ACCIDENT REPORT

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

Report on the investigation of the capsize and sinking of the fishing vessel *Joanna C* (BM 265) with the loss of two lives 5 nautical miles south of Newhaven, England on 21 November 2020

VERY SERIOUS MARINE CASUALTY REPORT NO 7/2022 JUNE 2022

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.

Cover photo courtesy of Fishing News

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

°C	-	degrees Celsius
ALB	-	all-weather lifeboat
EMFF	-	European Maritime and Fisheries Fund
EPIRB	-	Emergency Position Indicating Radio Beacon
FRP	-	fibre reinforced plastic
GM	-	metacentric height
GPS	-	global positioning system
GZ	-	righting lever
HRU	-	Hydrostatic Release Unit
IFCA	-	Association of Inshore Fisheries and Conservation Authorities
IMO	-	International Maritime Organization
ISO	-	International Organization for Standardization
kg	-	kilogram
kN	-	kilonewton
LSA	-	Lifesaving Appliances Code
m	-	metres
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note
MSN	-	Merchant Shipping Notice
MMO	-	Marine Management Organisation
N	-	newton
Nm	-	nautical mile
PFD	-	personal flotation device
PLB	-	personal locator beacon
SAR	-	search and rescue

Seafish	-	Sea Fish Industry Authority
SOLAS	-	International Convention for the Safety of Life at Sea, 1974 as amended
THV	-	Trinity House vessel
t	-	tonne
UTC	-	universal time coordinated
VCB	-	vertical centre of buoyancy
VCG	-	vertical centre of gravity
VHF	-	very high frequency

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

Image courtesy of *Joanna C*'s owner

Joanna C

SYNOPSIS

At about 0515 on 21 November 2020, the scallop dredger *Joanna C* capsized and later sank south of Newhaven, England. Only one of the three crew survived.

Joanna C's crew were hauling in the fishing gear when the starboard dredge became snagged on a line of whelk pots and the vessel capsized rapidly. The mate was on deck and was thrown into the water, but the skipper and deckhand were trapped inside the initially floating, inverted, hull. The skipper managed to escape and joined the mate in the water before the vessel sank with the deckhand still trapped inside. The skipper was recovered alive after about three hours in the water; the body of the trapped deckhand was recovered from the wreck by divers the next day and, on 14 December 2020, the missing mate's body washed up on Bexhill beach.

The investigation found that *Joanna C* had very low reserves of positive stability and the snagging initiated a rapid heel to starboard that the vessel could not recover from, nor did the crew have time to respond effectively. *Joanna C*'s stability had been severely eroded by modifications and was insufficient to meet the required minimum criteria. The opportunity to detect this stability deficiency was missed when data from an inclining experiment in 2019 was not analysed and this omission was not followed up. *Joanna C*'s crew were therefore free to operate the vessel with inadequate reserves of stability.

After the capsize, *Joanna C*'s float free liferaft was released, but did not inflate because of insufficient buoyancy to trigger the inflation mechanism. The failure of the liferaft to inflate and come to the surface adversely affected the survival time of the crewmen in the water. The liferaft was not constructed or required to meet any industry minimum standard for buoyancy in the uninflated state, necessary to assure automatic inflation. As a result, an urgent MAIB safety recommendation was made to the British Standards Institution to propose the introduction of a minimum buoyancy requirement for liferafts certified by the International Organization for Standardization. The International Organization for Standardization's technical committee has subsequently included a buoyancy requirement for liferafts designed for float free launching in its revised liferaft standard. In light of this action, no recommendations have been made in this report regarding the buoyancy of uninflated liferafts.

A safety recommendation has been made to the Maritime and Coastguard Agency to ensure that stability requirements for small fishing vessels are applied as intended and that, where stability checks are required, fishing operations should be suspended until a vessel has been satisfactorily assessed.

SECTION 1 – FACTUAL INFORMATION

1.1 PARTICULARS OF *JOANNA C* AND ACCIDENT

SHIP PARTICULARS	
Vessel's name	*Joanna C*
Flag	United Kingdom
Classification society	Not applicable
IMO number/fishing numbers	BM 265
Type	Scallop dredger
Registered owner	Privately owned
Manager(s)	Not applicable
Construction	Steel
Year of build	1979
Length overall	13.94m
Registered length	13.60m
Gross tonnage	28.58
Minimum safe manning	Not applicable
Authorised cargo	Not applicable

VOYAGE PARTICULARS	
Port of departure	Newhaven
Port of arrival	Newhaven (intended)
Type of voyage	Coastal
Cargo information	Scallops
Manning	3

MARINE CASUALTY INFORMATION	
Date and time	21 November 2020 at about 0515
Type of marine casualty or incident	Very Serious Marine Casualty
Location of incident	50°43.60'N 000° 09.10'E
Place on board	Over the side
Injuries/fatalities	Two fatalities
Damage/environmental impact	Vessel lost, no environmental damage
Ship operation	Fishing
Voyage segment	Mid-water
External & internal environment	Air temperature 9°C, sea temperature 11°C, overcast, sea state rough, wind south- westerly force 6
Persons on board	3

1.2 NARRATIVE

1.2.1 The accident

At 2140 on 19 November 2020, *Joanna C* departed from Newhaven with a skipper and two crew on board. The vessel arrived at the fishing grounds about 40 minutes later and the crew began dredging for scallops. For the next 31 hours *Joanna C*'s crew operated a continuous cycle of shooting the gear, towing the dredges for around 90 minutes, hauling the gear, and reshooting before processing the catch.

At about 0500 on 21 November, *Joanna C* had completed a tow and the crew were getting ready to haul the dredges back on board. The skipper was in the wheelhouse to operate the winch controls, the mate was on deck and the deckhand was resting in the bunk room.

At 0515, the skipper took the engine out of gear and began raising the port and starboard dredges by winching in the dredge wires. When the dredges were at the surface, the skipper raised both derricks and used the topping winches to bring the gear out of the water and into the side of the vessel. The mate was standing on the port side of the deck ready to attach the port dredge. As the dredges were raised above the water, the skipper noticed a blue rope tangled round the starboard dredge bar. *Joanna C* began to heel to starboard, and the skipper attempted to lower the derricks. Before the derricks could be lowered, the starboard dredge swung away from the side of the vessel and *Joanna C* continued to roll. The mate was thrown into the water and *Joanna C* inverted rapidly to starboard and remained floating, with the skipper and deckhand trapped inside.

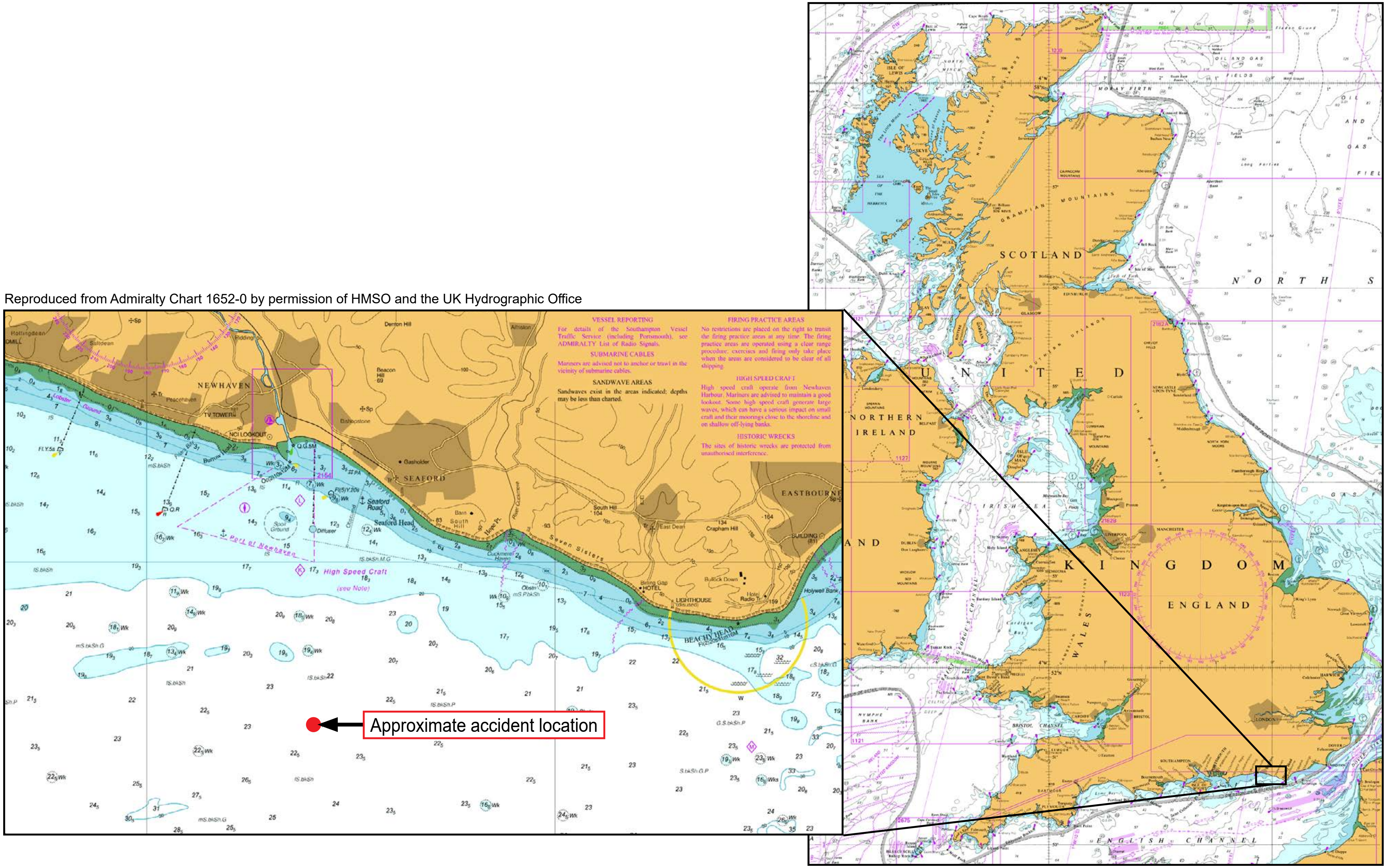
Inside the upturned hull, the skipper found his way to the bunk room where he and the deckhand remained for around 40 minutes. At about 0555, *Joanna C* began to sink by the stern. The skipper noticed the change in angle and opened the escape hatch on the bunkroom deckhead (which was now the deck). After alerting the deckhand that they needed to escape, the skipper swam down and out of the escape hatch, round the whaleback and out of the starboard side access, near to the engine room hatch. The skipper surfaced and *Joanna C* sank with the deckhand still trapped inside **(Figure 1)**. At 0555, *Joanna C*'s Emergency Position Indicating Radio Beacon (EPIRB) activated.

When the skipper surfaced, he called out to the mate and found him in the water clinging to a lifebuoy. It was dark and the skipper and mate could see the lights of other fishing vessels nearby. The mate was tangled in an orange rope attached to the lifebuoy and was very cold. While attempting to untangle the mate, his lifejacket was removed and was lost. After a while, the mate succumbed to the cold and drifted away, leaving the skipper holding onto the lifebuoy.

1.2.2 Search and rescue

The coastguard contacted *Joanna C*'s owner after receiving the EPIRB alert and also attempted to hail the vessel via very high frequency (VHF) radio. At 0621, the coastguard broadcast a 'Mayday Relay'; the fishing vessel *Girl Macy* responded and headed to the scene. RNLI[1] all-weather lifeboats (ALB) were launched from Newhaven and Eastbourne and headed out to the search area and, at 0630, the coastguard tasked R163, a search and rescue helicopter. At 0647, the Newhaven

[1] Royal National Lifeboat Institution.



Reproduced from Admiralty Chart 0002-0 by permission of HMSO and the UK Hydrographic Office

Reproduced from Admiralty Chart 1652-0 by permission of HMSO and the UK Hydrographic Office

Figure 1: Approximate accident location

ALB arrived on scene, followed shortly afterwards by *Girl Macy* and, at 0658, R163. The Newhaven ALB coordinated the search and, at 0845, a second helicopter, R175, arrived. At 0851, the Newhaven ALB recovered the skipper from the water and the search continued for the missing crew under the coordination of the Eastbourne ALB. The skipper was taken to hospital, where he was treated for hypothermia and ingestion of seawater then discharged the next day.

The search continued throughout the day and, at 1118, *Joanna C*'s EPIRB was recovered. The search assets included R163, a coastguard fixed wing aircraft, the Newhaven and Eastbourne ALBs, three fishing vessels and two wind farm support vessels. At 1500, the Trinity House vessel (THV) *Galatea* was tasked with locating and marking the wreck and began to travel to the search area.

The search for the missing crewmen was suspended overnight and resumed at 0800 on the 22 November; however, only debris was recovered. At 1500, the search was terminated. That evening, THV *Galatea* located *Joanna C*'s wreck **(Figure 2)**.

On 25 November 2020, a personal flotation device (PFD) was recovered from Newhaven East beach. On 14 December 2020, a body, later identified as the missing mate, washed ashore at Bexhill.

