicable
Authorised cargo	Fish
VOYAGE PARTICULARS	
Port of departure	Peterhead, Scotland
Port of destination	Peterhead, Scotland (intended)
Type of voyage	Fishing
Manning	8
MARINE CASUALTY INFORMATION	
Date and time	6 March 2022 at 1330
Type of marine casualty or incident	Very Serious Marine Casualty
Location of incident	North Sea, 150nm north-east of Peterhead, Scotland
Injuries/fatalities	1 fatality
Damage/environmental impact	Vessel lost, negligible harm to the environment
Voyage segment	Processing catch
Environmental conditions	Light airs; calm seas; air temperature 9°C; sea temperature 6°C
Persons on board	8

1.2 NARRATIVE

1.2.1 Before the accident

At 1222 on 5 March 2022, the 26.56m stern trawler *Njord* departed Peterhead harbour, Scotland to head for fishing grounds in the Norway sector of the North Sea **(Figure 1)**. On board were the skipper/owner (skipper), a relief skipper and six deckhands.

By 0450 on 6 March, *Njord* had arrived at a position about 130 nautical miles (nm) north-east of Peterhead and shot its fishing net over a gas pipeline connected to the Sleipner A gas platform. The vessel towed its net along the pipeline until 1100, when the net was hauled in. The catch was the largest the crew had ever seen and was estimated to contain the equivalent volume of about 700 to 750 boxes of fish.

The crew brought the net to the starboard side of *Njord* using the power block and secured it to the starboard winch. They then used the Gilson winch[1] and a lifting becket[2] to divide the catch into manageable loads of about one tonne (t) at a time in the cod end. The catch in the cod end was lifted and transferred into the fish hopper **(Figure 2)** and this process was repeated about ten times until the fish hopper was full. With the hopper full, *Njord* was listed between 15º to 20º to starboard.

Once the fish hopper was full, the crew proceeded toward the fish processing room **(Figure 3)** below the top deck. They walked through a weathertight door in the starboard passageway and each removed and hung up their personal flotation device (PFD). The crew noticed an accumulation of water in the starboard passageway and bailed it out. Five of the crew in the fish processing room started to process the fish in the hopper. The two other crew positioned themselves in the fish room to receive and pack the processed fish into iced boxes. The skipper remained in the wheelhouse.

1.2.2 The accident

After approximately an hour of processing and stowing around 90 boxes of fish, the skipper, keen to load the catch on board as quickly as possible, left the wheelhouse to look in the hopper and noticed that there was room for more fish. The skipper went down to the main deck through the forward hatch and asked the crew to load more fish into the fish hopper.

The crew made their way to the top deck without putting on their PFDs. They conducted two more lifts of fish from the net using the cod end and released them into the fish hopper but, while attempting a third lift, the starboard list became so severe that the five crew on the top deck abandoned the operation and shouted down to the two crew members in the fish room, instructing them to evacuate the area. Concerned about the cause of the list, the skipper looked over the side and observed that the fish inside the net had sunk. As the net was lashed to the starboard winch, the skipper deduced that the weight of the fish in the net was responsible for the starboard list.

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[1] Used to lift the cod end of the net up to the fish hopper.

[2] A choker rope used to form a bag at the cod end of the net.

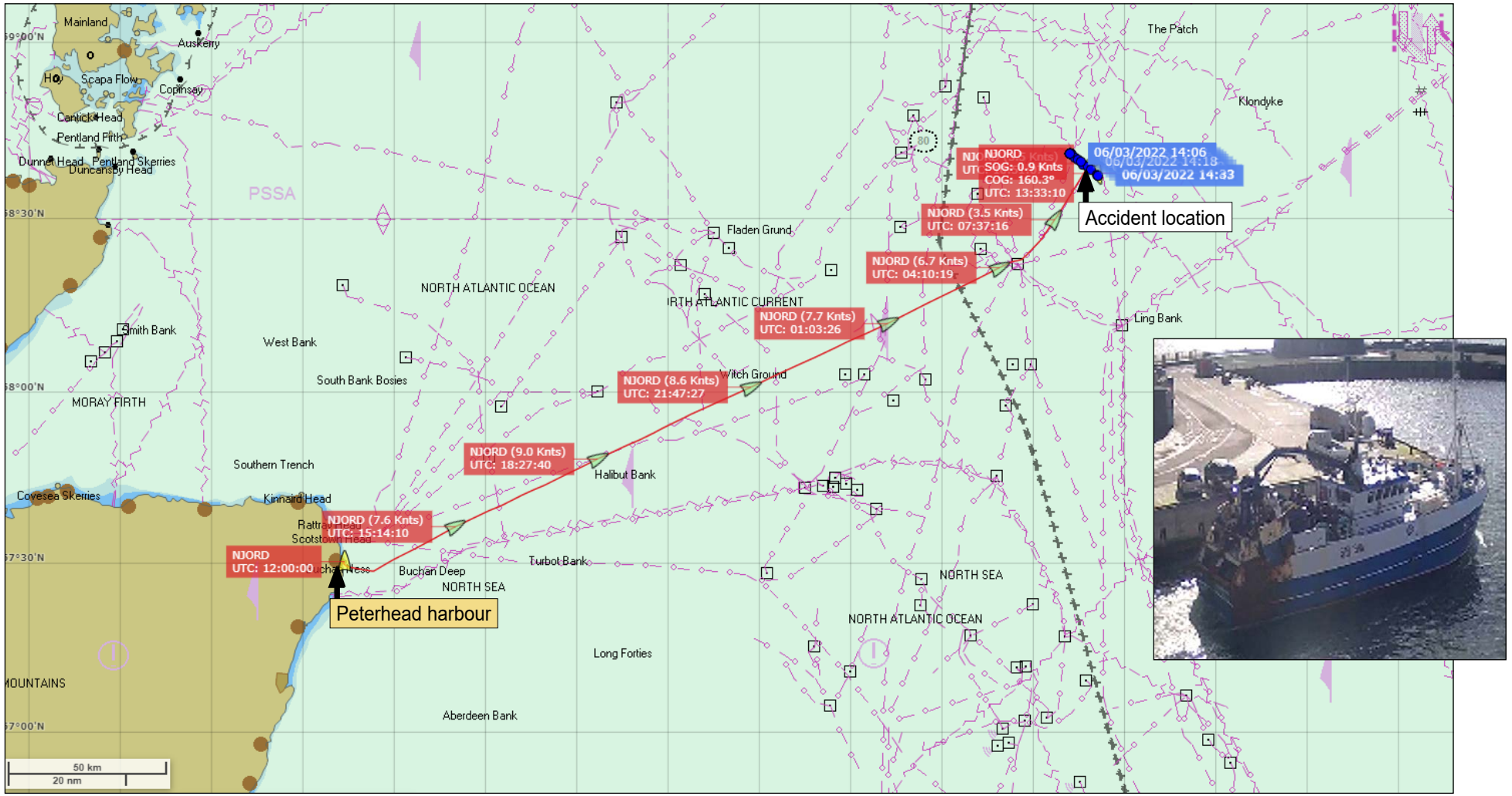


Figure 1: Track of *Njord* and (inset) CCTV still, showing the vessel leaving port at 1222 on 5 March 2022

Photograph courtesy of Ricard Paton (www.shipspotting.com)

For illustrative purposes only: not to scale

Figure 2: *Njord* net indicative lashing and general layout

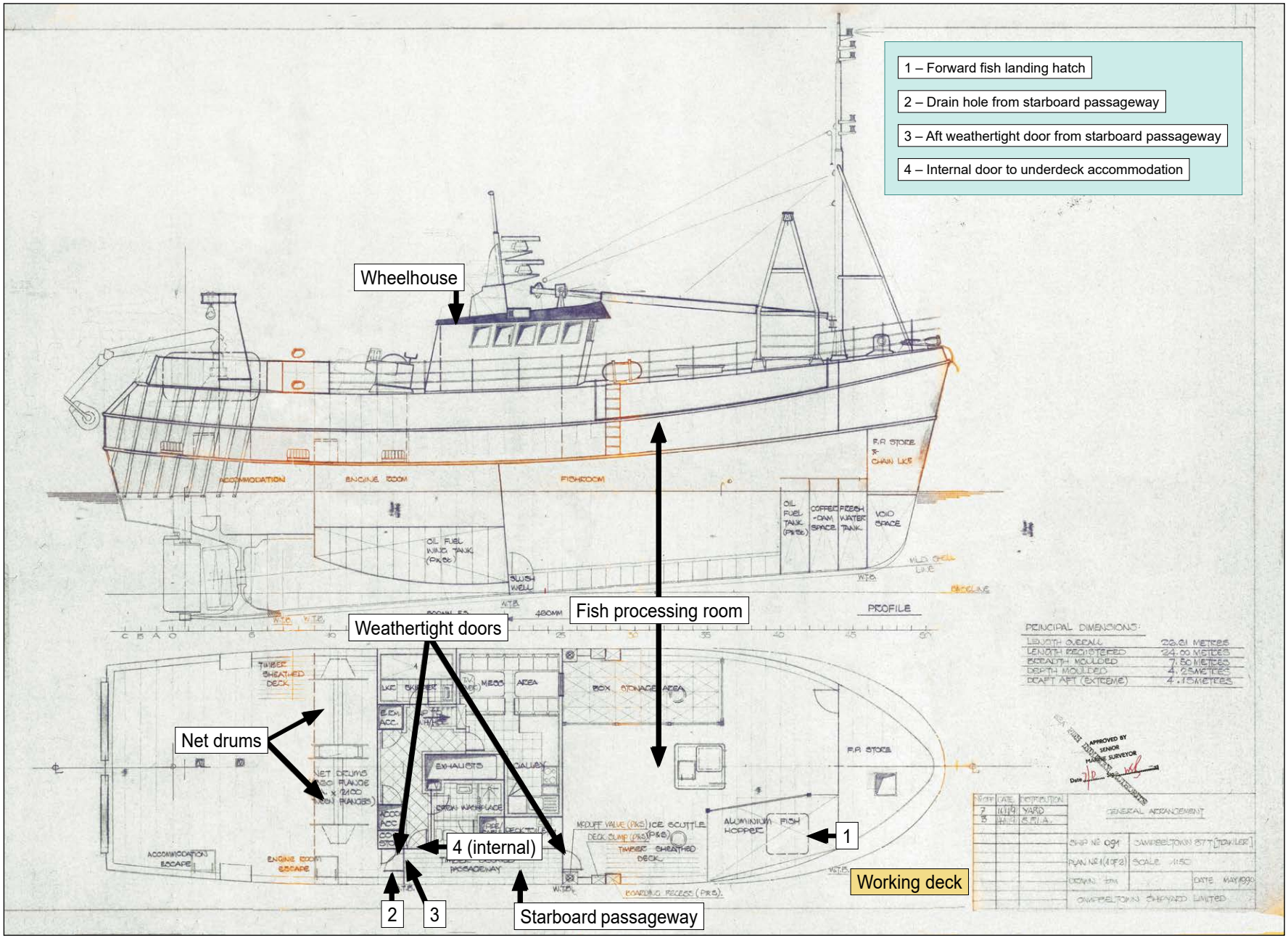


Figure 3: *Njord* general arrangement and downflooding points 1 to 4

After the crew on the top deck had gathered on the vessel's port side, the relief skipper asked one of the deckhands to go below and close the aft weathertight door that led into the starboard passageway. The deckhand closed the door and observed that the water level had reached about a quarter of the way up it; the deckhand then returned to the port side of the top deck and rejoined the rest of the crew.