Image courtesy of Trinity House

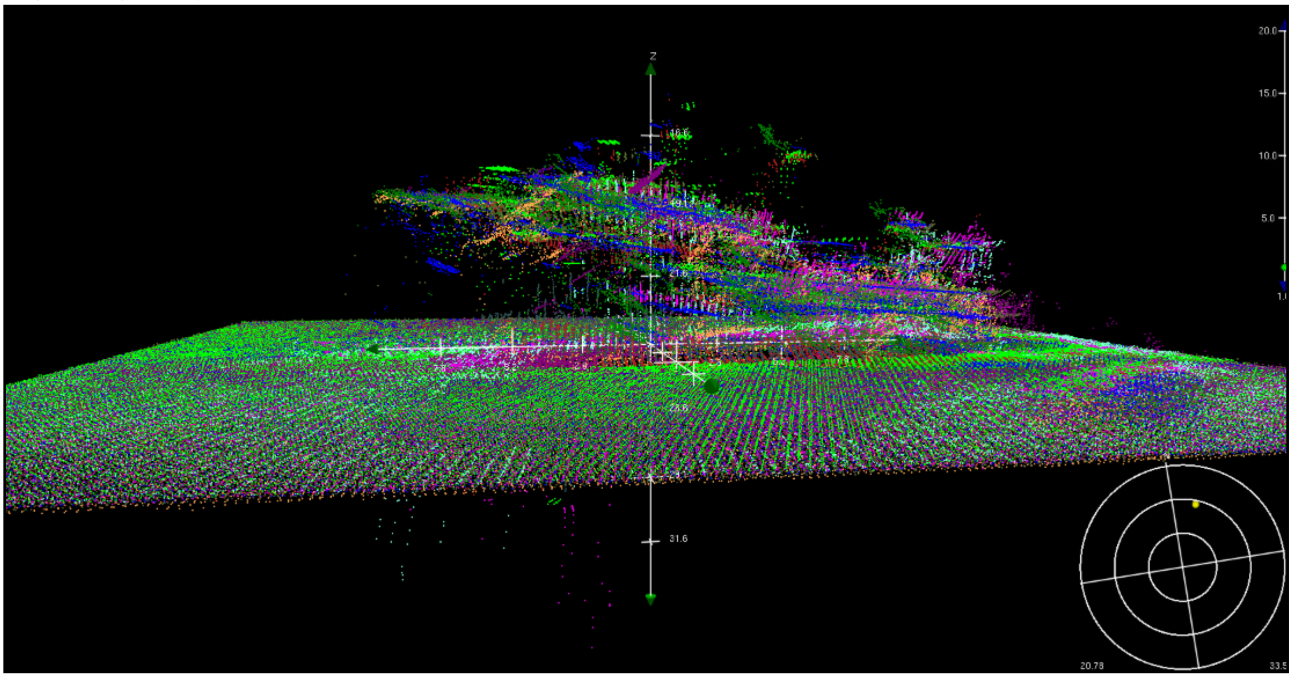


Figure 2: Survey image of *Joanna C*'s wreck from THV *Galatea*

1.2.3 Environmental conditions

At the time of the capsize the wind was south-westerly force 6, it was overcast, and visibility was poor. The sea state was rough with a 3m swell and the tidal flow was 1 knot in the direction of 285°. The sea temperature was 11 degrees Celsius (°C), and the air temperature was 9°C. It was dark when *Joanna C* capsized; sunrise was at 0726 on 21 November.

1.3 UNDERWATER INSPECTIONS

1.3.1 Body recovery dive

On 23 November 2020, *Joanna C*'s owner commissioned a team of local divers to recover the deckhand's body from within the wreck. During the recovery, the divers observed that *Joanna C* was resting upright on the seabed with no obvious signs of damage, the derricks were raised, and the liferaft was not in the cradle.

1.3.2 Dive survey

Between 27 and 28 November 2020, the MAIB commissioned a team of commercial divers to survey the wreck. The dive team conducted five dives with live video and audio links to a surface team that included MAIB inspectors. The dive survey found that *Joanna C*'s liferaft had been released from the cradle and was floating, uninflated mid-water at the end of the painter **(Figure 3)**. Inspection of the fishing gear found that all 12 dredge bags were full **(Figure 4)** and that there was a line of whelk pots entangled around the starboard dredge bar **(Figure 5)**. Divers recovered several items during the survey, including *Joanna C*'s liferaft and a whelk pot.

Figure 3: Image from dive survey, showing liferaft floating mid-water

Figure 4: Image from dive survey, showing full dredge bags

Figure 5: Image from dive survey, showing whelk pot on starboard dredge and (inset) rope caught round dredge bar

1.4 *JOANNA C*

1.4.1 General description

Joanna C's keel was laid in1979 at Robertson, McNaught and Co. Ltd. in Neyland, Wales. It was completed in 1980, then registered in Guernsey. In 1981, *Joanna C* transferred to the UK register. *Joanna C* initially operated in the south-west of England. In 2007, it was relocated to Shoreham. In 2013, the owner at the time of the accident purchased *Joanna C* and the vessel moved to Brixham. Between 2015 and the accident, *Joanna C* split operations between Brixham and Newhaven. At the time of the accident, *Joanna C* was rigged as a scallop dredger, but had previously operated as both a beam and stern trawler **(Figure 6)**.

Image courtesy of *Joanna C*'s owner

Figure 6: *Joanna C* in 2013

Joanna C's wheelhouse was at the forward end of the working deck with an access door on the starboard side. The four-berth accommodation cabin was forward of the wheelhouse and below the whaleback[2]. The cabin was accessed via a set of steps in the wheelhouse. An escape hatch in the deckhead of the cabin opened on the port side of the whaleback. The whaleback had two access doors, one on each side of the vessel, and an escape hatch at the forward end. *Joanna C*'s engine room was accessed via a hatch on the starboard side under the whaleback. *Joanna C* had two gantries: a main gantry on top of the main winch housing and a smaller 'goalpost' gantry at the aft end **(Figure 7)**.

[2] Whaleback refers to an enclosed area of the forward deck. In addition to providing a sheltered space, whalebacks also assist with shedding water over the vessel sides in the event of shipping waves over the bow.

Image courtesy of [Fishing News]

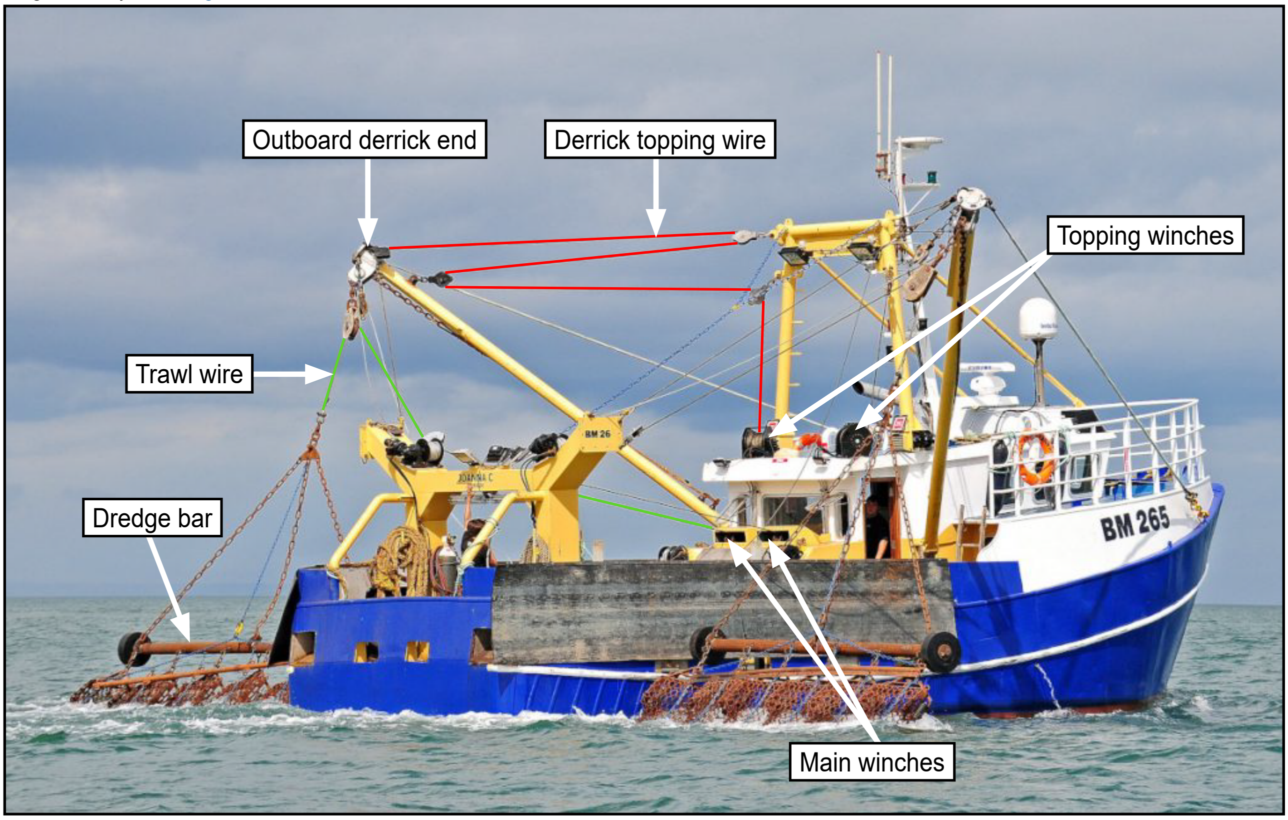


Figure 7: *Joanna C*’s fishing gear

Joanna C was last inspected by the Maritime and Coastguard Agency (MCA) on 1 June 2018 and issued with a small fishing vessel certificate, with no deficiencies noted, valid until 27 September 2023. Crew reported *Joanna C* to be a “*good sea boat*”.

1.4.2 Crew

Joanna C's skipper was a career fisherman and had skippered the vessel since 2013. He had completed the mandatory Sea Fish Industry Authority (Seafish[3]) safety training courses[4] comprising sea survival, firefighting, first aid and safety awareness and risk assessment, as well as the voluntary intermediate stability awareness course. The skipper had completed all the required training modules, except the 5-day navigation qualification, for the voluntary under 16.5m Skipper’s Certificate of Competency.

Robert Morley, referred to as the mate in this report, was a 38-year-old career fisherman and was *Joanna C*’s relief skipper. He held an under 16.5m Skipper’s Certificate of Competency and had completed all the mandatory Seafish courses, as well as the voluntary intermediate stability awareness course.

The deckhand, Adam Harper, was 26 years old and had worked in the fishing industry since 2014. He started work on *Joanna C* three weeks prior to the accident, having previously been a crewman on the owner’s other vessel *Golden Promise*. He had completed the four basic Seafish safety courses.

[3] Seafish is a non-departmental public body with a mission to support a profitable, sustainable, and socially responsible future for the seafood industry.

[4] Fishermen who work in the UK are required to complete basic safety training courses in sea survival, first aid, firefighting and prevention, and health and safety. Fishermen with over two years’ experience are also required to complete a Seafish safety awareness and risk assessment course.

1.4.3 Fishing gear and catch hauling sequence

Joanna C carried two sets of scallop dredges, one on each side of the vessel. Each set comprised six dredge bags fitted with tooth bars at the opening and a 'bag' at the rear for collecting the dredged scallops. The top of each dredge was attached to a towing bar with wheels at each end. The scallop dredging was controlled using two sets of winches, two main winches operated the trawl wires, and two derrick topping winches adjusted the derricks' position. The main winches had a capacity of 3.5 tonnes (t) and were housed in a casing on the main deck, aft of the wheelhouse. The derrick topping winches had a 2.5t capacity and were mounted on top of the wheelhouse **(Figure 7)**. The trawl wire ran from the dredge bar, through a block at the end of the derrick then to a block on the aft gantry and then to the main winch.

Joanna C's fishing gear was fitted with an emergency quick release on each side of the vessel. When dredging, the quick release could be activated and the derrick end block would be dropped to the aft gantry, bringing the gear to the stern of the vessel. Activating the quick releases with the derricks raised was assessed as dangerous, and onboard practice was to use them only when the derricks were lowered.

To haul the catch the main winches brought the dredges to the surface and then the derrick topping winches raised the derricks, bringing the dredge bars out of the water and into the side of the vessel. After this, the dredge bags were tipped onto the catch conveyors. The catch was sorted to remove any stones, debris or undersized catch and the scallops were bagged and placed in the refrigerated fish hold. Each bag of scallops weighed around 35kg and a typical haul yielded about 10 bags of catch in total. The fish hold capacity was about 10t, approximately 290 bags of scallops. The crew did not routinely store catch on deck.

Joanna C's crew had loaded about 200 bags of scallops prior to the accident, equating to around 7t of catch in the fish hold.

1.4.4 Operational cycle

Local restrictions[5] limited *Joanna C* to daytime fishing only out of Brixham. When operating from Newhaven, depending on factors such as the weather and how productive the fishing was, a fishing trip's duration was typically five days.

1.4.5 Risk of snagging

Both potting and dredging vessels operated in the fishing grounds south of Newhaven. Since moving to the Newhaven fishing grounds on 1 November 2020, *Joanna C*'s crew had snagged whelk potting gear at least seven times. When the gear had snagged previously, the crew used knives to cut it away from the scallop dredges.

Whelk fishing gear typically consisted of individual weighted pots attached by short lengths of rope to a main line to form a string of pots, which was anchored to the seabed at each end. The number of pots in each string varied between operators, but strings of 50 to 100 pots were commonplace. Whelk pots varied in weight according to their construction; a 12kg pot was recovered during the dive survey **(Figure 8)**.

[5] Paragraph 22 (d) of the Devon and Severn IFCA Mobile Fishing Permit Byelaw permitted scallop dredging between 0700 and 1900 only.

Figure 8: Recovered whelk pot

1.5 *JOANNA C* MODIFICATIONS

1.5.1 Modification history

In 2007, *Joanna C* underwent a series of modifications that included a replacement wheelhouse and deck machinery. At the same time the vessel's length was reduced by 1m to comply with local fishing restrictions in the operational area. In 2014, *Joanna C*'s working deck was modified and catch conveyors added.

In 2019, *Joanna C* underwent another series of modifications **(Figures 9a** and **9b)**, which included:

- Replacement of the engine, shaft, and propeller
- New fresh water and hydraulic tanks
- Replacement of main and derrick topping winches
- Addition of a whaleback
- Renewal of hull and deck plating and replacement of deck beams
- Raised bulwarks

- Extension of the wheelhouse
- Renewal and improvement of accommodation areas
- Replacement of the refrigeration system and installation of fish room insulation
- Replacement of fishing gear

Images courtesy of *Joanna C*'s owner

Figure 9a: *Joanna C* before the 2019 modifications

Figure 9b: *Joanna C* after the 2019 modifications

The 2019 modifications also included moving the derrick attachment points and main gantry from on top of the main winch housing to the sides and roof of the wheelhouse respectively **(Figure 10)**. The MCA was not notified of the start of the 2019 modification work and became aware that the alterations had been carried out after completion.

In July 2020, *Joanna C*'s derricks and gantry were moved back to their original position on the winch housing **(Figure 11)**. The MCA was not notified.

Image courtesy of *Joanna C*'s owner

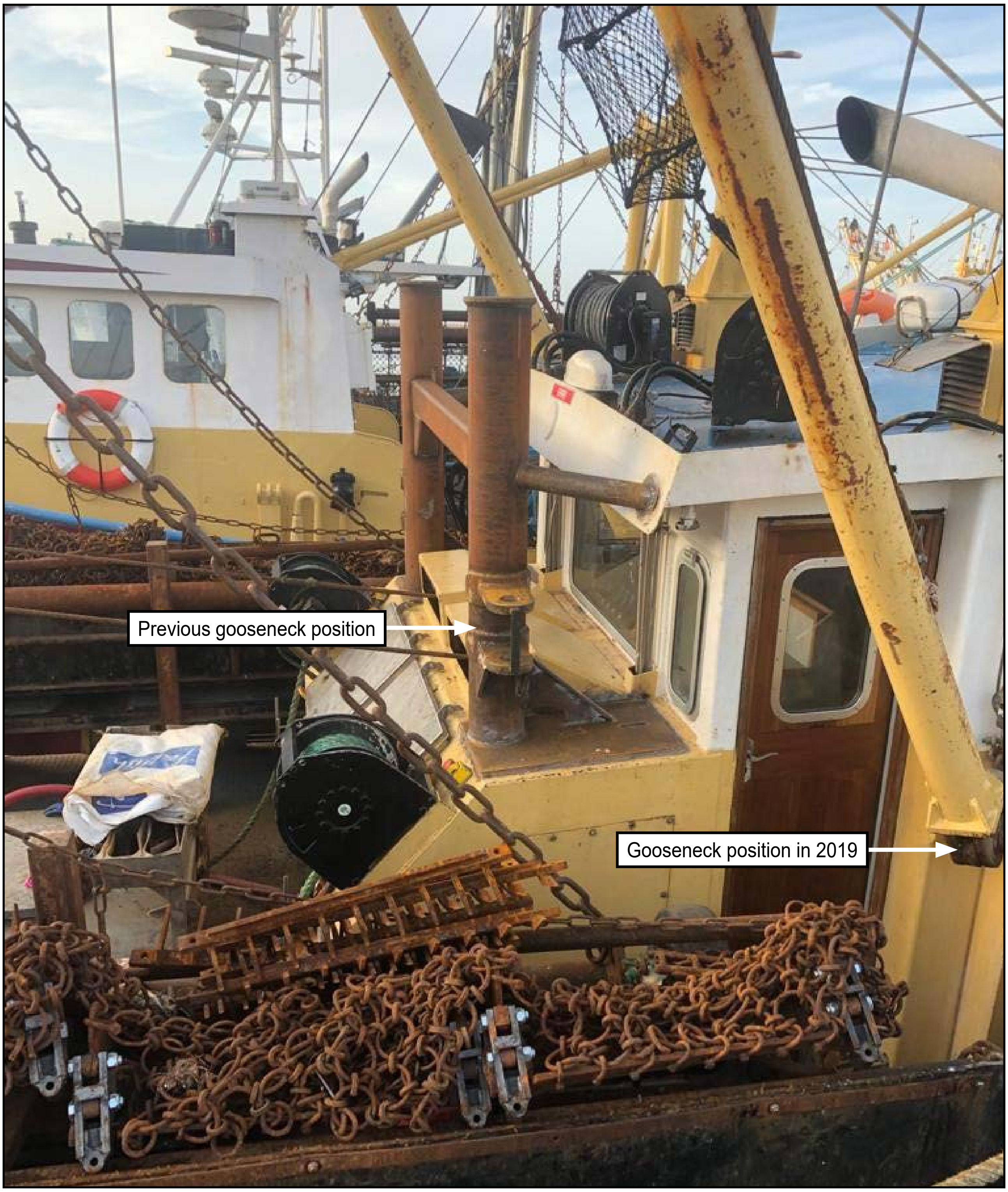


Figure 10: Derrick gooseneck position after the 2019 modifications

Image courtesy of *Joanna C*'s owner

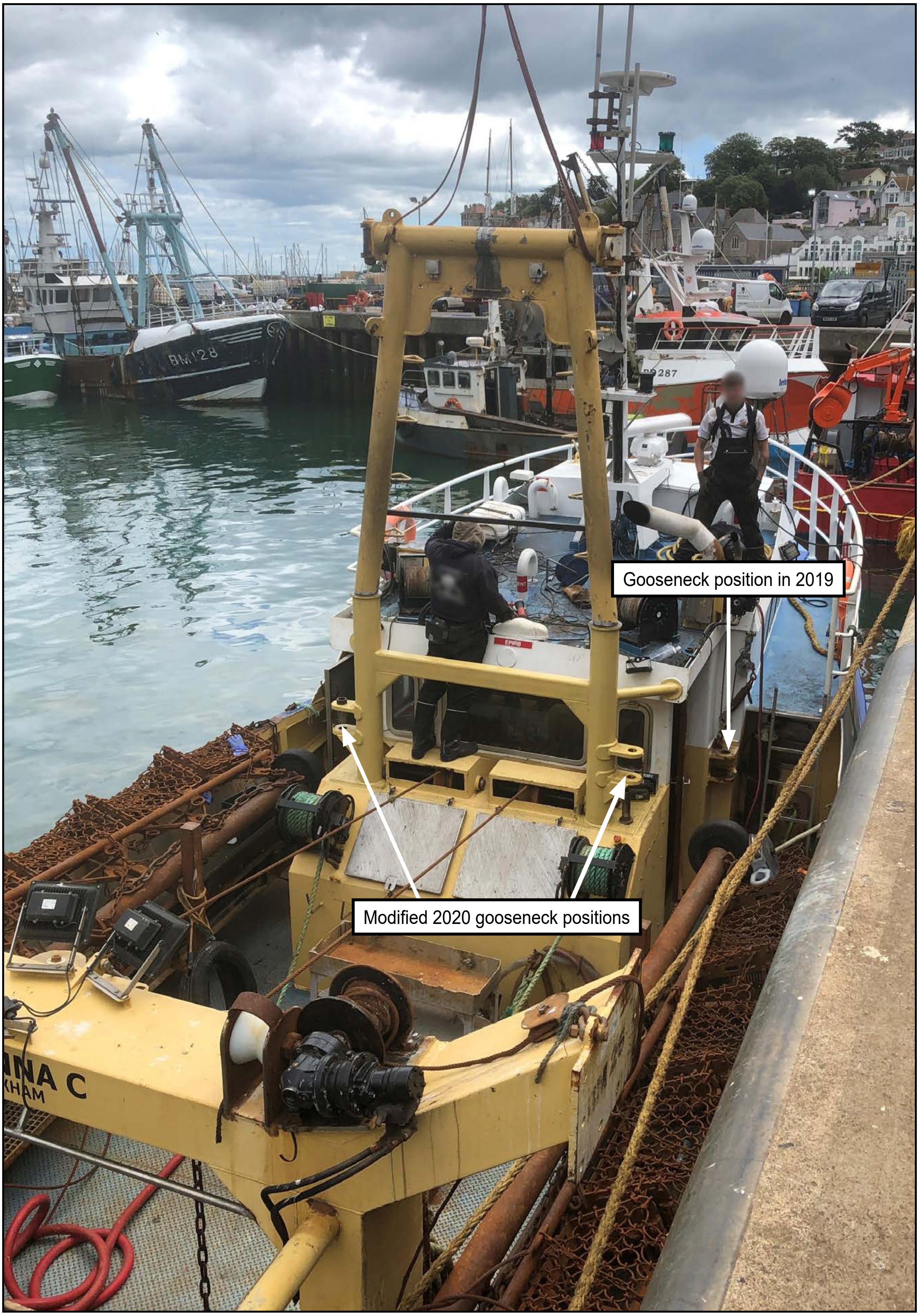


Figure 11: Derrick gooseneck position after the 2020 move

1.5.2 Funding support for 2019 modifications

Joanna C's owner sought funding support for aspects of the 2019 modifications from the European Maritime and Fisheries Funding (EMFF) scheme administered through the Marine Management Organisation (MMO). This grant system enabled owners to apply for partial funding for vessel modifications to improve areas such as safety, crew working conditions and fuel efficiency. Applications were submitted to the MMO for approval. Where it was considered that the proposed modification would affect the stability of the vessel, the MMO forwarded the application to the MCA for review.

Joanna C's owner submitted three funding applications in respect of some aspects of the 2019 modifications and the MMO forwarded them to the MCA for comment. The applications and outcome of the MCA discussions and MMO decisions are summarised below:

Aim	Works	MCA approval	MMO
Improving vessel safety and crew working conditions	Refit wheelhouse, galley, accommodation, new lighting, and electrics, landing winches, new wheelhouse door	Not approved by MCA Reasons for refusal not related to stability	Application approved by MMO 1 month before MCA refusal recommendation received
Improving fuel efficiency	New propeller, shaft, and stern tube	Approved by MCA with condition that there were no changes to anything outside the application and that weight added no greater than weight removed	Application approved 2 weeks before MCA comments received.
Improving catch quality	Refit fish hold and refrigeration, icemaker, deck wash, bilge pump and pipework alterations	Approved by MCA on the understanding that a stability assessment be undertaken	Approved

Table 1: Summary of EMFF grant applications

1.6 SMALL FISHING VESSEL STABILITY

1.6.1 Overview

Stability is the capacity of a vessel to return to an upright condition following a heel. It is dependent on the vessel's weight and buoyancy and is determined by the relationship between the vertical centre of gravity (VCG)[6] and the vertical centre of buoyancy (VCB)[7].

A vessel's metacentric height (GM) is a measure of its initial stability. GM is calculated as the distance between the vessel's VCG and its metacentre[8]. A larger GM implies greater initial stability against overturning.

With positive stability, as a vessel heels, a righting lever (GZ) is created between the forces acting from the VCB and VCG as the shape of its underwater volume changes. This righting lever creates a restoring moment to bring the vessel upright. As angle of heel increases, GZ also increases up to a maximum point, after which it decreases with further heel. The point at which GZ reaches zero is known as the angle of vanishing stability and any heel beyond this results in a negative stability condition.

Modifications to a vessel that involve the addition, removal and/or relocation of weight may alter the VCG. A vessel's VCG is determined using the results of an inclining experiment[9] and a computer model of the subject vessel's hull form.

1.6.2 The Fishing Vessels (Safety Provisions) Rules 1975

A wide range of safety standards, including stability criteria, were introduced in *The Fishing Vessels (Safety Provisions) Rules 1975* (the 1975 Rules). These rules required the preparation of a stability book demonstrating that the vessel complied with the criteria. To ensure the stability calculations remained valid, the 1975 Rules further required that the stability book be amended whenever accuracy was materially affected by alteration of the vessel.

Between 1984 and 2001, *Joanna C*'s stability was in accordance with the 1975 Rules.

1.6.3 Requirements between 2001 and 2017

In April 2001, the *Fishing Vessels (Code of Practice for the Safety of Small Fishing Vessels) Regulations 2001* came into force. The 2001 Regulations applied to all fishing vessels under 12m registered length and did not include any specific stability or freeboard requirements. The 2001 Regulations were amended in 2002 to include

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6 The centre of gravity is the point where the mass of a vessel is acting downward. It is affected by the construction and layout of the vessel and the weight and location of equipment. The centre of gravity will alter if weights are moved, added, or removed, but it is not affected by the vessel's motion.

7 Buoyancy is the vessel's ability to float. All the hull below the waterline contributes to the vessel's total buoyancy. The centre of buoyancy moves depending on the draught, trim and heel.