Meanwhile, the skipper retrieved a knife from the wheelhouse and began cutting through the net suspended from the winch. After cutting about halfway through, the skipper felt that *Njord* was on the verge of capsizing; recognising the imminent danger, the skipper stopped and went to the port side of the vessel to join the rest of the crew. The skipper handed the knife to one of the deckhands, who used it to cut the securing straps for one of the liferafts. The released liferaft fell to the starboard side and came to rest against a stack of fish boxes stored on the top deck.

As the starboard list increased further, the skipper went into the wheelhouse, retrieved an emergency handheld very high frequency (VHF) radio from its charger and attempted to make a distress call on one of the fixed VHF radios. The worsening list and the sight of the starboard wheelhouse windows submerged underwater compelled the skipper to leave and return to the port side of the top deck.

At 1333, *Njord*'s automatic identification system (AIS) stopped transmitting the vessel's position. As the list continued to worsen, reaching approximately 90° to starboard, all eight crew climbed over the handrails onto the port side of *Njord*'s hull. They carried a life ring with them for safety. One crew member slipped and fell into the water but was able to swim to the vessel's stern, where the hull's shape allowed the skipper to help them back on board using the life ring. The skipper attempted to use the handheld VHF radio to call for help, but the battery failed as soon as the transmit button was pressed, preventing them from making a distress call.

1.2.3 Search and rescue

While the crew stood together on *Njord*'s hull **(Figure 4)**, they noticed that the vessel's Emergency Position Indicating Radio Beacon (EPIRB) had released; the flashing light on the top of the unit indicated that it had activated and, at 1339, the Norwegian Coast Guard received the EPIRB alert. A Norwegian Joint Rescue Coordination Centre (JRCC) contacted the nearby vessel *Olympic Challenger* and asked it to assist. The crew standing on the upturned hull of *Njord* could see that *Olympic Challenger* had changed course and appeared to be heading towards them.

Image courtesy of SAR helicopter

Figure 4: The crew standing on the upturned hull of *Njord*

At 1353, the JRCC contacted the crew of a search and rescue (SAR) helicopter stationed on the Johan Sverdrup oil platform, 14

miles away, for assistance. At 1416, the SAR helicopter arrived at *Njord*'s location. On arrival, the helicopter crew conducted a strategy briefing to assess whether to rescue the crew from the upturned hull or remain on station and monitor the situation until *Olympic Challenger*'s fast rescue craft (FRC) could be launched to rescue them. Four minutes after the SAR helicopter's arrival, *Njord* began to sink by the stern. The crew moved towards the bow but, moments later, the hull sank beneath them and all eight crew members entered the water. Diesel fuel rose to the surface as *Njord* sank further. A few minutes later, *Olympic Challenger* arrived and its crew launched the vessel's FRC and made their way towards *Njord*'s crew in the water.

Six of *Njord*'s crew managed to locate and hold on to the life ring but the remaining two crew were a few metres away; with nothing to hold on to, they had to swim to stay afloat.

When *Njord* sank, the SAR helicopter crew immediately abandoned their strategy briefing and prepared to lower a winchman to the two crew members who were swimming to stay afloat. At 1422, one of the two crew members was lifted out of the water and recovered to the helicopter where they briefly lost consciousness due to ingested seawater and diesel fuel; the crew member had not sustained any physical injuries.

The helicopter winchman was immediately lowered again to rescue the other crew member, a deckhand, who was recovered unresponsive from beneath the sea surface. At 1428, he was lifted into the helicopter where the on board medic immediately started cardiopulmonary resuscitation. At 1430, the winchman was lowered to sea level for a third time and recovered one of the six crew members who were holding on to the life ring.

The SAR helicopter contacted *Olympic Challenger* and requested that its FRC rescue the remaining five crew members from the water. By 1441, the FRC had recovered the remaining five crew members and was heading back to *Olympic Challenger*. The SAR helicopter remained at the scene until all five crew members were safely on board the FRC **(Figure 5)** and then departed.

Image courtesy of *Olympic Challenger*

Figure 5: SAR helicopter and *Olympic Challenger* FRC at the scene

At 1551, following a refuelling stop at the Johan Sverdrup oil platform to take on sufficient fuel to safely undertake the flight, the SAR helicopter arrived at Haukeland University Hospital, Bergen, Norway. Shortly afterwards, and despite the attempts of the medical staff, the deckhand was pronounced deceased. The other two crew members were admitted to hospital for observation and were discharged 3 days later.

The five crew members rescued from the water by the FRC were recovered to *Olympic Challenger* and subsequently transferred by helicopter to Stavanger, Norway, where they were accommodated in a local hotel. They were joined by the other two crew members after their discharge from the hospital in Bergen and were later flown back to the UK.

1.3 HUMAN PERCEPTION OF TIME[3]

The surviving crew members expressed concern that the SAR helicopter hovered close to the upturned hull of *Njord* for a considerable amount of time. Timings for the salient parts of the SAR operation were extracted from the metadata embedded in photographs taken by the crews of the SAR helicopter and *Olympic Challenger*.

The internal clock used by humans to perceive time does not represent real time (clock time) but is based on external references experienced during daily activities. Time perception can be altered during traumatic events when the section of the brain responsible for processing emotions is activated. This activation can cause the brain to focus intensely on what is happening right at that moment. Individuals who experience trauma often report that time seems to slow down, or that events seem to happen in slow motion.

Others have reported that time seems to go by very quickly during traumatic events. This can occur when an individual's brain is overwhelmed by the experience, leading to a state where they feel disconnected from reality. In this state, they might have difficulty forming accurate memories of the event, including a clear sense of how much time has passed. This phenomenon is known as 'time dilation' or 'time distortion'.

Njord's crew gave differing accounts of how long the SAR helicopter hovered over the upturned hull of their vessel, with the time period ranging from 7 to 20 minutes. Evidence indicated that the actual time was around 4 minutes.

1.4 ENVIRONMENTAL CONDITIONS

The weather was fine and sunny with light winds and calm seas, with good visibility at over 10nm. The air temperature was 9°C and the sea temperature was 6°C.

[3] Hancock and Weaver (2007).

1.5 CREW

1.5.1 General

The skipper of *Njord* was a career fisherman who held a Maritime and Coastguard Agency (MCA) Deck Officer Class 1 Fishing certificate of competency (CoC) and had a valid ENG1[4] medical certificate.

The relief skipper held an MCA Deck Officer Class 2 Fishing CoC and was undertaking familiarisation of the operation of *Njord* in preparation for taking command, having joined *Njord* and completed one fishing trip before the accident. The relief skipper did not have a fisherman's work agreement or a valid medical certificate.

The six deckhands had worked for *Njord*'s skipper for a long time as share fishermen, earning a share of the profits from the sale of each landed catch. Four of the deckhands were Filipino nationals who were qualified and certified to work on a UK fishing vessel; all held work agreements for employment on board *Njord*, and had valid medical certificates. The two other deckhands were UK nationals, for whom no evidence of a valid medical certificate or work agreement was made available during the investigation.

1.5.2 The deceased

Ronald MacKinnon was a 56-year-old UK national and career fisherman who had worked for the skipper of *Njord* for many years. His postmortem examination recorded drowning as his cause of death.

1.6 *NJORD*

1.6.1 General description

Njord was a 26.56m Campbeltown 87 stern trawler, built in 1992 at Campbeltown Shipyard, Scotland. Originally named *Guardian Angell*, it had a registered length (RL) of 24.4m and comprised three decks.

The top deck had a wheelhouse amidships, forward of which the open deck area was used to store empty fish boxes. On the starboard side, close to the bow, a lifting frame was positioned over a fish hopper **(**see **Figure 2)**. The fish hopper had a capacity of approximately 10t, which was equivalent to about 250 boxes of white fish. Two main trawl winches were located one on each side of the deck just aft of the wheelhouse. Two net drums were positioned inboard and aft of the trawl winches. At the aft end of the top deck was a raised gantry, to which was fitted a crane with a power block attachment and a sonar cable drum winch.

The working deck was below the top deck and comprised a centre trawl winch at the forward end to facilitate a twin net operation. There was access down to the fish room from this area. Aft of this was the fish processing area, which was equipped with a conveyor system that transported fish from the fish hopper to a processing table. Further aft was the accommodation, comprising the galley and messroom and stairs down to the crew sleeping area and engine room on the lower deck. These areas could be accessed via a passageway on the starboard side of

[4] The standard medical fitness certificate for UK seafarers on seagoing vessels.

the vessel's working deck. This passageway was used to store oilskins and safety equipment, such as PFDs when not in use, and there was a weathertight door at each end **(**see **Figure 3)**. Aft of the accommodation was the original net shooting area equipped with two net drums. Emergency escapes from the engine room and sleeping accommodation were located on the starboard side of this deck.

Njord was powered by a single diesel engine that drove a variable pitch propeller via a reduction gearbox.

1.7 EMERGENCY PREPAREDNESS

1.7.1 Safety equipment

Njord was equipped with an EPIRB housed in a float-free enclosure mounted on the wheelhouse roof. When activated, the EPIRB would transmit a GPS position to satellites on the 406MHz frequency; this signal would then be relayed to the nearest ground station to the activated unit.

Two 10-person SOLAS A[5] liferafts were stored forward of the wheelhouse on the top deck. The liferafts were mounted on separate cradles and each was fitted with a hydrostatic release unit (HRU).

Several life rings were distributed around the top deck; some were fitted with lifelines and others had lights attached to them.

Njord's wheelhouse was fitted with a VHF radio with a digital selective calling (DSC)[6] feature.

While working on deck the crew would wear auto-inflate PFDs. In addition, they each had a foam lifejacket and an immersion suit stowed in their sleeping accommodation.

1.7.2 Emergency drills

The records detailing the frequency of emergency drills on board *Njord* were lost with the vessel. Anecdotally, the crew had participated in several drills that were conducted in a single session in November 2021. These drills covered procedures for abandoning ship, firefighting and responding to man overboard situations. No emergency drills had been carried out between November 2021 and the day of the accident. The relief skipper had received an induction on joining the vessel but had not participated in any emergency drills on board.