8 Metacentre is a point through which the force of buoyancy acts on a vessel. If a line of buoyancy force is extended it will meet the line of gravitational force. This point of intersection is called the metacentre.

9 An inclining experiment is a physical test conducted with the subject vessel afloat. Known weights are moved across the deck in sequence and the resultant angle of heel measured. The results of the incline are combined with the draught information, obtained using hydrostatic data from the computer model, to determine the vessel's VCG. This value and the modelled hull form can then be used to perform an analysis of the stability characteristics of the subject vessel.

all fishing vessels under 15m overall length. This amendment effectively removed the requirement for stability criteria to be applied to fishing vessels of between 12m registered length and 15m overall length.

In 2007, the requirements of the 2001 Regulations were revised and published as Merchant Shipping Notice (MSN) 1813 (F), *The Code of Practice for the Safety of Small Fishing Vessels*. MSN 1813 (F) stated the intention to reintroduce mandatory stability requirements for 12 to 15m fishing vessels and indicated that the necessary underpinning legislation was in production. In the interim, these vessels were recommended to meet the MSN's stability requirements and five-yearly lightship checks.

In December 2010, the MCA published Marine Guidance Note (MGN) 427 (F), *Stability Guidance for Fishing Vessels of under 15m Overall Length*. MGN 427 (F) stated that full stability requirements for 12 to 15m fishing vessels would be reintroduced in the near future.

In April 2014, MGN 502 (F), T*he Code of Practice for the Safety of Small Fishing Vessels - Standards which can be used to prepare for your MCA Inspection*, was published. MGN 502 (F) provided a voluntary small fishing vessel Code of Practice that was based on MSN 1813 (F) and advised that substantial modifications should be notified to the MCA prior to work taking place.

1.6.4 2017 Regulations and Code of Practice

On 23 October 2017, Statutory Instrument 2017 No. 943, *The Fishing Vessels (Codes of Practice) Regulations 2017* (the Regulations) came into force. Article 7(1) of the Regulations placed an obligation on the owner of a UK registered fishing vessel to notify the MCA of proposed modifications to the vessel.

Following publication of the Regulations, the MCA withdrew MSN 1813 (F) and MGN 502 (F) and replaced them with MSN 1871 Amendment 1 (F), *The Code of Practice for the Safety of Small Fishing Vessels of less than 15m overall length* (MSN 1871). MSN 1871 included a requirement that substantial modifications and those affecting overall dimensions, structure or stability should only be undertaken after consultation with, and approval from, the MCA.

MSN 1871 also required new[10] fishing vessels of 12 to 15m to have approved stability information relevant to their intended method of operation and the preamble indicated that this requirement also extended to significantly modified 12 to 15m vessels. The body of MSN 1871 did not contain a requirement for modified vessels to have approved stability information and there was no definition of what constituted a significant modification.

The requirements of the Regulations and MSN 1871 applied to *Joanna C* at the time of the accident.

[10] This included vessels that were built before 2007 and were coming onto the UK register for the first time.

1.6.5 Stability criteria

The mandatory intact stability criteria for vessels over 12m engaged in twin boom fishing methods were the same under the 1975 Rules and MSN 1871. The criteria were:

1. area under the GZ curve up to 30° not less than 0.066 metre-radians
2. area under the GZ curve up to 40° not less than 0.108 metre-radians
3. area under the GZ curve from 30-40° (or downflooding) not less than 0.036 metre-radians
4. angle of maximum GZ occurs at not less than 25°
5. GZ of at least 0.24m at an angle equal to or greater than 30°
6. GM at least 0.42m.

The intent of the criteria was to provide a reserve of positive stability for vessels when analysed in a standard set of static conditions such that sufficient stability would be available in operational conditions where dynamic effects and the deployment of fishing gear would deplete the vessel's reserve.

1.6.6 Operational guidance

In 2010, recognising the increased risks associated with these fishing methods, the MCA published MGN 415 (F) *The Hazards Associated with Trawling, including Beam Trawling and Scallop Dredging*. MGN 415 (F) emphasised the dangers of trawling and noted that recurring factors in analysis of casualty data included snagging of gear and loss of stability. The MGN provided general safety advice for the owners and crew of these vessels, including the need for vessel familiarity and awareness of what to do in an emergency. The MGN also discussed stability and noted that:

> *Even with the increased stability reserves that are required for beam trawlers, the vessel's stability may not be adequate in some sea conditions when recovering the fishing gear and catch with the derricks raised.*

The MGN went on to recommend that supplementary stability conditions for operational fishing were analysed and added to the stability book for newly acquired vessels and after structural or gear alterations to existing vessels.

The MCA published the *Fishermen's Safety Guide*[11] for owners, crew and all those involved in fishing vessel operations. The guide contained safety advice in several key areas, including stability. The stability advice emphasised that capsize was one of the major causes of fatalities in under 15m fishing vessels and that one of the key reasons for this was an overly high centre of gravity. The guide urged caution with vessel modifications and highlighted the need for MCA approval and consideration of the effects on centre of gravity and hence stability. The guide also reminded fishermen that when derricks were raised with a suspended load the vessel's centre of gravity was also raised as the weight acted at the point of suspension. The guide noted that stability was a major concern for vessels engaged in beam trawling (including scallop dredging) because of the substantial gear involved and the use of derricks to lift the gear.

[11] https://www.gov.uk/government/publications/fishermens-safety-guide

1.7 *JOANNA C* STABILITY

1.7.1 Stability history to 2001

Joanna C's keel was laid in 1979 and the stability requirements of the 1975 Rules applied. *Joanna C*'s initial registration in Guernsey and the subsequent transfer to the UK register meant that it was not until 1983 that the vessel was subject to an inclining experiment, and a stability book prepared that showed compliance against the 1975 criteria in all analysed load conditions[12]. The stability book was initially approved by the MCA in April 1984, with additional conditions for beam trawling added in November 1984.

In 1993, *Joanna C* underwent a lightship survey conducted by a naval architect consultant[13]. The naval architect reported that there had been a lightship increase of 4.65t (10.4%), of which only 1.5t could be accounted for by known additional weight. In 1994, the naval architect carried out a further lightship survey, which confirmed the indicated 10.4% increase in lightship. In June 1994, an inclining experiment was conducted, after which the naval architect reported that the calculated lightship had increased by 19% since the first inclining experiment in 1983. The naval architect assessed one loading condition against the stability criteria and determined that the vessel still passed, although the margins of stability had reduced; he recommended that a full new stability book was not required.

For the next 18 months, while the vessel stability awaited approval, the MCA issued *Joanna C* with short-term fishing vessel certificates. In January 1996, the MCA required the preparation of a new stability book, citing concerns about potential stability margins in load conditions other than the single condition assessed in 1994. The naval architect prepared a stability book that showed *Joanna C* exceeded the minimum criteria in all 14 analysed conditions, including deep sea beam trawling, day trawling and stern trawling. In March 1996, the MCA approved the stability book.

Joanna C's lightship was next checked in 1997, when the vessel was rigged as a scallop dredger. At this check the naval architect reported that the lightship was 2.27% greater than at the 1994 incline, which was attributed to the presence of additional fishing gear on board. The MCA accepted the lightship growth with an advisory that the vessel should be re-inclined at the next survey if further weight growth occurred. The final lightship check recorded for *Joanna C* was in May 2001, when the vessel was again rigged as a stern trawler. The growth in lightship values over the 1994 incline was 2.25% and the naval architect reported that the lightship showed good agreement with the 1997 value. The MCA accepted this and, in May 2002, issued a fishing vessel certificate with a 2005 expiry date.

Joanna C underwent four lightship checks between 1993 and 2001, each undertaken by the same naval architect. After 2001, there were no records of any further lightship survey or stability analysis.

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[12] The seven standard static loading conditions were: lightship, depart port, arrival at grounds, depart grounds (100% catch), arrive in port (100% catch), depart grounds (20% catch), arrive in port (20% catch).

[13] Referred to in this report as 'the naval architect'.

1.7.2 Stability during modifications

Joanna C's owner purchased the vessel in 2013, when there was no regulatory requirement for compliance with minimum stability criteria, and the 1996 stability book was not transferred with the vessel. In 2014, *Joanna C* was fitted with a catch conveyor system. Before fitting the system, *Joanna C*'s owner requested a quotation from a naval architect[14] to perform a stability assessment.

The naval architect's quotation noted that *Joanna C* was shortened in 2007 and the 1996 hull form definition and associated stability book could no longer be used. The naval architect further noted that he was not involved with the 2007 modifications and that a new hull survey was required to confirm the revised transom position and either calibrate or reinstall transom draught marks. The naval architect provided a quotation for survey and verification of the draught marks, attending the vessel during the modifications, completing an inclining experiment after the modification and preparing a new stability book.

The quotation included the following text:

> *The stability characteristics of the vessel, prior to the length modifications, were generally good with significant margins above minimum MCA requirements and, in the opinion of the undersigned; this should not be compromised by the proposed deck conveyor installation.*

The naval architect's July 2014 quotation was not taken up and the effect of the additional weight of the catch conveyors on the vessel's stability was not assessed.

In December 2018, the owner sought a quotation from the same naval architect for refit consultancy and stability assessment, including attending the vessel during the modifications and an inclining experiment after completion of the work. This quotation included the following text:

> *The stability characteristics of the vessel, prior to the length modifications, were generally good with significant margins above minimum MCA requirements and, in the opinion of the undersigned; this should not have been compromised by the previous deck conveyor installation.*

This quotation was also not taken up.

In February 2019, the naval architect again quoted for refit consultancy and stability assessment. The quotation text was identical to the December 2018 letter, including the comment on *Joanna C*'s previously good stability characteristics. The owner accepted this quotation and engaged the naval architect's services. The naval architect visited *Joanna C* several times during the modifications to record dimensions and information in preparation for the new stability book. During these visits, the naval architect gave the owner general information about removal and fitting of machinery and the need for weights removed to be the same as new weights put on.

[14] This was the same naval architect that conducted *Joanna C*'s stability work between 1993 and 2001.

1.7.3 2019 inclining experiment

On 25 July 2019, following completion of *Joanna C*'s modifications (section 1.5.1), the naval architect conducted an inclining experiment with the owner and an MCA surveyor in attendance.

The naval architect had no in-house stability software and conducted calculations by hand; when his volume of work was too great, he subcontracted parts of the analysis work to other consultants. The naval architect would then use the subcontracted work to complete the stability book for the vessel under consideration. In the later part of 2019 and the beginning of 2020, the naval architect was experiencing significant stress in his personal life that led to a period of around 3.5 months when he was unable to work.

On 26 July 2019, the naval architect sent the data from *Joanna C*'s inclining experiment to a subcontractor for him to complete the stability analysis calculations. On 6 September 2019, having not received a response, the naval architect emailed the subcontractor who assured him that he would move the work up his priorities list. The incline report and analysis were not completed and there was no further communication between the owner, the naval architect, or the MCA.

The naval architect conducted a second inclining experiment on an under 15m fishing vessel on the same day as *Joanna C*, and with the same MCA surveyor in attendance. The MAIB investigation found that this vessel's incline report and analysis were also not completed following the experiment[15].

1.8 POST-ACCIDENT ANALYSIS

1.8.1 Hull modelling and stability

The University of Southampton's Wolfson Unit for Marine Technology and Industrial Aerodynamics (Wolfson Unit) produced a digital model of *Joanna C* using the vessel's lines plan[16]. The model was validated against the data from the 1996 stability book and modified to represent *Joanna C*'s 2019 hull form by introducing a whaleback and deck camber and reducing the length. The Wolfson Unit then used the data from the 2019 inclining experiment to perform a stability assessment of *Joanna C* against the criteria in seven loading conditions.

The Wolfson Unit's analysis **(Annex A)** found that *Joanna C* failed to meet any of the stability criteria in any of the analysed loading conditions. The analysis also found that the vessel's lightship had grown by 19.8% and the VCG and GM values were 11.4% higher and 54.5% smaller respectively than the values in the 1996 stability book.

[15] The second vessel's stability analysis was completed at a later stage following the loss of *Joanna C* and the vessel was found to comply with the required criteria.

[16] A lines plan is a two-dimensional rendering of a vessel's underwater hull definition.

1.8.2 Post-accident analysis of the loss condition

Following the development of the stability model and analysis of the stability in the static loading conditions, the MAIB used the computer model of *Joanna C* to calculate the probable stability at the time of loss. The modelled load condition was based on the following estimations:

- fuel at 80% tank capacity (1000 litres used from total capacity 5000 litres in the 31 hours of operation)
- freshwater and provisions at 80%, in line with fuel usage
- catch loading of 7t in the fish hold (equating to 200 x 35kg bags)
- both derricks in the raised position with dredge bars hanging freely
- all six bags on both dredge bars (12 in total) full and an estimated weight of 144kg of catch each side
- no additional weight for stones and by-catch.

The stability in the loss condition was first calculated with an equal load on the port and starboard side to represent the situation without the additional load of the line of whelk pots. In this condition, the maximum GZ was calculated at 0.044m at 14° and the angle of vanishing stability was 25.2°.

After the equal load condition an additional load, representing the snagged whelk pots, was modelled on the starboard dredge bar to find the estimated load at which the modelled stability became negligible. The loss of positive stability occurred with an additional load of 300kg.