1.7.3 International Labour Organization

On 16 November 2017, The International Labour Organization Work in Fishing Convention No.188 (ILO 188) came into force. In November 2018, the UK government enacted legislation to implement ILO 188 and its ratification was registered in January 2019. ILO 188 applied to all fishermen working on fishing vessels of any size. The convention entitled fishermen to written terms and conditions of employment, adequate accommodation and food, access to medical

[5] The minimum standard of construction, equipment and operation specified by the International Convention for the Safety of Life at Sea (SOLAS), 1974 as amended.

[6] A digital alerting system that, on the press of a single button, can send a vessel's identity, position and a generic distress alert to all DSC-equipped vessels and shore stations within range.

care, regulated working time, repatriation provision, social protection and health and safety measures on board. The convention also set minimum standards for crew recruitment, including a mandatory requirement for crew to possess a certificate of medical fitness.

In March 2019, the MCA published Marine Guidance Note (MGN) 587 (F) Amendment 1 – *International Labour Organization Work in Fishing Convention (No.188) Health and safety: responsibilities of fishing vessel owners, managers, skippers and fishermen*. This publication provided guidance on how to comply with the ILO 188 regulations.

1.7.4 *Njord* safety management

The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 required owners and skippers to conduct a suitable and sufficient assessment of the risks to the health and safety of fishermen. *Njord* operated in compliance with the MCA *Code of Practice for the Construction and Safe Operation of Fishing Vessels of 24m Registered Length and Over* (The Code of Practice), as outlined in Merchant Shipping Notice (MSN) 1873 (F), which came into force in October 2017.

On shipboard and fishing operations, chapter 8 of the Code of Practice required that:

> *The Owner must establish plans and instructions, including checklists as appropriate, for key shipboard and fishing operations concerning the safety of the ship and crew and the prevention of pollution.* [sic]

The chapter included guidance on and the requirement for regular crew training and drills in abandon ship, fire, anchoring and man overboard duties and procedures.

1.7.5 Fishing Safety Management Code

Introduced in October 2017, the aim of the Fishing Safety Management Code (FSM Code) was to assist fishing vessel owners and operators to comply with ILO 188 and the applicable Code of Practice. The MCA developed the FSM Code in collaboration with the fishing industry and the guidance was issued as Marine Information Note (MIN) 558 (F). In November 2018, MIN 558 (F) was replaced by MGN 596 (F) *Fishing Safety Management Code: Helping to improve the management of Safety on Fishing Vessels*. The FSM Code included guidance on maintenance management, safety reviews, crew certification, incident reporting and environmental management. On establishing a safety management system (SMS) on board a fishing vessel, the FSM Code recommended that documentation and records should include:

- *The Safety Management Manual;*
- *Company Safety and Environment Policies;*
- *All crew certification and training records;*
- *Planned maintenance system;*
- *Vessel Operation (operating procedures and risk assessments);*

- *Testing/Certification relating to the lifesaving appliances and fire-fighting equipment;*
- *Accident and incident reports and any remedial actions taken thereof;*
- *Evidence of reviews of your safety management system, self-audit Reports and close outs thereof;*
- *Environmental management and pollution prevention; and*
- *Records of drills and safety training.* [sic]

Annex 2 to the FSM Code was a document review aide-memoire to assist fishing vessel owners and skippers to create an SMS.

All the material evidence that could have demonstrated a structured approach to safety management on board *Njord* was lost with the vessel. The folders containing monthly safety updates from an online safety forum and generic risk assessments had been stored in the wheelhouse but most of the crew were unaware of the existence of these folders and had little or no working knowledge of how on board risks were managed.

1.7.6 Cold water immersion and hypothermia

Sudden immersion in water less than 15°C can result in cold water shock and cold incapacitation.

Cold water shock occurs within the first 30 seconds to 2 minutes following immersion and is associated with a gasp reflex, hyperventilation and a rapid increase in heart rate and blood pressure as the body encounters cold water. These involuntary reactions can result in cardiac arrest, especially if the casualty has an existing cardiovascular condition. Panic can cause hyperventilation to continue after the initial physiological effects of cold water shock have subsided.

Cold water incapacitation usually occurs within 2 to 15 minutes of entering the water. The blood vessels become constricted as the body tries to preserve heat and protect vital organs. This results in the blood flow to the extremities being restricted, causing cooling and consequent deterioration in the functioning of muscles and nerve ends. Hands and feet lose useful movement, which impacts the casualty's ability to perform survival tasks, and the progressive incapacitation of arms and legs impedes the casualty's ability to swim.

Hypothermia is a potentially dangerous drop in body temperature, usually caused by prolonged exposure to cold temperatures. Cold water exposure can cause the body to lose heat 25 times faster than if it was exposed to the same air temperature.

1.8 VESSEL MODIFICATIONS

1.8.1 Historic modifications

On 18 July 2000, *Njord* underwent an inclining experiment in Lerwick, Scotland that resulted in 9t of fixed ballast being added to the fish room for the vessel to meet the applicable stability requirements.

A 50mm drain was cut into the lower starboard corner of the aft bulkhead of the starboard passageway **(Figure 6)** and fitted with a stub pipe, to which a valve was fitted on the inside of the bulkhead. The drain allowed accumulated water in the starboard passageway to flow to the outside deck. The MAIB investigation found that the drain had been in situ for some years before the skipper had purchased the vessel. The drain was neither referenced on the general arrangement plans nor in the vessel's stability book, and there was no record of it in any MCA documentation to indicate that it had been reported to the organisation for approval.

Image courtesy of *Njord*'s previous owner

Figure 6: Position of the drain from the starboard passageway

1.8.2 Recent modifications

Njord was designed as a stern trawler to fish on the seabed using a single net shot from the stern. Trawl doors were used to keep the mouth of the net open **(Figure 7)**. On 9 June 2021, shortly after purchasing *Njord*, the skipper made several modifications to the vessel.

The modifications included the addition of two net drums aft of the wheelhouse on the top deck to store twin-rig prawn nets. An additional winch was fitted to the forward working deck, with rollers and guide sheaves added along the decks to control the centre towing wire needed when operating a twin net trawl. A clump ramp and storage area were added to *Njord*'s stern to facilitate the towing of a clump weight between the two nets when using the twin-rig net arrangement **(Figure 8)**.

Sections of the top deck's aft bulwark were also removed to enable the shooting of prawn nets through the stern. Additionally, a gantry was constructed between the towing gallows to raise the power block crane from the deck, and to allow the shooting of the prawn nets. A sonar cable drum was also installed on this raised gantry. Various other modifications were made to the top deck, including the removal of storage pounds, relocation of a capstan and its base, removal of other steel structures, and the addition of steel net running tracks to the deck.