1.9 LIFERAFT

1.9.1 Regulatory requirement

MSN 1871 required fishing vessels to carry a liferaft of sufficient capacity to accommodate all persons on board. Liferafts purchased and fitted prior to 23 October 2017 were permitted to remain in service until 23 October 2022. After this date, MSN 1871 required liferafts on vessels operating over 150 nautical miles (nm) from a safe haven to conform with the International Maritime Organization's (IMO) International Convention for the Safety of Life at Sea, 1974 as amended (SOLAS) Lifesaving Appliances Code (LSA Code). Liferafts on vessels operating less than 150 nm from a safe haven could either conform to the LSA Code, or with the International Organization for Standardization (ISO) 9650 standard[17].

MSN 1871 required that liferafts be stowed such that they *float-free, inflate and break-free automatically*, referred to as 'float free'.

[17] International Organization for Standardization standard 9650-1:2005 – Small craft inflatable liferafts.

1.9.2 Liferaft inflation system

Inflatable liferafts were made up of three main components: the outer casing or canister, the inflatable raft itself and the inflation system. The inflation system consisted of a cylinder of inflation gas with a valve, linked to an actuator wire and the painter line of the liferaft. When sufficient force[18] was applied to the painter line the actuator wire activated the inflation by opening the valve on the gas cylinder. This inflation mechanism was the same whether a liferaft was designed to be launched automatically or manually.

For vessels where there was a potential for rapid capsize without time to launch liferafts manually, Hydrostatic Release Units (HRU) were used to secure the liferaft canister into its cradle such that it released automatically as the vessel sank.

The liferaft release sequence with an HRU was **(Figure 12)**:

1. vessel begins to sink;
2. HRU sinks below the depth of operation, activates, and severs the rope securing the liferaft canister to the cradle;
3. liferaft canister is released from the cradle and inherent buoyancy in the uninflated raft pulls out the painter line to its entire length;
4. actuator wire activates the inflation system;
5. buoyancy of the inflated raft overcomes the breaking force of the weak link and the liferaft floats to the surface.

HRUs were also fitted to EPIRB housings to enable float free operation in the event of the vessel sinking rapidly. HRUs fitted to EPIRBs did not have a weak link.

1.9.3 *Joanna C*'s liferaft

Joanna C was fitted with a 4-man Waypoint Coastal liferaft in a rigid fibre reinforced plastic (FRP) canister, mounted in a cradle on top of the wheelhouse and fitted with a green Hammar HRU. *Joanna C*'s liferaft was manufactured in 2016 and due for servicing in December 2019. The outer canister of the liferaft had a pictorial launching guide, showing manual inflation of the liferaft **(Figure 13)**.

The Waypoint Coastal liferaft was intended for the leisure market and did not conform to any manufacturing standards. The liferaft was vacuum-packed and available in either a rigid FRP canister or a soft valise. The canister was fitted with drain holes on its underside, to drain away water that might collect in the canister.

Hammar's green HRU was intended for use with 4 to 12-man non-SOLAS liferafts where the buoyancy of the inflated raft would be insufficient to overcome the weak link of the standard (yellow) HRU designed for higher capacity rafts. The green Hammar HRU had a design release depth of between 1.5 and 4m and a weak link breaking strain of 1.2 (+/- 0.4) kilonewtons (kN).

[18] ISO 9650 requires a maximum force of 150N for activation of the inflation system.

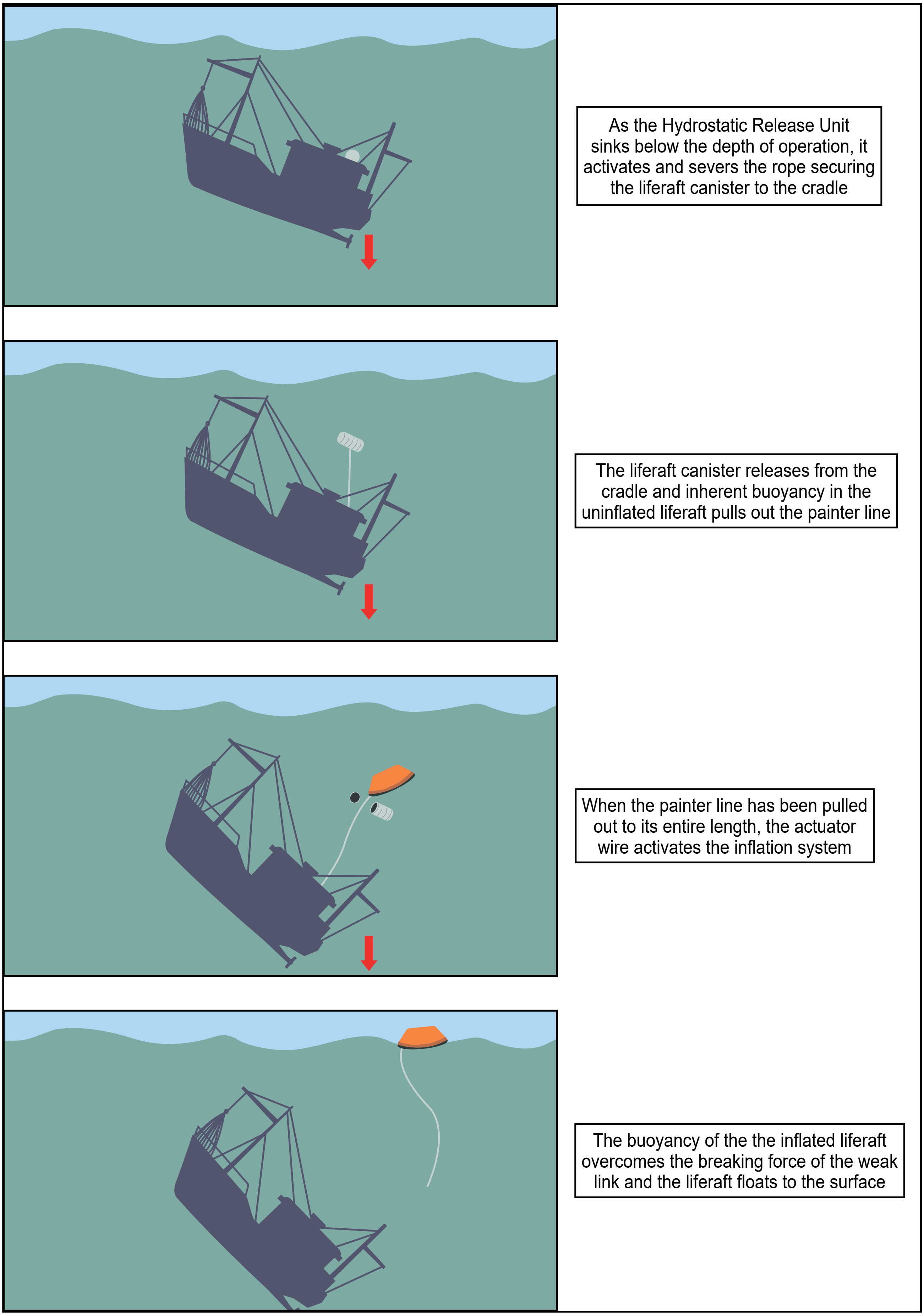

Figure 12: Operational sequence of a Hydrostatic Release Unit

Figure 13: *Joanna C*'s liferaft canister as recovered

1.9.4 Post-accident and recovery

Joanna C's uninflated liferaft was located during the MAIB dive survey, floating mid-water at the end of the painter line. Visual inspection showed that the liferaft was buoyant and being held on the activation wire for the inflation system, and that the flexible sealing grommet had remained in the casing **(Figure 14)**. After the liferaft had been located, it was recovered to the surface. During recovery the painter was inadvertently pulled and the liferaft inflated. The inflated liferaft and canister were recovered to the dive support vessel where the liferaft was deflated and transported to the MAIB's evidence storage facility. Inspection of the liferaft showed that the actuator wire and connection to the painter had been pulled through the flexible sealing grommet.

1.9.5 Post-accident liferaft testing

After the accident, *Joanna C*'s liferaft was returned to the manufacturer and repacked, the gas cylinder refilled and the inflation activation mechanism rearmed. The vacuum-packed liferaft was then placed into the original canister and straps fitted in accordance with the manufacturer's service protocol. The liferaft was then taken to Fleetwood Test House along with a new 4-man Waypoint Coastal liferaft. The new liferaft was identical to the accident raft except for a line of black tape across the join between the two halves of the canister. The manufacturer had introduced the tape in 2018 to inhibit water ingress into the canister **(Figure 15)**.

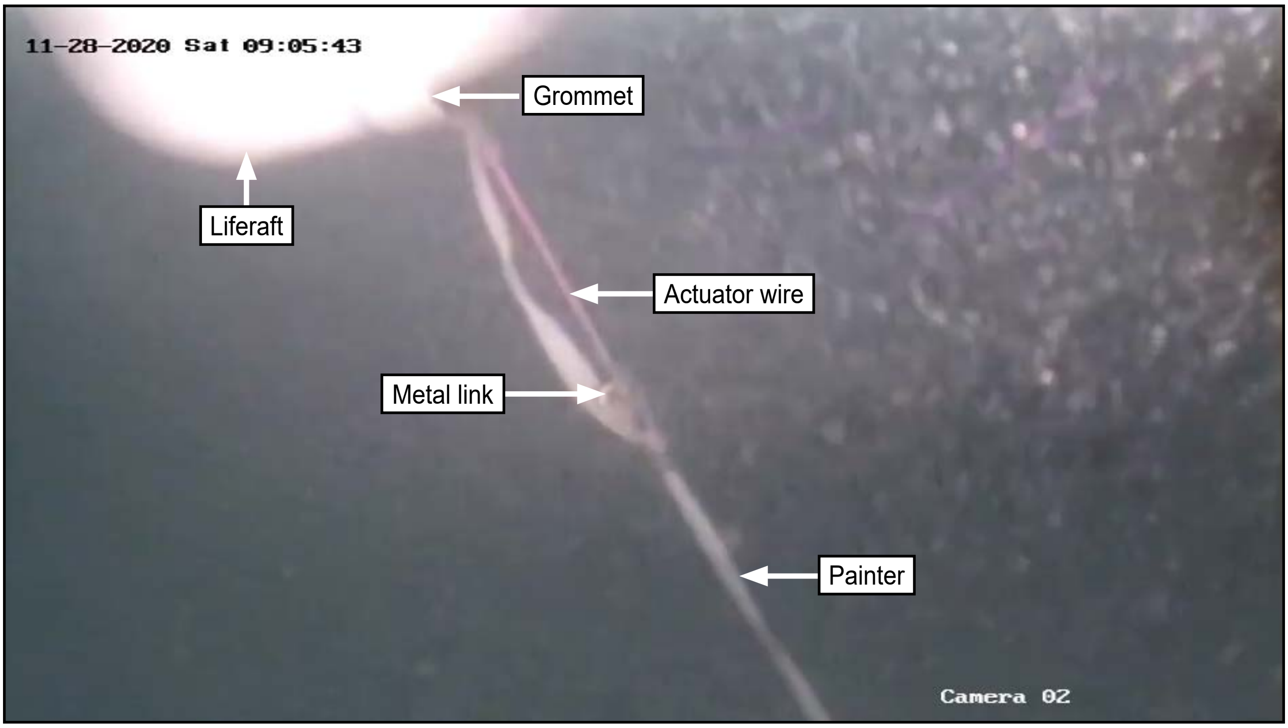

Figure 14: Close-up of *Joanna C*'s liferaft as found on dive survey


Figure 15: New liferaft, showing addition of manufacturer's black tape (left) and *Joanna C*'s repacked liferaft (right)

The liferafts were subjected to both a buoyancy test and a painter inflation pull force test. The buoyancy test was conducted in accordance with the ISO test specification for buoyancy testing PFDs[19]. Each uninflated liferaft was placed into the test cage and submerged in water. The buoyancy was measured initially and then at intervals for 45 minutes, after which the liferaft canisters were inverted and manipulated to ensure all air had been expelled and the buoyancy was measured again. The painter pull force test was conducted by attaching a load cell in line with the painter and measuring the force required to activate the inflation mechanism. This test was carried out on dry land.

A summary of the results is shown at **Table 2**, the full report is included at **Annex B**. The buoyancy values have been corrected for salt water.

[19] ISO 12402-9:2020(en) Personal Flotation Devices – Part 9: Evaluation.

Liferaft test	*Joanna C* liferaft (N)	New liferaft (N)
Initial buoyancy	309.61	419.64
Buoyancy after 15 minutes	212.47	347.00
Buoyancy after 45 minutes	211.51	288.97
Buoyancy after inversion	100.51	181.24
Buoyancy after 60 minutes	100.58	115.39
Force required for inflation	247.00	137.80

Table 2: Summary results of liferaft testing

During the buoyancy test it was observed that the black tape on the new liferaft was successful in minimising initial water ingress and the amount of air escaping from the canister was observed to be less than that from *Joanna C*'s liferaft. During the painter pull force test the flexible sealing grommet from *Joanna C*'s liferaft remained in place and the inflation activation wire and knot in the painter had to be pulled through it. On the new liferaft the grommet pulled out of the canister immediately as force was applied to the painter.