Image courtesy of Seafish

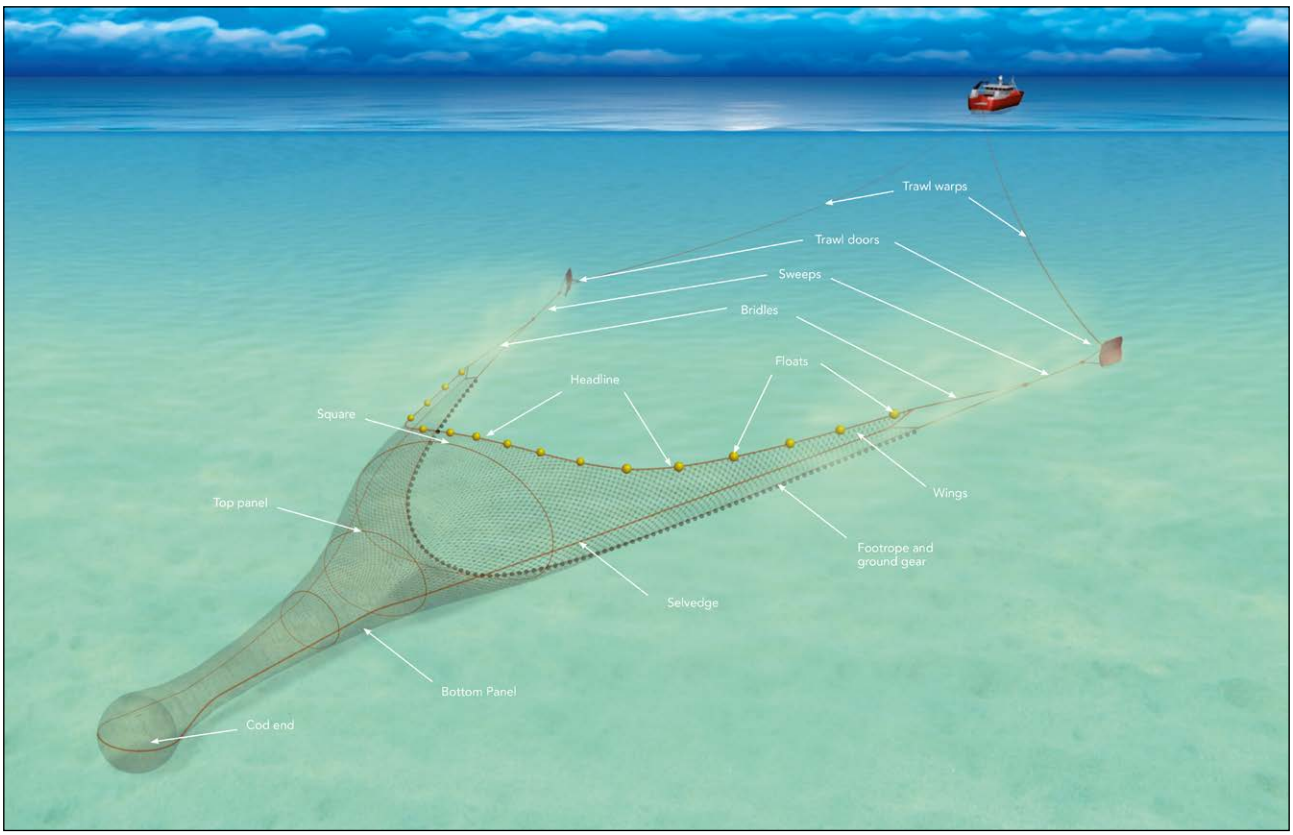


Figure 7: Single net trawl method

Image courtesy of Marine Data International

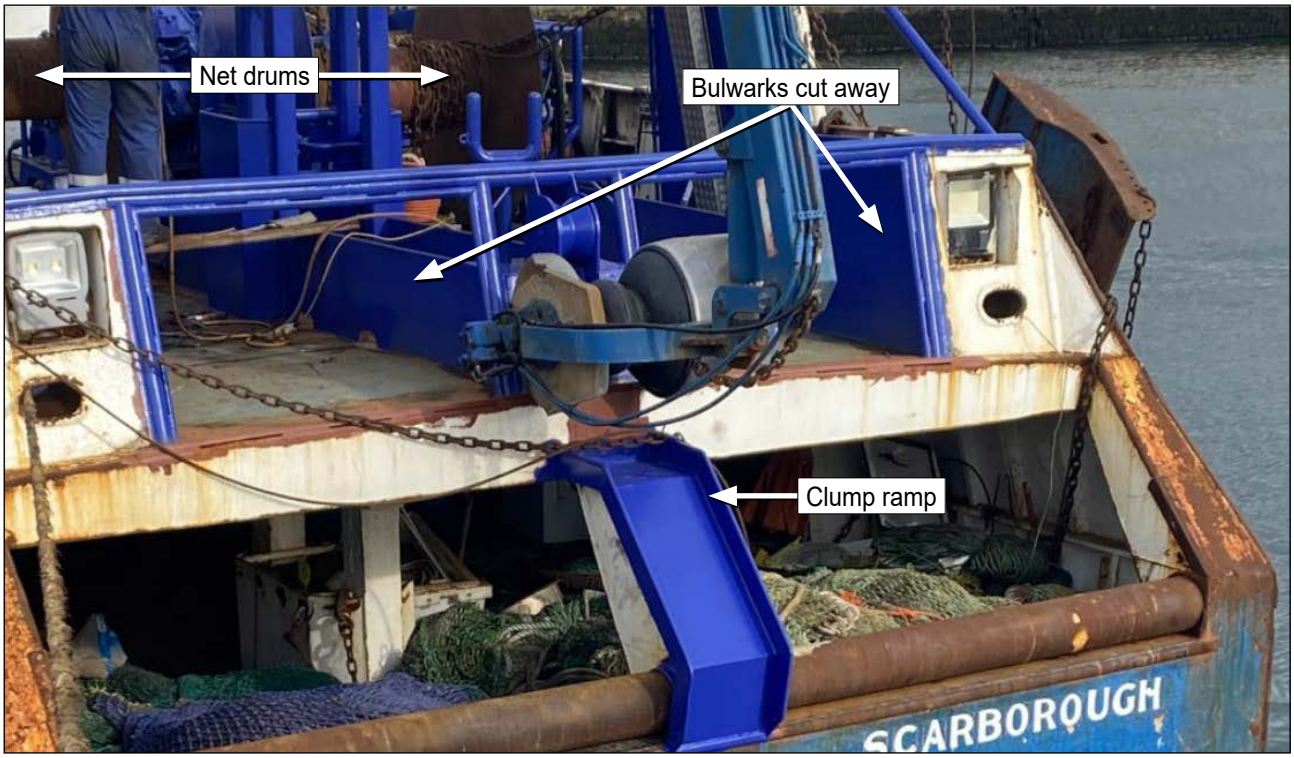


Figure 8: Clump ramp and cut away bulwarks on *Njord*'s stern

The reason for these modifications was to enable *Njord* to fish for prawns using twin nets **(Figure 9)**, which were towed across the seabed with a clump weight rigged between them to keep the nets in contact with the seabed.

As built, *Njord* was designed to load and store bulk ice from ashore. During the 2021 modification, an ice-making machine was added to the working deck, housed in a new aluminium enclosure. The ice-making machine was rated to produce 2,500kg of ice per day. Fresh water was supplied to the ice-making machine from the original freshwater tank. A desalination plant was also added to the vessel to keep the freshwater tank constantly topped up.

Image courtesy of Seafish

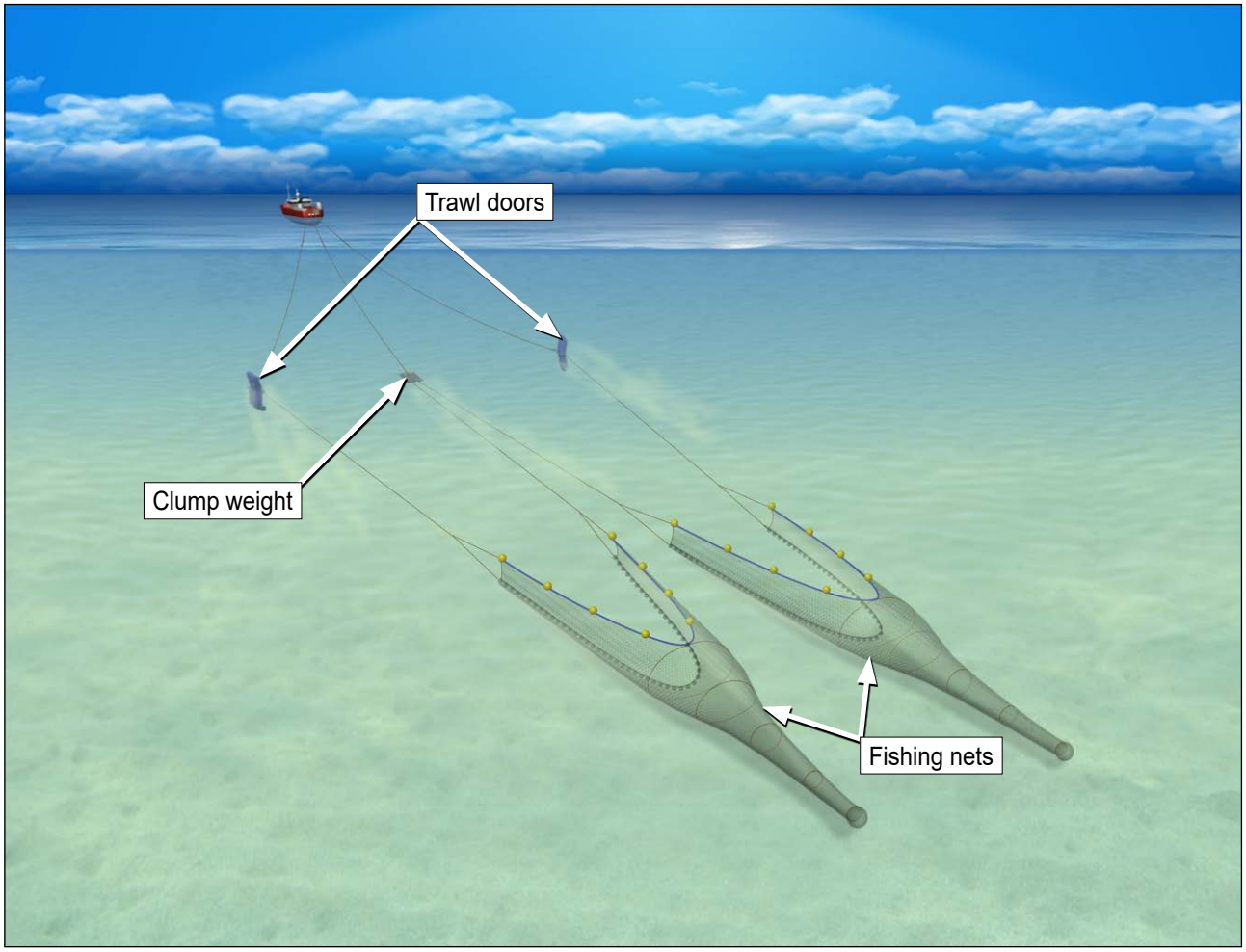


Figure 9: Twin net trawl method

1.8.3 Maritime and Coastguard Agency guidance

The MCA's Marine Survey Instructions for the Guidance of Surveyors (MSIS) on Fishing Vessels, Chapter 1 – General (MSIS 27), section 1.8, stated that a Certificate of Compliance may be considered invalid if, among other things, modifications were made *without approval/involvement of the MCA*. MSIS 27 further instructed that:

- *All Codes of Practice require owners to inform MCA of significant modifications to their vessels. It is a requirement for notification to arrive with the MCA prior to work starting. It is expected that MCA will be given reasonable time to comment prior to the work envisaged taking place.*

- *No significant modification should take place without the express involvement of the MCA as there is a significant risk to the owner that the vessel may not continue to comply with the Code of Practice.*

On the enforcement of compliance with the Code of Practice, the requirement for the owner or master to notify the MCA of alterations to vessels included:

> *Section 7 of The Fishing Vessels (Codes of Practice) Regulations 2017 No. 943 provides that in respect of any vessel to which a Certificate of Compliance has been issued the owner or skipper shall give notice to the MCA at the earliest opportunity of any alteration or modification:*
>
> *i. to the vessel's hull, equipment or machinery which affects the efficiency or the seaworthiness of the vessel; or*
>
> *ii. affecting the efficiency or completeness of the appliances or equipment which the vessel is required to carry by The Fishing Vessels (Codes of Practice) Regulations 2017 No 943* [sic]

The MCA's MSN 1873 Amendment 1 (F) – The Code of Practice for the Construction and Safe Operation of Fishing Vessels of 24m Registered Length and Over (MSN 1873) stated, in its section on changes to the revised Code, that:

> *Significant repairs, substantial structural modifications or alterations carried out to the structure or machinery of a vessel, shall only be undertaken after consultation and with the MCA's approval to ensure it complies with the requirements of the Code, as applicable to a new vessel, to the satisfaction of the MCA.*

MSN 1873 required vessel owners to ensure that their vessel was presented for survey before completing significant repairs or modifications.

Before undertaking the modifications in 2021, a naval architect advised *Njord*'s owner of the MSN 1873 requirement that, where vessel modifications affected stability:

> *the ship must be re-inclined whenever, in comparison with the approved stability information, deviation from the light-ship displacement exceeding 2% or a deviation of the longitudinal centre of gravity exceeding 1% of L is found or anticipated.*

The skipper was confident that the weight removed and the weight added to *Njord* during the 2021 modifications amounted to less than 2% growth of the lightship displacement **(Annex A)**; no further stability checks or calculations were therefore conducted to assess the impact of these modifications on the vessel's stability. The MCA was not formally notified before, during or after *Njord*'s modifications.

1.9 MARITIME AND COASTGUARD AGENCY SURVEYS AND INSPECTIONS

1.9.1 Overview

On 19 February 2021, the MCA issued *Njord* with an International Fishing Vessel Certificate for fishing vessels 24m and over. This was valid until 22 May 2023.

1.9.2 Change of ownership

The skipper had informed the UK Ship Register (UKSR), which is part of the MCA, of a change of ownership using form MSF 4705 (bill of sale). This form was dated 9 June 2021 and the UKSR amended the ownership details on 30 July 2021. The skipper submitted a further form, MSF 4741 (application for a change of name and/ or port of choice), which was dated 14 July 2021. The UKSR updated the ship register with the new port of registry and fishing number information for *Njord* on 31 August 2021.

The MCA's survey and inspection department was not informed by either the UKSR or the skipper that the ownership of *Njord* had changed in June 2021.

1.9.3 MCA guidance to surveyors on change of ownership

On change of owner and inspection, MSIS 27 stated that it was *a requirement of the Merchant Shipping (Registration of Ships) Regulations 1993, as amended that the owner informs the MCA when there has been a change of owner*.

The skipper had fulfilled the requirement through the notification to the UKSR but, as this information was not passed to the MCA survey and inspection department, no change of ownership survey was conducted.

1.10 STABILITY

1.10.1 Compliance

Njord was required to comply with the Fishing Vessels (Safety Provisions) Rules 1975; UK Statutory Instrument 1975 No: 330 (1975 rules) and to possess a stability book that complied with MGN 281 (F) Fishing Vessels Freeboard and Stability Booklet – Recommended Format. *Njord* had been issued with a stability booklet by the shipyard at its time of build, under its previous name of *Guardian Angell*.