1.9.6 Buoyancy requirements for float free liferafts

Regulation 4.2.6.1 of the LSA Code set out the requirements for inflatable liferaft canisters. Sub-regulation 4.2.1.2 required that canisters be:

> *Of sufficient buoyancy when packed with the liferaft and its equipment, to pull the painter from within and to operate the inflation mechanism should the ship sink.*

ISO 9650 did not contain any requirement for buoyancy of the uninflated liferaft or its canister.

1.10 OTHER LIFESAVING APPLIANCES

1.10.1 Electronic Position Indicating Radio Beacon

MSN 1871 required fishing vessels over 10m in length to carry a global positioning system (GPS) enabled EPIRB. Existing vessels built before October 2017, when MSN 1871 came into force, had until October 2019 to fit a GPS enabled EPIRB. GPS enabled EPIRBs could pinpoint the position of the distress alert more accurately than satellite only devices. The requirement for EPIRBs to be GPS enabled was introduced following an MAIB recommendation issued to the MCA after the 2014 flooding and foundering of the 17m fishing vessel *Ocean Way* with the loss of three lives[20]. The report concluded that the search would have been more effective had a GPS enabled EPIRB been fitted.

Joanna C was equipped with a McMurdo E5 SmartFind EPIRB in a float free housing on top of the wheelhouse that was fitted with an HRU. The McMurdo E5 SmartFind EPIRB was not GPS enabled.

[20] https://www.gov.uk/maib-reports/capsize-and-sinking-of-stern-trawler-ocean-way-with-loss-of-3-lives

1.10.2 Personal lifesaving

There were three types of lifejackets carried on board *Joanna C*: solid foam abandon ship lifejackets, constant wear PFD with integral personal locator beacons (PLB) and spare constant wear PFDs without PLBs.

Joanna C's solid foam abandon ship lifejackets were stored in the safety cupboard and not used during routine operations. In October 2019, *Joanna C*'s owner purchased nine Mullion Safelink SOLO Compact Supreme 150N constant wear PFDs with integral PLBs for use on *Joanna C* and *Golden Promise*. On *Joanna C*, these were kept on hooks at the top of the companionway leading from the accommodation to the wheelhouse. The vessel also carried several spare inflatable PFDs.

1.10.3 Recovered personal flotation device

Three days after *Joanna C* was lost, a Mullion Compact 150N inflatable PFD was recovered from the beach east of Newhaven **(Figure 16)**. The lifejacket was marked with several logos, including that of Seafish and *GP02* was written on the outer fabric. The MAIB inspected the lifejacket and found that: it appeared well worn, the inflation mechanism status indicators were both red, the manual pull toggle was in the 'armed' position, the chest strap and crotch strap were both undone, the length of chest strap was approximately 90cm, and the lifejacket service indicator showed that it had been due for service in May 2020.

1.11 COLD WATER IMMERSION

Accidental immersion in cold water under 15°C has immediate and profound effects on the body. On initial immersion (between 30 seconds and 2 to 3 minutes) in cold water the sudden lowering of skin temperature can cause a rapid rise in heart rate, and therefore blood pressure, accompanied by a gasp reflex followed by uncontrollable rapid breathing. If the head goes underwater during this cold shock stage it can lead to water ingestion and subsequent drowning.

If the cold shock response is survived, then cold incapacitation can set in within 2 to 15 minutes. During this response, incapacitation of the limbs occurs when blood flow to the extremities is limited as the body attempts to preserve heat and protect vital organs. Without a PFD, cold incapacitation can lead to death by drowning as the individual loses the ability to maintain their airway above the water.

With a water temperature of 10 to 16°C, loss of dexterity can occur within 10 to 15 minutes and exhaustion or unconsciousness in 1 to 2 hours. The expected survival time in water of this temperature ranges from 1 to 6 hours.

1.12 PREVIOUS ACCIDENTS

1.12.1 Overview

In the decade prior to this accident, MAIB's records show that there were 33 reported capsizes involving UK-registered fishing vessels, including *Joanna C*; nine of these capsizes resulted in 12 fatalities.

Figure 16: Personal flotation device recovered from Newhaven beach

1.12.2 *Nancy Glen* – capsize and foundering

On 18 January 2018, the 12.98m prawn trawler *Nancy Glen* capsized and sank while trawling when its starboard net became fouled with mud and debris from the seabed during a turn to starboard, only one of the three crew survived (MAIB report 6/2019[21]).

The MAIB investigation established that through-life modifications to *Nancy Glen*, culminating in the replacement of the crane with a heavier model, had reduced the vessel's stability, significantly increasing its vulnerability to capsize. Despite the skipper's attempt to bring the situation under control, the combined effect of the increased towing load from the fouled net, the turn to starboard and the limited stability meant that *Nancy Glen* was unable to recover from the rapid heel to starboard.

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[21] https://www.gov.uk/maib-reports/capsize-and-sinking-of-prawn-trawler-nancy-glen-with-loss-of-2-lives

The report highlighted that evidence suggested owners and skippers were unaware of the risks of not conducting stability assessments and noted that the case for introducing stability criteria for small fishing vessels had been made by the MAIB and accepted by the MCA. The report further highlighted that, until such criteria have been implemented, the risk of capsize resulting from unknown stability conditions remained.

The MCA was recommended[22] to ensure that the stability of small fishing vessels is regularly assessed.

1.12.3 *Stella Maris* – capsize and foundering

On 28 July 2014, the 9.96m trawler *Stella Maris* capsized and sank while hauling fishing gear (MAIB report 29/2015[23]). The vessel's two crew were uninjured. *Stella Maris* had been significantly modified prior to its loss, including the fitting of an A-frame gantry and a winch for lifting the cod end. These modifications were partially funded by a European Fisheries Fund (EFF)[24] grant application. No calculations had been required or carried out regarding the effects of this work on the vessel's stability.

The subsequent MAIB 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. The investigation also identified that although the MMO sought MCA advice on the stability impact of the proposed EFF funded modifications, this advice was never received, and the funding application was approved regardless. In any case the application was not supported by sufficiently detailed information for the MCA to conduct a robust assessment.

The report highlighted a number of small fishing vessel losses that had resulted from insufficient stability, including that of *Heather Anne* where EFF subsidised modifications were highlighted as a contributing factor.

Following the accident, the MCA undertook to introduce a requirement for notification and agency approval of substantial modifications.

The MCA and MMO were recommended[25] to work together to ensure that funded modifications were reviewed for their impact on vessel stability and safety. The MCA was also recommended[26] to introduce intact stability criteria for new and significantly modified fishing vessels under 15m in length.

[22] MAIB Recommendation 2019/109 https://www.gov.uk/maib-reports/capsize-and-sinking-of-prawn-trawler-nancy-glen-with-loss-of-2-lives

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

[24] The EFF grant scheme was the predecessor to the EMFF scheme and administered along similar lines.

[25] MAIB Recommendation 2015/170.

[26] MAIB Recommendation 2015/165.

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

Joanna C's crew were in the process of hauling the catch with the derricks raised in preparation for swinging the dredges inboard. At this point, control of the situation was lost when the vessel started to heel to starboard. This happened because the starboard dredge bar was snagged on a line of whelk pots, effectively anchoring *Joanna C* and inducing the heel, from which it could not recover.

Having capsized, only one of the three crew escaped immediately, with the other two trapped inside, and the liferaft remained uninflated. The skipper later managed to escape as *Joanna C* sank; he was the only survivor.

Joanna C capsized because it did not have sufficient righting moment to recover from the initial heel. This section of the report will assess the causes of the capsize and the other safety issues highlighted by the accident, including stability management and lifesaving appliances.

2.3 THE ACCIDENT

The dive survey following the loss of *Joanna C* showed that both sets of dredge bags were full of catch and that there was a line of whelk pots tangled round the starboard dredge bar **(Figures 4** and **5)**.

Entanglement with static gear was a known hazard for bottom trawling vessels and *Joanna C*'s crew had encountered whelk potting gear in the area before, including seven times in the three weeks before the accident. *Joanna C*'s crew had freed these previous snags using a knife. At the time of the accident, the derricks were raised so operating the quick releases was not advised and the skipper opted to attempt to lower the derricks hydraulically; however, the heeling moment developed rapidly, and *Joanna C*'s righting lever vanished before the skipper could take any effective action **(Figure 17)**.

The capsize sequence was rapid and did not afford the crew opportunity to take any restorative actions, raise the alarm manually or, in the case of the skipper and deckhand, escape from inside the vessel.

2.4 LOSS STABILITY CONDITION

Joanna C was modified several times during its 40 years of operation, including extensive modifications in 2007 and 2019, the cumulative effect of which eroded *Joanna C*'s reserves of stability and increased the vessel's vulnerability to capsize.

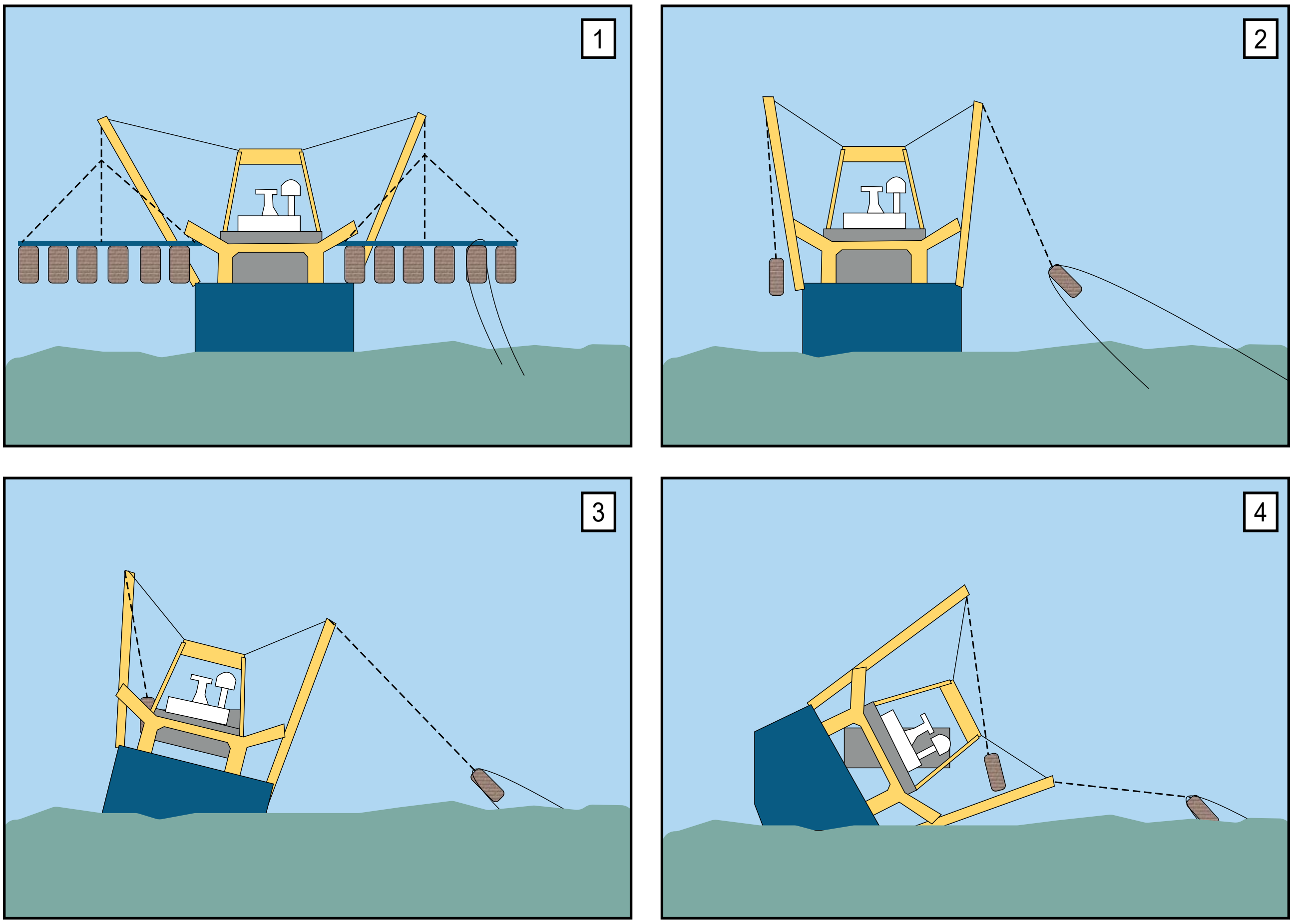

Figure 17: Likely capsize sequence

Figure 18 shows *Joanna C*'s GZ curves over time, along with an example GZ curve meeting the minimum stability criteria (curve b). Curves a and c were derived from the 1994 and 2019 inclining experiments and were calculated for Condition 4[27]. Curve d was calculated with the vessel in the estimated condition at loss, with 7t of scallops in the fish hold, derricks raised, and the full dredge bags suspended from the dredge bar. In this condition the weight of the dredge bars and catch was acting at the point of suspension, which was the outboard end of the derrick.

Joanna C had a very small range of positive stability with the derricks raised in the loss condition (curve d), and the angle of vanishing stability occurred at around 25°. The maximum GZ in this condition was 57% lower than the calculated value for the 2019 static condition and occurred at just 14° angle of heel; significantly lower than the required 25° minimum. The low angle of maximum GZ meant that after 14° of heel the righting lever rapidly reduced, and the ability to recover from any further heel diminished. The extremely low value and angle of occurrence for maximum GZ coupled with the low range of positive stability meant that *Joanna C* was vulnerable to capsize given any initiating heel factor in this condition. This was demonstrated when the addition of 300kg to the starboard dredge bar in the theoretical model reduced the positive stability to the point of nonexistence. *Joanna C*'s actual vulnerability was increased, as the stability analysis and modelling of the loss condition was for the static condition and did not take account of dynamic effects such as wind and waves, further reducing the vessel's ability to recover from an angle of heel.