1.10.2 Lightship displacement

Lightship displacement refers to a floating vessel and includes all equipment, excluding consumables, stores, cargo, crew and effects, and without any liquids on board other than machinery and piping fluids such as lubricants and hydraulics at operating levels.

On lightship surveys, section 3.8 of the MCA's MSIS 27 Part B – Stability of Fishing Vessels of 15m LOA and Over – instructed that:

- *This section applies to all fishing vessels carrying an approved stability book in compliance with section 3.4.6, 3.7.6, 3.8 and 3.12.7 of MSN 1871, Chapter 3.1.1.1 of MSN 1872 and 3.1.1.2 of MSN 1873*

- *At each renewal survey a stability assessment is required to ensure that the vessel remains compliant with the required stability criteria and the approved stability book remains valid. This assessment is normally carried out by means of a lightship survey, but there are occasions when this is not appropriate, for example:*

    - *Vessels having no margins on one or more of the stability criteria in any seagoing sailing condition should be inclined instead, and;*

    - *When "unapproved" modifications to the vessel come to light during the survey which could have an adverse impact on stability.*

    Additional requirement for vessels to which MSN 1873 applies

    - *Vessels meeting MSN 1873 are inclined at least every 10 years (in practice this means every second renewal survey)* [sic]

1.10.3 Lightship history

As built in 1992, *Njord* had a lightship displacement of 236.14t. A survey carried out on 25 May 2000 indicated the lightship had increased by over 20t to 257.003t. A vessel incline test on 18 July 2000 found the lightship to be 256.119t. When the stability was calculated using the new lightship, the vessel failed the worst-case scenario stability condition. The naval architects who had carried out the incline calculated that if 9t of fixed ballast was added to the fish room the vessel would meet all the required stability criteria; the 9t of concrete was added to the fish room on 5 January 2001, increasing the lightship displacement to 265.119t. The vessel was issued with a new approved stability book in 2001.

On 5 July 2004, while *Njord* was out of the water for periodic maintenance, the aft draught marks were moved from the aft perpendicular on the sides of the vessel to the centre of the transom. Due to the complexity of the task, errors affecting the accuracy of stability calculations could be introduced when moving draught marks.

On 20 July 2004, *Njord* was inclined again and the lightship was found to be 265.275t. The repositioning of the aft draught marks were recorded on 4 August 2004 by an MCA principal surveyor.

Njord was inclined again in 2014 and 2018. The vessel's recorded lightship weight did not change significantly, with 266.120t and 266.195t recorded for the 2014 and 2018 incline tests respectively. A revised stability book was issued in 2019.

The investigation found that the calculations made in 2004 and 2014 to determine *Njord*'s lightship contained errors. The accurate lightship during this period would be difficult to determine due to the passage of time and that alterations to the vessel had not been recorded. Also, it was not documented whether the MCA had verified the position of the transposed draught marks on the transom of *Njord*. The 2001 and 2018 lightship results were very similar, which could suggest that the transposition of the aft draught marks was completed accurately. The actual position of the aft draught marks cannot be determined with any confidence from the information available after the vessel's loss.

1.10.4 Stability books

A vessel's trim and stability book included general particulars about the vessel, instructions on how and where the vessel was to be operated and what stability regulations the vessel was bound by.

The working instructions section of *Njord*'s stability book stated:

> *Carriage of fish in the hopper:*
>
> *Not more than 4.00 tonnes of fish should lie in the hopper and it should be stowed below as soon as possible.*

The list of assumptions in *Njord*'s stability book included:

> *The vessel is assumed to depart port with 25.00 tonnes of crushed tube ice (density 0.641 t per cubic metre) stowed in the fish hold port and starboard ice pounds. The ice is assumed to melt at a uniform rate of 1.000 tonnes per day.* [sic]

Njord's stability book included a list of operating assumptions that were made to facilitate the calculation of seven likely stability conditions:

1. *lightship (non-seagoing)*
2. *depart port for fishing ground with 100% consumables on board*
3. *arrival at fishing grounds 90% consumables*
4. *depart fishing grounds with 100% catch and 75% consumables*
5. *depart fishing grounds with 20% catch & 50% consumables*
6. *depart fishing grounds with 100% catch & 10% consumables*
7. *arrival in port with 20% catch & 10% consumables*

1.10.5 General stability assessment

Using the 2001 displacement, *Njord* complied with the 1975 rules on stability standards for all seven conditions. In 2018, the stability was verified with an updated lightship and the calculation of the worst-case condition 7, arrival in port with part catch, which it marginally passed. Post-loss calculations indicated that condition 3, arrival at fishing grounds with 90% consumables, was the worst-case condition. Had this condition been calculated by the MCA, *Njord* would have been found to be noncompliant with the 1975 rules.

1.10.6 Stability assessment 2021

The investigation commissioned naval architects to conduct a post-accident stability assessment of *Njord*. Digital models were created for *Njord* in the vessel's 2019 condition before modifications, and for the vessel's 2021 post-modification condition. To determine *Njord*'s post-modification lightship displacement as accurately as

possible, the details of the 2021 modifications were used; the resulting calculation of 271.360t showed an increase of 5.165t on the 2018 lightship displacement, which was equal to 1.94%.

> Due to the possible inaccuracy of the 2018 lightship calculations (see 1.10.3), all resultant figures in the following assessment should be treated as indicative and not definitive values.

Using the 2021 post-modification condition, *Njord* complied with six of the seven conditions; as shown at **Table 1**, the vessel failed to comply with the 1975 rules on stability for condition 7 – arrival in port with 20% catch and 10% consumables.

Loading condition	**Draught**		**GM[7] [m] (0.350m required)**		**GZ[8] [rad.m] (Heel 0° to 40°, 0.090 required)**		**1975 Rules complied**
	Forward [m]	**Aft [m]**	**Result**	**Margin**	**Result**	**Margin**	
Digital Model Results using 2021 Lightship							
01	1.90	4.05	0.436	0.086	0.092	0.002	Pass
02	2.89	4.26	0.477	0.127	0.105	0.015	Pass
03	2.95	4.23	0.446	0.096	0.097	0.007	Pass
04	3.14	4.39	0.550	0.200	0.116	0.026	Pass
05	2.61	4.34	0.481	0.131	0.100	0.010	Pass
06	2.56	4.56	0.579	0.229	0.112	0.022	Pass
07	2.25	4.31	0.384	0.034	0.076	-0.014	Fail

Table 1: Stability results compared with 1975 rules

The models were used to determine what effect the modifications and operating conditions had on the statical stability of the vessel. Assessments were conducted to validate the electronic models against the 2001 and 2019 stability books.

The 5 March 2022 departure port condition and the condition of *Njord* shortly before the accident were determined from information provided during the investigation. As an ice-making machine had been fitted to *Njord* during 2021, the vessel did not routinely load bulk ice from ashore. *Njord* had departed port on 5 March with around 8t of ice in the fish room, rather than the 25t assumed in the stability book. The investigation determined that *Njord* had around 12.5t of ice in the fish room at the time of the accident.

[7] The distance between the centre of gravity of a ship and its metacentre.

[8] Righting lever.

An assessment of *Njord*'s general arrangement was undertaken to identify the following possible sources of downflooding **(**see **Figure 3)**:

1. forward fish landing hatch

2. drain hole from starboard passageway

3. aft weathertight door from starboard passageway

4. internal door to underdeck accommodation

A progressive flooding sequence was used to determine whether the list caused by a load in the fish net, resulting in the initial flooding of the starboard passageway through the drain hole (downflooding point 2), would be sufficient to submerge the aft weathertight door sill (downflooding point 3); and whether flooding of the working deck accommodation would be sufficient to submerge the internal door sill to the underdeck accommodation area (internal downflooding point 4). The starboard passageway drain was assessed to be the most likely source of downflooding due to its position.

When parcels of fish were being loaded from the net into the hopper the acting point of the weight changed dynamically, from the handrail to a position between the securing point and the lifting frame over the hopper. For the purpose of calculation, and since the weight was acting at the handrail for the majority of the time, it is at this point where the weight was considered in the various scenarios **(Figure 10** and **Table 2)**.

The fishing industry often referred to a volume of fish in a net using the unit 'boxes of fish', as this was how they visualised what a catch might be worth. A box of white fish caught by *Njord* weighed, on average, 40kg. This figure was used throughout the stability calculations.

The calculations accounted for the weight of the fish brought on board into the fish hopper and stowed in the fish room plus 12.5t of ice in the ice pounds, and considered four scenarios:

- Scenario A – pre-accident loading condition, using the 2021 lightship weight and adding sufficient load to immerse downflooding point 2 and start progressive downflooding.

- Scenario B – pre-accident loading condition, using the 2021 lightship weight and adding sufficient load to cause immediate capsize without downflooding.

- Scenario C – pre-accident loading condition, using the 2018 lightship weight and adding sufficient load to immerse downflooding point 2 and commence progressive downflooding.

- Scenario D – using the 2021 lightship weight, with *Njord* operated in line with the stability book's assumptions; 4t of fish loaded in the fish hopper and 24t of ice in the fish room (24 hours after leaving port with 25t of ice on board).

The downflooding angles differed for each scenario due to the draught of the vessel changing with the loading condition.