[27] Departure from fishing grounds with 100% catch, the closest match of the seven pre-determined static conditions to the time of loss.

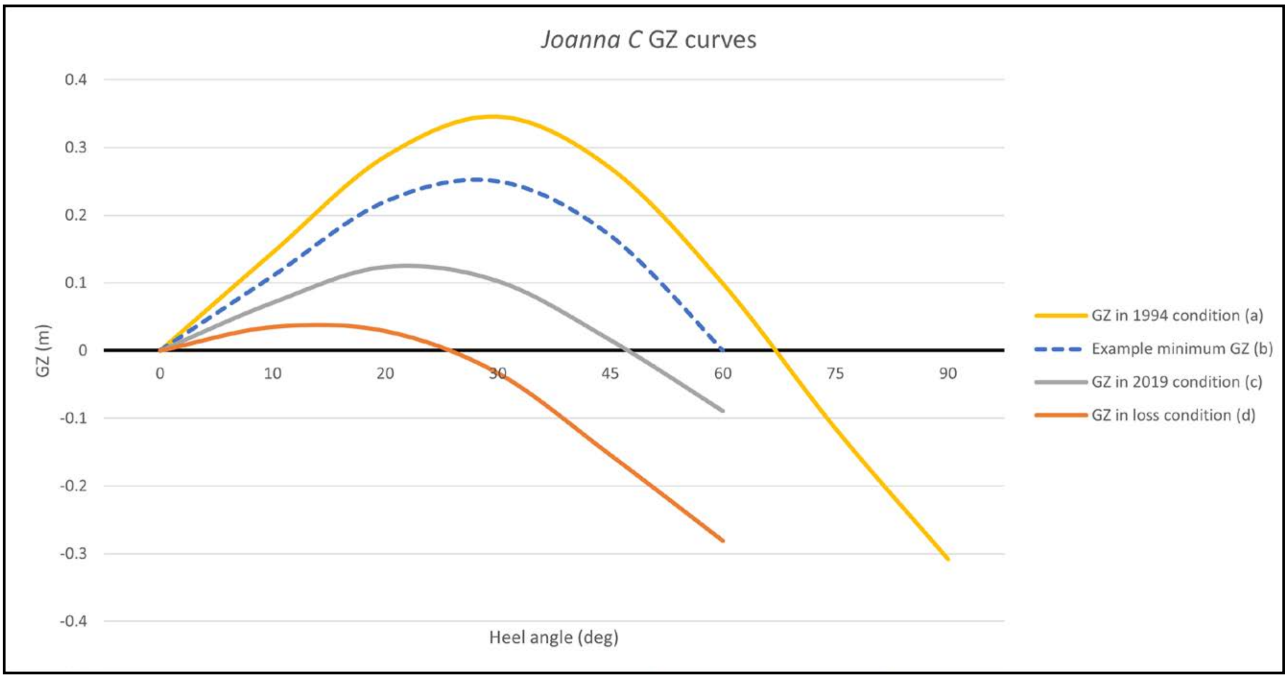

Figure 18: GZ curve comparison

Joanna C's rapid capsize was caused by the additional loading of the line of whelk pots on the starboard dredge bar. With the weight of the dredge bar, catch, and string of whelk pots acting at the point of suspension, *Joanna C* was effectively anchored to the seabed at the outboard derrick end. The vessel's centre of gravity was high as the derricks were in the raised condition and there was insufficient reserve of positive stability to overcome the starboard heeling moment induced by the whelk pots **(Figure 17)**. Once *Joanna C* heeled beyond around 14°, and with the heeling moment continuing to be applied and including dynamic effects, capsize was inevitable.

2.5 MODIFICATIONS

2.5.1 Effect on stability

The cumulative effect of modifications to *Joanna C*, culminating in the extensive refit in 2019, severely eroded the vessel's margin of positive stability.

Joanna C was extensively modified in the 25 years between the 1994 and 2019 incline experiments, including significant structural changes such as reducing the vessel length and fitting a whaleback. **Table 3** shows a comparison of Condition 4 results for the 1994 and 2019 incline experiments and the margin of passing, then failure, for each criterion. The table shows that, between 1994 and 2019, the reserves of stability had reduced from a state of greatly exceeding the requirement to that of failing by a wide margin. This happened because modifications increased *Joanna C*'s displacement and raised the centre of gravity, meaning the vessel had a lower metacentric height and consequentially unfavourable stability characteristics.

Condition 4 (Depart grounds with 100% catch)	1994 % Pass	2019 % Fail
Area under GZ curve up to 30°	+62%	-32%
Area under GZ curve up to 40°	+53%	-46%
Area under GZ curve 30° to 40°	+61%	-64%
Angle of maximum GZ occurrence	+20%	-14%
GZ value at 30°	+44%	-57%
Minimum GM	+88%	-8%

Table 3: Comparison of Condition 4 results for 1994 and 2019 inclines

The erosion of *Joanna C*'s stability margins probably began with the 2007 length reduction and modifications; however, as there was no stability assessment at the time, the effect could not be determined. The stability margins were likely to have been further eroded by the installation of catch conveyors in 2014, but again this cannot be quantified.

Stability analysis is conducted with the vessel in standard static loading conditions and with fishing gear not deployed. The margins of these conditions exist to provide vessels with a reserve of stability so that, when in an operational condition, there is sufficient stability to withstand dynamic effects and the increased VCG brought about by fishing operations and the local conditions. *Joanna C*'s margins had been exhausted by the effect of modifications. This lack of stability reserve meant that the vessel was vulnerable to the effects of heeling moments, be they from operations, weather effects, or as in this case, snagging.

2.5.2 Management of the 2019 modifications

The extensive 2019 modifications to *Joanna C* were almost certainly the main factor in reducing the margin of positive stability to a level where the vessel had a dangerously low reserve. Although the owner had sought advice from a naval architect, he was not involved in the modifications' design and there was no stability assessment of the vessel before work began. In addition, despite being involved in funding applications for parts of the work, the MCA was not notified of the proposed modifications and consequentially there was no regulatory oversight or approval of the process.

Measures to increase the level of MCA involvement in EMFF funding applications were put in place in response to concerns around the potential for modifications to adversely affect stability raised in the MAIB's *Nancy Glen* and *Stella Maris* investigation reports. Despite these measures there were evident shortcomings in the process of *Joanna C*'s funding applications and the MMO granted approval before receiving the MCA's comments. Although this meant MCA comments were not taken into account, it is unlikely that the premature approval of funding affected the outcome with *Joanna C*'s stability as the MCA endorsed all but one of the applications and the reasons cited for the one refusal did not include stability concerns. The MCA had also included a requirement for post-modification stability analysis as a condition of approval, acting as a safety net. Finally, not all the modifications were subject to EMFF funding requests and the approval of these did not equate to MCA agreement to the modifications.

The underpinning Regulations and MSN 1871 required modifications to be approved by the MCA, although MSN 1871 only required approval for *significant* modifications. Despite being aware of the requirement for a stability assessment following the work, and having engaged a naval architect, *Joanna C*'s owner did not notify the MCA of the work in advance and the modifications were not subsequently approved. This meant there was no MCA oversight during the work and that the modifications were not inspected to ensure compliance with relevant Seafish construction standards. Although the responsibility to notify the MCA lay with the owner, the funding application process was a missed opportunity to prompt him about the need to notify the MCA before starting work.

The MCA took no action on discovering that the modifications had been undertaken without notification or approval, instead relying on the post-modification stability analysis mandated as a condition of one of the EMFF approvals. *Joanna C*'s fishing vessel certificate remained valid and was not withdrawn, even though the vessel was operating with unapproved modifications and unverified stability characteristics. This was almost certainly because MSN 1871 did not definitively mandate stability analysis for modified 12 to 15m vessels, despite indications in the preamble that it would do so. The apparent voluntary nature of the stability requirement reinforced the MCA surveyor's impression that it was not essential for the continued safety of the vessel. The MCA's view was probably also influenced by the involvement of a naval architect, whose presence would have reassured other parties.

Notwithstanding that the MCA were not notified that modifications had started, the requirement of an incline and stability assessment as a condition of funding was sensible and intended to identify any stability deficiencies introduced by the work. However, there was no mechanism to alert the MCA to the modifications in the absence of the owner fulfilling his obligation to notify and, despite the owner's breach of MSN 1871 and the unknown condition of the vessel stability, the MCA did not withdraw the vessel's certificate.

2.5.3 Involvement of the naval architect

The MCA and *Joanna C*'s owner had a high level of confidence in the naval architect's knowledge because he had performed *Joanna C*'s stability analysis and lightship checks between 1994 and 2001. His involvement in the modification process and incline, and previous written assurances regarding the vessel's stability, gave the MCA and the owner grounds to believe that the stability would remain sufficient. As established by post-accident analysis, the naval architect's assurances were incorrect.

In 2001, when the naval architect completed his final lightship check, *Joanna C*'s stability characteristics exceeded the mandatory criteria by a significant margin; however, when the vessel was modified in 2007, and catch conveyors installed in 2014, the stability characteristics changed. This change and the effect on stability compliance could not be quantified because no assessment was made of the vessel at the time. Despite this, the consultant reassured the owner three times that the vessel stability margins had previously been good and that he considered that it was not likely to have been affected by either the 2007 modifications or the 2014 installation of catch conveyors. Given that *Joanna C*'s stability characteristics were unknown, this statement was without basis and the wording gave the owner false reassurance about *Joanna C*'s stability. In the case of the 2014 quotation, it is possible that this false reassurance deterred the owner from voluntarily undertaking a stability assessment of *Joanna C* before installing the catch conveyors, resulting in a missed opportunity to re-evaluate the stability. Without a stability assessment following either the 2007 modifications or 2014 work, there was no way to know how much of *Joanna C*'s stability reserves remained before the 2019 modifications were carried out.

The involvement of the naval architect also gave the MCA confidence in the modification process. This confidence almost certainly influenced the MCA's lack of action on discovering the unauthorised modifications and contributed to the perception that the inclining experiment and stability analysis were probably a formality, given the reported previous good stability condition.

2.6 INCOMPLETE STABILITY ANALYSIS

2.6.1 Overview

Inclining experiments are only the first part of a stability analysis and do not give immediate results about the stability characteristics of a vessel and compliance or otherwise with criteria. *Joanna C*'s incline data was not analysed following the 2019 incline, which meant that, between July 2019 and November 2020, *Joanna C* was operating in a vulnerable condition with insufficient positive stability.

Three agencies had an interest in ensuring that the stability analysis was complete: *Joanna C*'s owner, the MCA, and the naval architect, none of whom effectively followed up on the missing analysis. This happened because of an absence of any organisational process governing the incline, so the stability inadequacies went undetected.

2.6.2 *Joanna C*'s owner

The Fishermen's Safety Guide and MGN 415 (F) made clear that scallop dredging was a hazardous activity and emphasised the importance of maintaining stability on vessels engaged in this fishing method. It follows that scallop dredgers need to take particular care around both stability and other safety aspects on their vessels because of the possibility for rapid capsize and loss.

Joanna C's owner had made efforts to improve the fishing efficiency and crew comfort of the vessel in the seven years he had owned it; however, despite engaging a naval architect in 2019, he had given little consideration to the effects of the proposed modifications on stability. Although the naval architect had given general advice that *weight put on should be the same as weight removed*, and the available guidance also reinforced the importance of weight control during modifications, there is no evidence that the owner took this into consideration when specifying the work to be done.

Joanna C passed its most recent MCA inspection in 2018; however, between the inspection and the accident the liferaft and spare PFDs on board had passed their required service dates and the owner had not replaced the EPIRB with a GPS model, despite the requirement to do so. This demonstrates the owner's lack of effective safety management outside of MCA compliance activity, which potentially also applied to stability management. Although the owner had some understanding of the pitfalls and need for specialist naval architecture support, he had followed up on this to a limited extent and was not sufficiently motivated to involve the naval architect in the modifications' design to ensure stability was not adversely affected. The lack of importance attached to stability concerns was also demonstrated by the owner not notifying the MCA of either the 2019 modifications or the 2020 derrick movement, despite a requirement to do so.

Joanna C's owner had not experienced the process of an inclining experiment or stability analysis before, and the successful completion of the incline readings on the day, as confirmed by both the MCA witness and the naval architect, probably gave him a false sense of security that the stability was sufficient and an impression that the analysis was complete. As *Joanna C*'s certificates remained in force, the vessel was free to operate and there was no penalty attached to the outstanding stability analysis and no motivation for the owner to pursue the naval architect for results.

Although he made some positive efforts to engage with the modification process, *Joanna C*'s owner did not attach sufficient importance to stability considerations and had a limited understanding of the stability analysis process. His lack of understanding meant that he did not appreciate the danger of operating a scallop dredger with unknown stability characteristics and, without restriction on *Joanna C*'s continued operation, was not motivated to ensure that the stability analysis was completed.