Photograph courtesy of Ricard Paton (www.shipspotting.com) For illustrative purposes only: not to scale

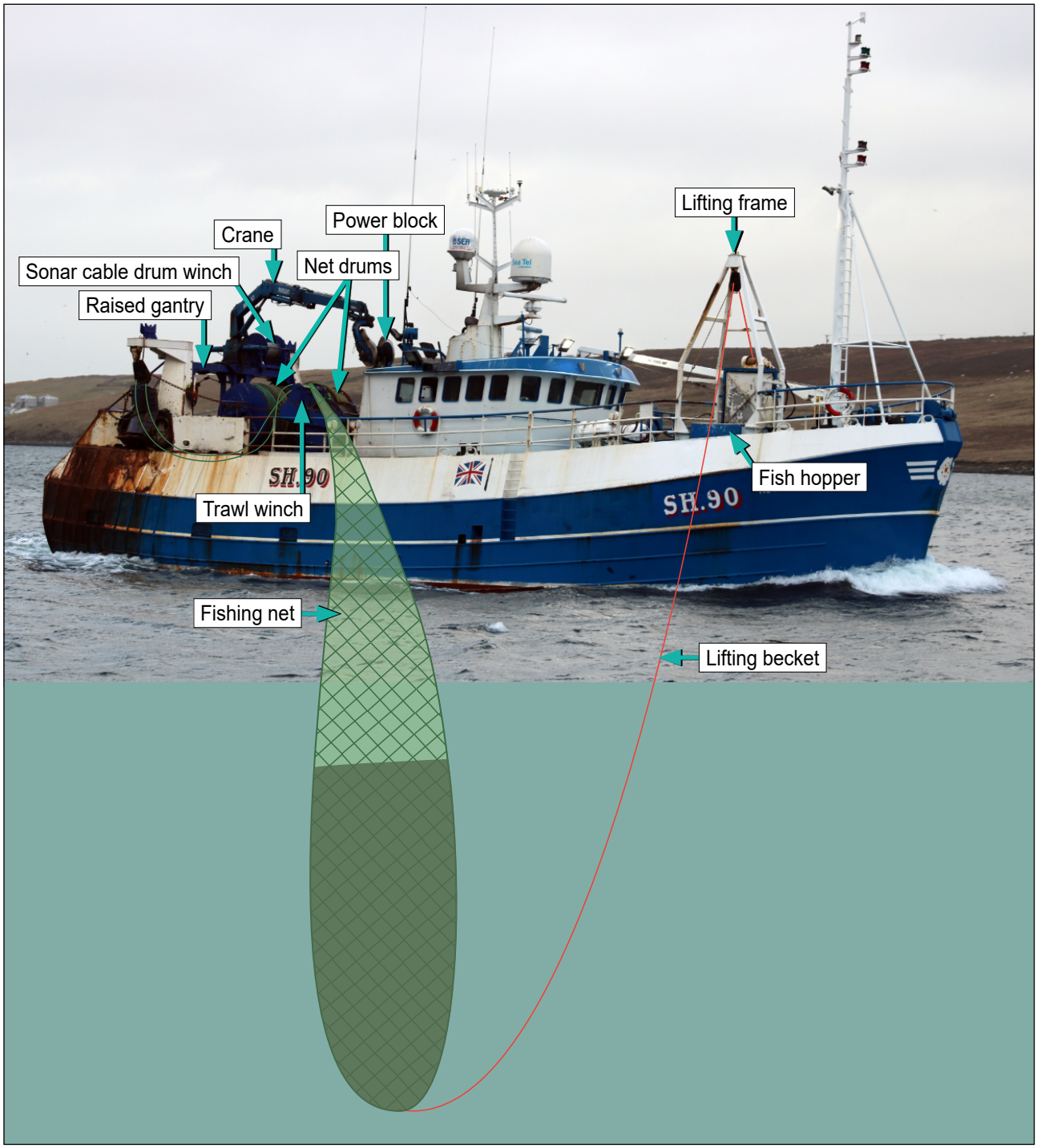


Figure 10: Position of net during loss scenario

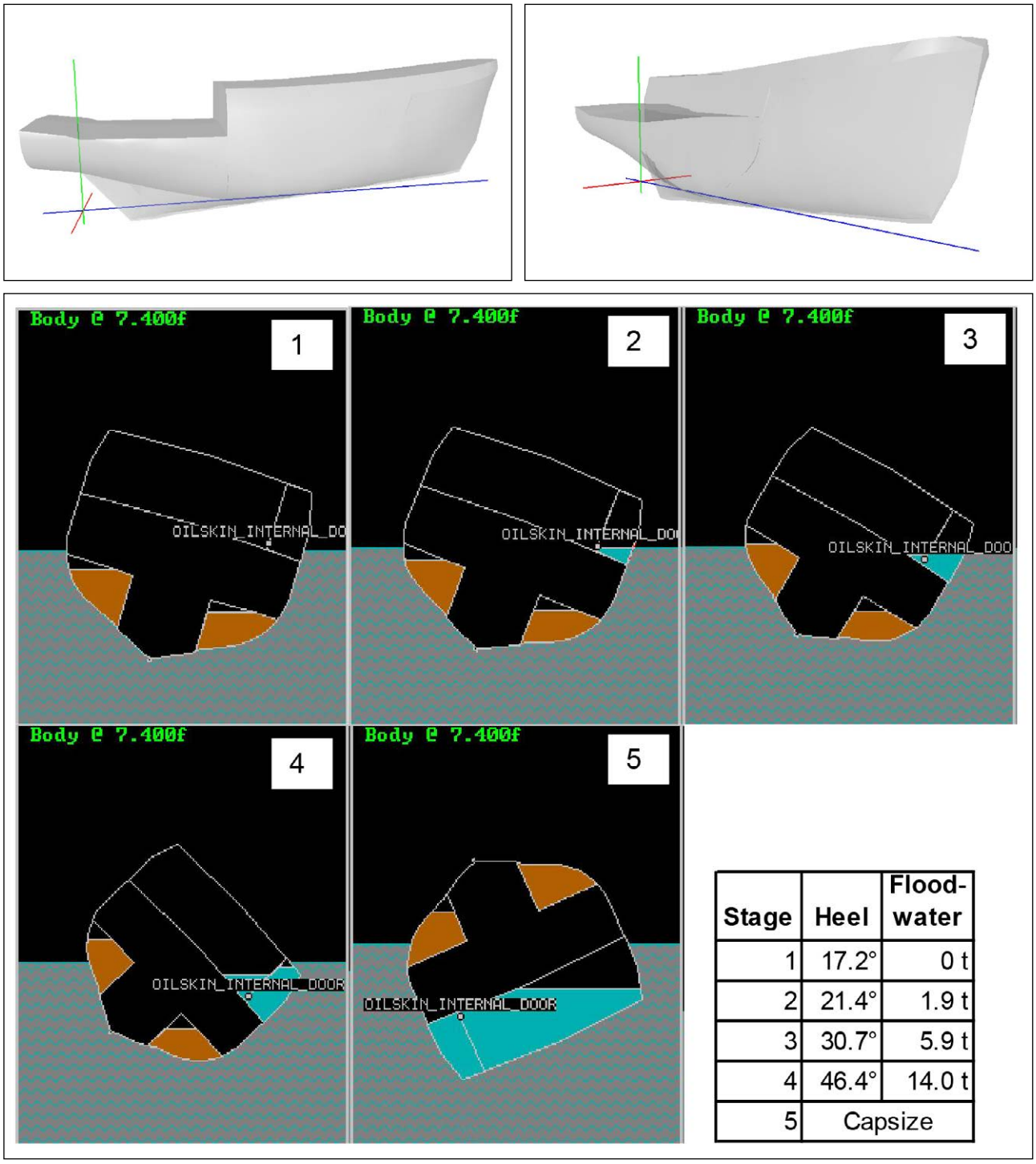
Scenario	Lightship weight (year)	Load in net (t)	Downflooding angle (°)
A	2021	3.10	17.2
B	2021	9.90	Capsize
C	2018	4.40	17.8
D	2021	7.40	16.4

Table 2: Stability modelling scenario results

The results of the scenario A loading condition indicated that 3.10t was required to act at the net lashing position for progressive flooding to immerse the starboard passageway drain hole (downflooding point 2) and begin flooding the passageway. The digital model demonstrated that a list of 46.6° would capsize the vessel before flooding of the lower accommodation through an internal door (internal downflooding point 4) would occur **(Figure 11)**.

The results of the scenario B loading condition indicated that *Njord* would have immediately capsized without downflooding if a load of 9.9t or more had been applied to the net lashing position. It would not have been possible to apply sufficient net load to submerge the fish landing hatch (downflooding point 1) before capsize occurred.

Images courtesy of ABL Group



Stage	Heel	Flood-water
1	17.2°	0 t
2	21.4°	1.9 t
3	30.7°	5.9 t
4	46.4°	14.0 t
5	Capsize	

Figure 11: *Njord*'s likely flooding sequence

The results of the scenario C loading condition indicated that a weight of 4.4t was required to act at the net lashing position to immerse the starboard passageway drain hole, (downflooding point 2) and commence progressive downflooding.

The results of the scenario D loading condition indicated that a weight of 7.4t applied to the net lashing position would be required to bring the vessel to a 16.4° angle of list, sufficient to initiate downflooding through the starboard passageway drain hole (downflooding point 2).

1.10.7 Weight and volume of fish

The white fish targeted by *Njord* could adjust their buoyancy to float up or sink down by altering the amount of air within their swim bladders. The average density of white fish is 1080kg/m^3 and they would sink after death as their swim bladders emptied; in comparison, average seawater density was considered to be 1025kg/m^3. The catch of white fish would therefore become heavier in the net as they died in seawater, resulting in an average weight of 55kg/m^3 (1080 kg/m^3 - 1025 kg/m^3).

The crew of *Njord* estimated the size of a catch in volumetric terms, i.e. the number of boxes of fish, rather than by weight. The internal volume of a standard fish box was 0.075m^3. When expressed as additional weight in the net in seawater, each box equated to 4.125kg (55kgm^3 x 0.075m^3) as the fish died. The number of boxes of fish that would have been required to be in the suspended net in each of the modelled scenarios is shown at **Table 3**.

Scenario	Lightship weight (year)	Load in net (t)	Equivalent boxes of fish in net	Initial list angle (°)
A	2021	3.10	751.5	17.2
B	2021	9.90	2400	Capsize
C	2018	4.40	1066	17.8
D	2021	7.40	1793	16.4

Table 3: Weight of fish and equivalent fish box volume

1.11 PREVIOUS ACCIDENTS

1.11.1 *Stella Maris* – capsize and foundering

On 28 July 2014, the 9.96m LOA trawler *Stella Maris* capsized and sank while hauling fishing gear. The vessel's two crew were uninjured (MAIB report 29/2015[9]). *Stella Maris* had been significantly modified before its loss, including the fitting of an A-frame gantry and a winch for lifting the cod end. Calculations for the effects of this work on the vessel's stability were neither required nor carried out.

The investigation identified that *Stella Maris* capsized as a result of insufficient stability due to an overly high gantry supporting a heavy cod end, lifted by a winch with excessive power. *Stella Maris* had a sister vessel that was similarly modified.

[9] https://www.gov.uk/maib-reports/capsize-and-sinking-of-stern-trawler-stella-maris

1.11.2 *Sarah Jayne* – capsize and foundering

On 11 September 2012, the 14.94m fishing vessel *Sarah Jayne* was lost approximately 6nm east of Berry Head, England when two waves swamped the deck during loading of the catch, leading to flooding of the fish hold and eventual capsize and resulting in the loss of the skipper (MAIB report 13/2013[10]).

Sarah Jayne was trawling for sprats and approximately 20t of fish had been loaded into the fish hold via a flush deck scuttle. There was catch still left in the net and, as the next portion of the catch was being lifted on board, a wave swamped the starboard quarter. A second wave then swamped the deck, leaving *Sarah Jayne* with a starboard list and substantial water on deck. Shortly afterwards, the vessel capsized to starboard. The mate and crewman managed to swim clear of the vessel and were rescued 20 minutes later by the crew of another fishing boat that was nearby. The skipper was lost with the vessel.

Sarah Jayne's liferaft failed to surface and inflate, probably as a result of being obstructed by the overhang on the wheelhouse roof on release from its stowed position on the aft external bulkhead.

1.11.3 *Joanna C* – capsize and sinking

On 21 November 2020, the scallop dredger *Joanna C* capsized and later sank south of Newhaven, England. Only one of the three crew survived (MAIB report 7/2022[11]). The investigation found that *Joanna C* had very low reserves of positive stability, which had been severely eroded by modifications and was insufficient to meet the required minimum criteria. The opportunity to detect this was missed when analysis of data from a 2019 inclining experiment was not completed and this omission was not followed up. *Joanna C*'s crew were therefore free to operate the vessel with inadequate reserves of stability.

A safety recommendation was made to the MCA to:

2022/124 – Ensure that fishing vessel stability compliance activity is effectively monitored such that stability requirements for small fishing vessels are applied as intended. Where stability checks are required, fishing operations should be suspended until a vessel's stability has been satisfactorily assured.

This recommendation was accepted by the MCA.

As a result of the *Joanna C* investigation, the Chief Inspector of Marine Accidents wrote to the **British Standards Institution** on 28 June 2021 to issue the following recommendation:

2021/116 – Propose to the International Organization for Standardization that the revised ISO 9650 standard includes a buoyancy requirement for uninflated canister-packed liferafts when intended for use with float free, automatic inflation devices. The buoyancy requirement should be sufficient to exceed, by a suitable factor of safety, the force required to activate the liferaft's inflation mechanism.

[10] https://www.gov.uk/maib-reports/capsize-and-sinking-of-multipurpose-fishing-vessel-sarah-jayne-east-of-berry-head-near-brixham-england-with-loss-of-1-life

[11] https://www.gov.uk/maib-reports/capsize-and-sinking-of-scallop-dredger-joanna-c-with-loss-of-2-lives

SECTION 2 – ANALYSIS

2.1 AIM

The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

2.2 OVERVIEW

Njord's crew were processing an unusually large haul of fish as the vessel progressively listed to starboard. Despite this the crew continued to bring more fish on board, further increasing the list to the point of downflooding. *Njord* eventually capsized and sank.

All eight crew abandoned the capsized vessel to its upturned hull, where they remained for approximately 45 minutes. Once *Njord*'s EPIRB had automatically activated, a SAR helicopter and an offshore vessel in the area were tasked to assist. *Njord* sank shortly after the helicopter arrived on scene, leaving all eight crew in the water from where they were subsequently rescued.

Three crew members were winched into the helicopter, while the remaining five crew members were rescued by the FRC launched from the offshore vessel. One of the crew members who was rescued by the helicopter died due to drowning.

The analysis will consider the factors contributing to the capsize, including the impact on stability of *Njord*'s modifications and the vessel's operational practices. The analysis will also consider the rescue of the crew.

2.3 VESSEL MODIFICATIONS

The skipper had confidence in *Njord*'s safety and operational efficiency. They believed the modifications made in 2021 enhanced the vessel's fishing performance and considered the changes to be minor, expecting them to have minimal, if any, impact on stability. The opportunity to provide professional advice and guidance was missed because the skipper did not formally engage with the MCA or a naval architect to assess the impact of the modifications.

The skipper's justification was that the weights added were approximately the same or only slightly more than the weights removed. However, while weights for some of the equipment added and removed had been recorded, no accurate figures for the weight of steelwork or some of the ancillary equipment were recorded at the time of the modifications and a post-modification assessment of the lightship weight was not carried out.

The reason for the installation of the drain hole in the aft bulkhead of the starboard passageway is unknown; its purpose might have been to drain water from periodic cleaning of the space. The downflooding angle reduced from 46° to around 17° when the vessel was assessed in its pre-accident loading condition (scenario A) if the valve was left open. It is likely that *Njord* would not have capsized had the valve on the drain been closed, as it should have been, while the vessel was at sea.

2.4 VESSEL OPERATION

The skipper had owned and operated fishing vessels over 24m in length for many years and had experience of large catches. Most of the crew had fished with the skipper for many years. The crew had been operating *Njord* since November 2021, initially fishing for prawns and switching to white fish when the restrictions in the Norway sector of the North Sea were lifted. However, the move to fishing for white fish was recent and *Njord*'s crew might not have been familiar with what was considered a normal catch size for the vessel; their limited experience of fishing for white fish on *Njord* meant they had little knowledge on which to form a basis to challenge the skipper's actions or decision-making.

On 6 March, the skipper decided to fish over a gas pipeline in the recently opened Norway sector. This was the first haul of the trip, and the catch was over 30 times the size of a normal haul. The skipper and the crew were pleased with the potential profitability of the haul. However, they were unprepared for the cumulative effect the haul would have when *Njord* started to list heavily.

Although the skipper had encountered large hauls before, their biggest on *Njord* had occurred just a week before the accident with a catch of around 300 boxes (12t); the excess fish had been placed in the cod end on top of the fish hopper to keep them out of the water. That haul had been approximately a third of the size of *Njord*'s catch on the day of the accident.

It is likely that the new experience of such a large catch led the crew to perceive *Njord*'s heavy listing as normal under the circumstances. A large catch meant significant remuneration for all of the crew as share fishermen, and their delight might have influenced their judgement of and consideration towards safety when dealing with this exceptional volume of fish.

When the crew were tasked to bring additional lifts of fish into the hopper, additional weight of fish was being placed high up on a vessel that was already listing, adding to the heeling force. Had the net been cut away immediately, and the additional fish not been added to the hopper, the vessel might have been saved.

2.5 WEATHER CONDITIONS

The benign weather conditions could have rendered the skipper and crew content to spend hours processing their huge haul of fish. The initial list might have been expected or perceived as normal, but the progressive worsening of the list might not have been so easily noticed; the crew were primarily focused on the task of processing the abundant catch, which could have diverted their attention from the vessel's condition. Had *Njord* been rolling slightly, the gradual deterioration of its stability might have been more apparent; however, the benign conditions could have masked any warning signs, making it difficult to perceive the vessel's increasing list.

2.6 VESSEL STABILITY

2.6.1 General

The assumptions made in *Njord*'s stability book were designed to minimise variables, allowing intact stability to be calculated with reasonable accuracy. It was best practice for a vessel to be fished within the constraints of the assumptions made to ensure that the calculated stability safety margins were maintained.

However, the operating conditions on 6 March deviated significantly from the assumptions underpinning the vessel's stability book; only 12.5t of the assumed 25t of ice was on board and the fish hopper had been filled to the top with fish. This impacted *Njord*'s stability by reducing the weight required to list the vessel to an angle where downflooding would occur by over 50%. There were no markings on the inside of the fish hopper to indicate the assumed maximum fill level, which was not unusual in the industry. As a result, it was difficult for the crew to judge what 4t looked like in the fish hopper. The normal hauls of between 1t and 1.5t meant that loading the fish hopper to beyond the assumed maximum was not usually a concern. The skipper had filled the hopper completely on a previous trip, with no adverse effect, so was likely acting on previous experience when tasking the crew to take more lifts of fish out of the net. At the time, the skipper was unaware that the vessel was downflooding and that any further heeling moment would only add to the speed with which the vessel was flooding.

The crew estimated the net contents to be approximately 700 to 750 boxes of fish when hauled. About 90 boxes of fish had been processed and stowed in the fish room when the starboard list was noted to be worsening. The weight of the fish inside the full hopper was approximately 10t, the equivalent of about 250 boxes of fish. To list *Njord* to starboard to an angle where downflooding could occur required about 3.1t, the equivalent of approximately 750 boxes of fish, to be in the net, in the water and act on the handrail. The investigation estimated that the initial catch in the net was likely to have been equivalent to over 1,000 boxes of fish.

2.6.2 Historic stability assessments

Several inaccuracies were found in stability calculations conducted by MCA surveyors dating back over 20 years. The investigation was unable to conduct a full technical audit of all the historic stability assessments for *Njord*. While each of the inaccuracies discovered were minor in isolation, the cumulative effect cannot be known due to the limited information available, the passage of time and the vessel being lost. Had all conditions been recalculated in 2018, when only the assumed worst-case condition 7 was recalculated, it would have been evident that condition 3 was the worst-case condition and that was likely to have been marginally noncompliant. However, as condition 3 was not calculated at the time, the vessel was deemed to fully comply with the stability requirements.

As no stability checks were carried out by *Njord*'s owner following the 2021 modifications, the opportunity was missed to confirm the vessel's true stability condition before starting fishing operations.

In response to the recommendation made in the *Joanna C* report, the MCA amended its fishing vessel stability procedures, guidance and training of surveyors to improve oversight. The review process also identified actions to be taken by surveyors when modifications were found to affect stability.

2.7 EMERGENCY PREPAREDNESS

None of the crew were wearing a PFD while processing their catch on *Njord*'s working deck because of the area's enclosed environment. The crew who went up to the top deck to load more fish into the fish hopper likely did not don their PFDs because of the calm weather conditions. As the vessel started to capsize there was no time for crew members to collect their PFDs from the starboard passageway or their abandon ship lifejackets and immersion suits from the accommodation spaces.

Without a PFD and nothing buoyant to hold onto in water of 6°C, it is likely that the deckhand succumbed to cold water incapacitation, which led to him being unable to keep his head above the water and resulted in drowning. Had the abandon ship lifejackets been stowed in a box on deck, all of the crew could have collected one and put it on before abandoning to *Njord*'s upturned hull. The wearing of a PFD might have saved the deckhand's life.

The EPIRB activated as designed, alerting the JRCC to the emergency. When the portable VHF taken from the wheelhouse by the skipper failed to operate, the EPIRB remained the only available means of alert to the vessel's distress. Had it been trapped in the wreckage and not floated free, it is likely that all eight crew members would have perished because no one was wearing either an immersion suit or PFD. The vessel's liferafts did not float free when *Njord* sank and there was no means for the crew to alert anyone to their predicament.

Leaving a VHF radio on charge continuously could lead to overcharging, which could degrade the battery over time. To maximize the lifespan of a VHF radio battery, manufacturers recommend following optimal charging practices such as charging the battery when it is low and unplugging it once it is fully charged. This helps maintain the battery's health and ensures reliable performance.

It could not be determined why both liferafts did not inflate and rise to the surface. As found in the investigation into the loss of the fishing vessel *Sarah Jayne*, it is likely that *Njord*'s liferafts were trapped by the structure of the vessel as it inverted. The liferafts' canisters were then able to flood, rendering them neutrally buoyant when the vessel sank. As found in the *Joanna C* investigation, the loss of buoyancy resulted in the flooded liferaft not being able to trigger the self-inflation mechanism. Had one of *Njord*'s liferafts surfaced, the crew would have had the option to board it instead of standing on the upturned hull, and the deckhand might have survived.

Careful assessment must be made when choosing where to locate liferafts that are designed to float free in the event of a vessel sinking. Entrapment of the liferaft by the vessel's structure or fishing gear must be considered if the vessel becomes inverted.

2.8 THE RESCUE

The benign weather conditions posed a significant challenge for the SAR helicopter pilot; the lack of wind required significantly more power from the rotary wing aircraft to hover, intensifying the downwash from the helicopter's rotor blades and increasing the risks to both the people in the water and the winchman.