2.6.3 Maritime and Coastguard Agency oversight

MSN 1871 only required stability analysis for new fishing vessels of 12 to 15m, not those that had been modified, so there was no specific regulatory requirement for analysis following *Joanna C*'s 2019 modifications. Despite this, the MCA had required a post-modification stability analysis as part of its endorsement of one of the EMFF grant applications. This was reasonable and aimed to ensure that *Joanna C* maintained sufficient positive stability.

Although the stability analysis was not a mandatory regulatory requirement, the MCA had made it a condition of the funding application and witnessed the inclining experiment. However, there was no organisational process to ensure that the vessel did not operate until the stability was verified and *Joanna C*'s certificate remained valid. The lack of a mandatory requirement and the continued validity of the certificates meant there was no prompt to the MCA to follow up on the missing documentation because there was no indicator that it was outstanding or indeed required.

That a second under 15m fishing vessel was inclined on the same day as *Joanna C* and also had missing stability analysis (albeit without damaging consequences) further demonstrated the absence of MCA oversight and processes to ensure that stability assessments were carried out to completion, and the results passed to vessel owners and crew.

2.6.4 The naval architect

The naval architect submitted *Joanna C*'s incline data to a subcontractor to produce a computer model and an initial incline report. A month after submitting the data, the naval architect reminded the subcontractor of the outstanding work; however, despite reassurance that it would be prioritised, he received nothing. The naval architect did not pursue the matter and did no further work on *Joanna C*'s stability analysis.

With a high workload and without a computer modelling system, the naval architect struggled to manage, resorting to subcontracting work. Without prompts from either the owner or the MCA, and distracted by his personal circumstances, the naval architect simply did not complete *Joanna C*'s stability assessment.

2.7 SURVIVABILITY

2.7.1 Deckhand

When *Joanna C* capsized the deckhand was trapped within the upturned hull of the vessel and took refuge in the accommodation space along with the skipper. When the vessel started to sink, the skipper was able to escape, which was fortunate given the darkness and likely obstructions in his path. However, the deckhand remained trapped. Once the vessel had begun to sink water ingress to the crew accommodation was likely rapid, denying the deckhand any opportunity to escape.

2.7.2 Mate

The mate was preparing to bring in the catch when *Joanna C* capsized, and he was flung into the water. On the day of the accident, the sea temperature was 11°C and he probably experienced some of the effects of cold water shock; however, the PFD he was initially wearing kept his head above the surface. When *Joanna C* sank, and the skipper located the mate, he had been in the water for around 40 minutes and was suffering the effects of cold incapacitation. The consequent loss of dexterity and useful movement in his arms and legs meant that he could not maintain his hold on the lifebuoy, which was his only means of support following the loss of his PFD.

Without support, the mate's ability to maintain his head and airway above the water was lost and he likely slipped below the surface and drowned. It is unknown at what point the mate lost his hold on the lifebuoy; however, the timing of the skipper's rescue means that it was somewhere between 40 mins and 3 hours and 45 minutes after the capsize. After one hour in the water the mate was within the window for exhaustion, unconsciousness, and death from hypothermia and, without the support afforded by a PFD or the shelter of a liferaft, his chances of survival were significantly reduced.

2.7.3 Personal flotation devices

The skipper and deckhand were not wearing PFDs when *Joanna C* capsized, which was reasonable as they were inside the vessel. The mate was initially wearing a PFD; however, it was lost during the skipper's attempt to disentangle him from the orange rope attached to the lifebuoy and was not recovered in the initial searches.

A PFD was recovered from Newhaven East beach three days after *Joanna C* sank. Although not one of the newer constant wear PFDs that *Joanna C* was equipped with, it is probable that this was the PFD the mate was wearing when he was thrown into the water. The marking *GP02* was consistent with the owner's other vessel, *Golden Promise* and indicated that the recovered PFD may have been one of the spares known to be on board *Joanna C*. In addition, the status of the inflator mechanism indicators suggested that the automatic inflation mechanism had been activated and the gas cylinder discharged. Furthermore, the PFD's worn appearance, and loosened straps, indicated that it had been in use and removed rather than stored. Finally, no other PFDs were recovered from *Joanna C*, and it is probable that the PFD worn by the mate was the only one not trapped inside the vessel when it capsized.

The recovered PFD did not have an integral PLB; this meant that the mate had no electronic means of raising the alarm. In addition to the lack of PLB, the PFD was also overdue for servicing, although it inflated as intended. To ensure that equipment is up to date and serviceable, it is good practice to remove old survival equipment from a vessel when it has been replaced with newer equipment. In this case, although the PFD appears to have functioned correctly and initially provided support for the mate, newer PFDs were available that were in date for service and had the benefit of integral PLBs.

2.7.4 Electronic Position Indicating Radio Beacon

Joanna C capsized rapidly and without time for the crew to issue a distress call. Without any means of raising the alarm from inside the capsized hull and with the PLB fitted lifejackets not in use, raising the alarm was dependent on the operation of the float free EPIRB. *Joanna C*'s EPIRB did not activate until 0555, around 40 minutes after the vessel had capsized. It is probable that the release of the EPIRB was delayed because it either became entrapped under the upturned hull or the HRU did not reach sufficient activation depth (between 1.5 to 4m) until the vessel began to sink.

Once *Joanna C*'s EPIRB had activated, search and rescue efforts began without delay. Although the EPIRB was not GPS enabled, search and rescue (SAR) assets were rapidly assigned, and location information derived from the EPIRB data was used to initiate a successful search that resulted in the skipper's rescue. However, the absence of a GPS position to pinpoint the EPIRB potentially impacted the accuracy of the search. Despite this, any impact caused by the lack of GPS functionality is likely to have been eclipsed by the time taken for the EPIRB to release following the capsize.

The EPIRB's delayed release meant that the alarm was not raised, nor the search and rescue efforts started, until after *Joanna C* sank. This delay increased the amount of time the mate and skipper spent in the water and correspondingly reduced their chances of survival.

2.7.5 Liferaft

Although the HRU holding *Joanna C*'s liferaft canister into the cradle had released, the uninflated liferaft's buoyancy was insufficient to overcome the force required to activate the inflation mechanism. This meant that the liferaft did not inflate and was inhibited from coming to the surface by its painter, which was attached to *Joanna C* by the weak link.

Joanna C remained afloat inverted for around 40 minutes after the capsize. It cannot be determined when in this 40-minute period the HRU activated and released the liferaft canister from its cradle; however, given that it did not initially come to the surface, it is likely that it was not immediate. This meant that the liferaft spent time inverted and with the drain holes uppermost, allowing air to escape and water to ingress into the canister and reducing the amount of trapped air. Post-accident testing of the liferaft demonstrated that, uninflated, the buoyancy was only sufficient to overcome the inflation activation force of 247N upon initial immersion in the tank, and it had reduced to 212.47N after just 15 minutes. In the accident scenario, with the added motions induced by waves, the loss of air from the liferaft canister was probably more rapid, leading it to quickly flood and lose buoyancy. The dive survey footage and post-accident testing of *Joanna C*'s liferaft showed that the rubber grommet impeded the painter, and the activation mechanism was, in effect, stuck on the trigger, probably leading to the significantly higher force required when compared to the new control liferaft. However, testing demonstrated that after inversion and expulsion of air from the canister the new liferaft's buoyancy had also dropped below that required to trigger inflation.

When *Joanna C*'s liferaft was recovered the inflation mechanism was unintentionally triggered when the painter was pulled and the liferaft inflated. This demonstrated that the inflation system was functional despite the liferaft being nearly a year overdue for a service. The overdue service was therefore unlikely to be the cause of the failure to inflate during the accident. Nevertheless, it is important that lifesaving equipment is maintained in accordance with the manufacturer's approved service intervals.

Given that it was intended for the leisure market, there was no obligation for *Joanna C*'s liferaft to be manufactured to any standard, and MSN 1871 permitted this. After October 2022, all liferafts fitted to UK fishing vessels must at least conform to the ISO 9650 standard. Unlike the SOLAS LSA code, ISO 9650 was intended for manually launched liferafts and had no requirement for uninflated liferafts to have sufficient buoyancy to overcome the required force to initiate inflation. Without such a requirement in place there was no way for operators or the regulator to ensure that the liferaft would operate properly when used with an HRU, and hence comply with the MSN 1871 requirement to *float-free, inflate and break-free automatically*. This requirement was necessary because fishing vessels have the potential to capsize rapidly and without sufficient warning for the crew to manually launch a liferaft.

Joanna C's liferaft did not inflate because the buoyancy of the canister when uninflated was not sufficient to trigger inflation. This happened because there was no buoyancy requirement for the uninflated liferaft and therefore no assurance that it would operate correctly when used with an HRU. The mandating of ISO 9650 liferafts from 2022 is insufficient to address this issue and ensure that liferafts fitted to small fishing vessels have sufficient buoyancy to inflate. Without an inflated liferaft the skipper and mate had no means to shelter from the elements, or find refuge out of the water while awaiting rescue, and their chances of survival were consequentially reduced.

SECTION 3 – CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. *Joanna C* capsized because of insufficient stability to counter the effect of the whelk pots snagging during recovery of the full dredges. [2.3, 2.4]

2. The rapid nature of the capsize meant that the crew did not have time to operate the fishing gear quick releases, issue a distress signal or manually activate the EPIRB or liferaft. [2.3]

3. *Joanna C* was inherently vulnerable to capsize as it had a low margin of positive stability and did not comply with the MSN 1871 criteria. [2.4, 2.5, 2.6]

4. Post-accident analysis demonstrated that modifications to *Joanna C* between 1994 and 2019 had eroded the reserves of stability from exceeding the requirement to failing by a wide margin. [2.5, 2.6]

5. The opportunity to discover that *Joanna C*'s modifications had reduced the reserves of stability to an unacceptable condition was missed because there was no organisational process to assure satisfactory stability. Despite the involvement of three agencies: the owner, the regulator and a consultant naval architect, the 2019 inclining experiment was never followed up. This shortcoming went undetected because there was no mechanism to determine that the results of the inclining experiment had been analysed by the naval architect, then understood by the owner and crew. [2.6]

6. *Joanna C*'s liferaft did not inflate because it had insufficient buoyancy to overcome the force required for painter activation. This happened because there was no requirement for the liferaft to conform to any buoyancy standard; despite the requirement to be float free and to inflate automatically. [2.7.5]

7. The absence of the liferaft adversely affected the skipper and mate's chances of survival. [2.7.5]

3.2 OTHER SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT

1. The alarm was not raised for about 40 minutes after the capsize, despite the mate being immediately thrown clear. This happened because the PFD he was wearing was not fitted with a PLB. [2.7.3]

2. It is almost certain that the float free EPIRB did not surface until the vessel had sunk, and then did not provide the most accurate position for SAR assets as it was not GPS enabled. [2.7.4]

3.3 SAFETY ISSUES NOT DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. The absence of a performance standard for non-SOLAS liferafts meant there was no means of assuring that such a liferaft, secured with an HRU, would automatically deploy in the event of a vessel sinking. [2.7.5]

2. The MMO did not take into account the MCA input to EMFF grant applications. [2.5.2]

3. The extensive modifications to *Joanna C* in 2019 were not approved by the MCA prior to work starting and there was no assessment of the effect the modifications would have on the vessel's stability before completion. [2.5.2]

SECTION 4 – ACTION TAKEN

4.1 MAIB ACTIONS

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.*

This recommendation was accepted by the British Standards Institution (See 4.2).

The MAIB has also issued a safety flyer to the fishing industry **(Annex C)**.

4.2 ACTIONS TAKEN BY OTHER ORGANISATIONS

The **International Organization for Standardization** has introduced requirements in the updated ISO 9650 standard for liferafts designed for float free launching to have a minimum level of buoyancy linked to the inflation activation force, to be labelled as being suitable for float free launch or not, and to have a manufacturing test procedure to verify compliance.

Although not directly as a result of this accident, the **Maritime and Coastguard Agency** has published an updated Code of Practice for under 15m fishing vessels[28]. The new code included a specific requirement for owners to notify the MCA of proposed modifications and also stated that the modifications could only be carried out after consultation with, and approval from, the MCA. The new Code also contained a mandatory requirement for modified fishing vessels of 12 to 15m in length to undergo stability assessment against the criteria for new vessels.

The **Marine Management Organisation** has:

- Updated guidance for funding applicants[29] to make clear the requirement to engage with the MCA and that all work undertaken must meet MCA safety and stability requirements.

- Revised the funding application approval process to ensure details of submitted applications are sent to the MCA for review, and to include contacting the MCA at the claim stage to check that no funds are paid out without confirmation that the applicant has made the MCA aware of work undertaken.

The **National Federation of Fishermen's Organisations** has recruited a dedicated risk, safety and training officer. Part of this officer's role is to assist member vessels with the coordination of modifications and regulatory compliance activity.

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[28] MSN 1871 Amendment No.2 (F) The Code of Practice for the Safety of Fishing Vessels of Less Than 15m Length Overall: https://www.gov.uk/government/publications/msn-1871-amendment-no-2-f-the-code-of-practice-for-the-safety-of-small-fishing-vessels-of-less-than-15m-length-overall

[29] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1048215/1_Guidance_for_Fishing_Activities_v4.pdf

SECTION 5 – RECOMMENDATIONS

The **Maritime and Coastguard Agency** is recommended 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.

Safety recommendations shall in no case create a presumption of blame or liability

Marine Accident Report

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