The helicopter crew had assessed the situation on arrival at the scene and recognised the substantial risks associated with attempting to rescue the crew from *Njord*'s upturned hull. The relatively small surface of the exposed hull was slippery, creating the challenge of safely positioning the helicopter directly above it without introducing the possibility of the downwash blowing several of the vessel's crew into the water. Fortunately, the helicopter crew were aware that *Olympic Challenger* was on its way to the scene and would be able to launch its FRC to rescue *Njord*'s crew from the upturned hull.

The gravity of the situation escalated when *Njord* sank and all eight crew ended up in the water. The SAR helicopter crew then acted immediately, rescuing the first crew member 2 minutes later. By 1441, the rest of the crew had been rescued by the SAR helicopter and *Olympic Challenger*'s FRC.

SECTION 3 – CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT

1. *Njord* capsized and sank because the weight of fish in the net secured to its starboard side caused the vessel to list to an angle where downflooding could occur through the starboard passageway drain hole. [2.3]

2. It is likely that the starboard passageway flooded because the drain valve in the aft bulkhead had been left open. This reduced *Njord*'s downflooding angle from 46° to about 17°. [2.3]

3. A combination of the way *Njord* was operated, and the modifications made to the vessel in 2021 reduced the weight required to cause *Njord* to list to an angle where downflooding could occur. [2.3, 2.4]

4. It is almost certain that *Njord* would not have capsized had the vessel been operated in line with the assumptions made in the stability book. [2.6.1]

5. The deckhand drowned because he was not wearing a PFD when he entered the water after *Njord* sank, and he was unable to stay afloat with his airway clear of the water for long enough to be rescued. [2.7]

3.2 SAFETY ISSUES NOT DIRECTLY CONTRIBUTING TO THE ACCIDENT

1. The skipper was unable to make a "Mayday" call with the handheld VHF radio because the battery was defective. [2.7]

2. The EPIRB signal alerted the JRCC to initiate a rapid and effective search and rescue response. It is likely that all of the crew would have perished had the EPIRB not activated because the liferafts failed to float free, denying the crew the option of abandoning the upturned hull, and they were not wearing their working PFDs or abandon ship lifejackets. [2.7]

3. The MCA was not formally informed of the 2021 modifications to *Njord*, nor were any calculations completed by a naval architect to assess the impact of these modifications on the vessel's stability. [2.3]

4. Several minor inaccuracies were found in the calculated stability history of *Njord*. Collectively, these could have resulted in a marginal detrimental effect on *Njord*'s stability, the cumulative effect of which cannot be known. [2.6.2]

SECTION 4 – ACTION TAKEN

4.1 MAIB ACTIONS

The **MAIB** has issued a safety flyer to the fishing industry **(Annex B)** to highlight the importance of operating fishing vessels in line with the assumptions made in their stability books; and, to remind owners and operators of fishing vessels to consult with the MCA before undertaking any significant modifications to their vessels.

4.2 ACTIONS TAKEN BY OTHER ORGANISATIONS

The **Maritime and Coastguard Agency** has:

- Issued Marine Information Note 593 (F) Amendment 1, Vessel Modifications – pre-approval by MCA, providing guidance to the operators of fishing vessels on the need to seek MCA approval before modifications are carried out to ensure the safety of the vessel is not affected.

- In response to recommendation 2022/124 (MAIB report 7/2022[12]), revised the stability training courses delivered to new and existing surveyors.

[12] https://www.gov.uk/maib-reports/capsize-and-sinking-of-scallop-dredger-joanna-c-with-loss-of-2-lives

SECTION 5 – RECOMMENDATIONS

No recommendations have been made in this report.

Njord weight changes due to the 2021 modifications

MFV Njord - Weights off/on from 2018 inclining trial to 2022 loss

Items to come off

Item No.	*Item*	*Weight tonnes*	*LCG - metres about AP*	*Longitudinal Moment - t.m*
1	Powerblock crane in 2018 position (stowed)	2.000	1.020	2.040
2	Powerblock head in 2018 position (stowed)	0.400	1.020	0.408
3	Powerblock crane base in 2018 position	0.700	1.020	0.714
4	Aft bulwark plating as 2018	0.139	-0.975	-0.135
5	Aft bulwark frames as 2018	0.011	-0.930	-0.011
6	Deck pound stanchions as 2018	0.076	-0.190	-0.014
7	Deck pound boards as 2018	0.097	-0.190	-0.018
8	Shelterdeck hatch as 2018	0.070	2.760	0.192
9	Fishbox storage stanchions as 2018	0.210	15.540	3.267
10	Fishbox storage pound boards as 2018	0.278	15.540	4.327
11	Deck pound stanchions aft of FP bkhd	0.140	19.825	2.779
12	Deck pound boards aft of FP bulkhead as 2018	0.137	19.825	2.706
13	Capstan winch & base unit in 2018 position	0.340	3.380	1.149
14	Reduction in forepeak store shelving	0.090	21.470	1.932
15	Mooring bollards adjacent to deck pounds (x2)	0.150	-0.500	-0.075
16	Handrail sections P&S	0.060	4.800	0.288
17	Reduced catch crane base plate	0.076	19.560	1.490
18	Trawl block gantry support stanchions P&S	0.132	1.025	0.135
	Total items to come off:	***5.107***	***4.146***	***21.174***

Items to go on

Item No.	*Item*	*Weight tonnes*	*LCG - metres about AP*	*Longitudinal Moment t.m*
19	Powerblock crane in 2022 position (stowed)	2.000	1.380	2.760
20	Powerblock head in 2022 position (stowed)	0.400	1.380	0.552
21	P'b crane base - 2 x horiz'l beams (20x20x1cm)	0.565	1.215	0.686
22	P'b crane base - 4 x vertical pillars (10x10x.08cm)	0.169	1.215	0.206
23	P'b crane base - 12 x web plates	0.012	1.215	0.015
24	New trawl winch (aft of FP bulkhead)	2.650	19.349	51.275
25	New trawl winch support structure	0.279	19.349	5.405
26	Ice machine	0.500	17.420	8.710
27	Ice machine aluminium enclosure inc. frames	0.228	16.230	3.694
28	Additional electrical wiring and fittings	0.040	16.000	0.640
29	Door in ice machine aluminium enclosure	0.038	15.280	0.581
30	Desalination plant	0.145	20.920	3.033
31	Additional upper deck net drums (x2)	2.040	3.450	7.038
32	Net drums support structure	0.079	3.450	0.274
33	Capstan winch & base unit in 2022 position	0.340	4.355	1.481
34	Shelterdeck sheave 1 & baseplate	0.120	14.351	1.722
35	Shelterdeck sheave 1 wire hatch	0.006	14.000	0.084
36	Shelterdeck sheave 2 & baseplate	0.120	4.831	0.580
37	Shelterdeck sheave 3 & baseplate	0.120	3.641	0.437
38	Hydraulic pipework to new trawl winch and net drums	0.180	10.100	1.818
39	Additional steelwork around aft bulwark apertures	0.240	-0.660	-0.158
	Total items to go on:	***10.271***	***8.843***	***90.830***

Lightship Summary

Item	*Weight tonnes*	*LCG - metres about AP*	*Longitudinal Moment t.m*
Lightship from 2018 inclining trial	**266.195**	**9.977**	2655.828
Total items to come off	-5.107	4.146	-21.174
Total items to go on	10.271	8.843	90.830
Estimated Lightship at 2022 loss:	***271.360***	***10.044***	*2725.484*
Lightship difference: 2018 SIB to 2022 loss:	***+ 5.165 tonnes***	***+ 0.067 metres****	
% difference:	***1.94% (max 2%)***	***0.27% (max 1%)***	

**** Registered length (L) = 24.49 metres***

MAIB safety flyer to the fishing industry

MAIB

MARINE ACCIDENT INVESTIGATION BRANCH

SAFETY FLYER TO THE FISHING INDUSTRY

The capsize and foundering of the fishing vessel *Njord* (SH 90), resulting in one fatality, 150 miles north-east of Peterhead, Scotland, on 6 March 2022

Image courtesy of SAR helicopter

The crew standing on the upturned hull of *Njord*

Narrative

On 6 March 2022, the 26.56m stern trawler *Njord* (SH 90) capsized and foundered 150 miles north-east of Peterhead, Scotland while processing a very large haul of fish. The MAIB investigation found that the weight of catch, which was secured to the starboard trawl winch and acting on a handrail high up on the vessel's starboard side, caused it to list to starboard to an angle where downflooding occurred. A drain valve had been left open in the starboard weathertight bulkhead on the vessel's working deck, which allowed downflooding into *Njord*'s internal spaces. The starboard list subsequently increased further, resulting in the capsize of the vessel.

Njord's eight crew abandoned to the vessel's upturned hull, but none were wearing either a personal flotation device, an immersion suit or carrying a means to raise an alert. Fortunately, *Njord*'s Emergency Position Indicating Radio Beacon floated free of the wreck and alerted search and rescue (SAR) authorities, which tasked a helicopter and a nearby vessel to assist. The SAR helicopter arrived on scene 45 minutes later but *Njord* sank within minutes of its arrival and all eight crew ended up in the water. Neither of *Njord*'s liferafts surfaced and it is likely that these were trapped on board and then lost their buoyancy. Three of the crew were rescued by the SAR helicopter, but one of them drowned despite the efforts of the helicopter's on board medic. The remaining five crew were rescued by the nearby vessel's fast rescue craft.

The MAIB investigation determined that the modifications made to *Njord* in 2021 reduced the safety margin of the vessel's transverse stability. The Maritime and Coastguard Agency (MCA) was not formally informed of these modifications, nor were any calculations completed by a naval architect to assess the impact of the modifications on the vessel's stability.

The combination of a reduced margin of stability due to the modifications and the vessel's operational conditions during the incident directly contributed to *Njord*'s capsize.

Safety lessons

1. Fishermen are reminded that the MCA must be informed of any significant changes or modifications to a fishing vessel. Early engagement with a naval architect is essential to maintain safe margins of stability.

2. The consequences of operating a vessel outside the assumptions made in its stability book can be unpredictable and devastating. A trim and stability book includes the operating assumptions against which likely stability conditions have been calculated and fishing vessel owners and skippers must work within these to maintain the safe operation of their vessels and prevent accidents.

3. When things go wrong, smooth abandonment and rescue relies on serviceable equipment, knowledge, experience, training, and good communications. Training in the use of liferafts, EPIRBs, digital selective calling and issuing a "Mayday" is vital, as are frequent sea survival and man overboard drills.

4. Essential safety equipment needs to be accessible to save lives. Consider storing abandon ship lifejackets and immersion suits in a box on the working deck of your vessel to make certain they are within reach when there is no time to go below.

This flyer and the MAIB's investigation report are posted on our website: www.gov.uk/maib

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Extract from The United Kingdom Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of an such investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

NOTE

This safety flyer is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

Marine Accident Report

INVESTORS IN PEOPLE