MCIB
Marine Casualty Investigation Board
Bord Imscrúdú Taismí Muirí

REPORT OF AN INVESTIGATION INTO A MARINE CASUALTY INVOLVING THE FISHING VESSEL ARDENT EAST OF PORT ORIEL, CLOGHERHEAD, CO. LOUTH 31 OCTOBER 2022

REPORT NO. MCIB/320
(No.2 OF 2024)

The Marine Casualty Investigation Board (MCIB) examines and investigates all types of marine casualties to, or onboard, Irish registered vessels worldwide and other vessels in Irish territorial waters and inland waterways.

The MCIB objective in investigating a marine casualty is to determine its circumstances and its causes with a view to making recommendations to the Minister of Transport - for the avoidance of similar marine casualties in the future, thereby improving the safety of life at sea and inland waterways.

The MCIB is a non-prosecutorial body. We do not enforce laws or carry out prosecutions. It is not the purpose of an investigation carried out by the MCIB to apportion blame or fault.

The legislative framework for the operation of the MCIB, the reporting and investigating of marine casualties and the powers of MCIB investigators is set out in the Merchant Shipping (Investigation of Marine Casualties) Act, 2000.

In carrying out its functions the MCIB complies with the provisions of the International Maritime Organisation's Casualty Investigation Code and EU Directive 2009/18/EC governing the investigation of accidents in the maritime transport sector transposed into Irish law by the European Communities (Merchant Shipping) (Investigation of Accidents) Regulations 2011.

Leeson Lane, Dublin 2.
Telephone: 01-678 3485/86.
email: info@mcib.ie
www.mcib.ie

REPORT OF AN INVESTIGATION INTO A MARINE CASUALTY INVOLVING THE FISHING VESSEL ARDENT EAST OF PORT ORIEL, CLOGHERHEAD, CO. LOUTH 31 OCTOBER 2022

The Marine Casualty Investigation Board was established on the 25th March 2003 under the Merchant Shipping (Investigation of Marine Casualties) Act, 2000.

REPORT NO. MCIB/320
(No.2 OF 2024)

Glossary of Abbreviations and Acronyms

BIM	Bord Iascaigh Mara
C	Celsius
CFR	Common Fleet Register
CGR	Coast Guard Radio
CGU	Coast Guard Unit
CoC	Certificate of Competency
CoP	Code of Practice
ECHA	European Chemicals Agency
ETA	Estimated Time of Arrival
EU	European Union
FV	Fishing Vessel
FVSC	Fishing Vessel Safety Certificate
GMDSS	Global Maritime Distress and Safety System
hPa	Hectopascals
HSA	Health and Safety Authority
HSE	Health Service Executive
HW	High Water
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organization
ILO	International Labour Organization
LOA	Length Overall
LRC	Long Range Certificate
MAIB	Marine Accident Investigation Board
MCIB	Marine Casualty Investigation Board
MSO	Marine Survey Office
MCA	Maritime and Coastguard Agency
MHWN	Mean High Water Neaps
MHWS	Mean High Water Springs
MLWN	Mean Low Water Neaps
MLWS	Mean Low Water Springs
MN	Marine Notice
MRCC	Marine Rescue Co-ordination Centre
NEOC	National Emergency Operations Centre
PPE	Personal Protective Equipment
PPM	parts per million
RNLI	Royal National Lifeboat Institution
RSW	Refrigerated Sea Water
S.I.	Statutory Instrument
UTC	Co-ordinated Universal Time
UVI	Unique Vessel Identifier
VHF	Very High Frequency

Cubic metre	m^3
Gross tonnage	GT
Hour	hr
Kilogram	kg
Kilometre	km
Kilowatt	kW
Knot	kt
Metre	m
Millimetre	mm
Milligram	mg
Nautical mile	NM

Definition

The following terms are used in this report. The definitions are included here to distinguish how they differ between International Safety of Life at Sea for risk assessment to that used in National Legislation for enforcement.

Enclosed Space

The primary source of regulations is the International Maritime Organization (IMO), who define enclosed space as:

Enclosed space means a space which has any of the following characteristics:

1. limited openings for entry and exit;
2. inadequate ventilation; and
3. is not designed for continuous worker occupancy,

and includes, but is not limited to, cargo spaces, double bottoms, fuel tanks, ballast tanks, cargo pump-rooms, cargo compressor rooms, cofferdams, chain lockers, void spaces, duct keels, inter-barrier spaces, boilers, engine crankcases, engine scavenge air receivers, sewage tanks, and adjacent connected spaces. This list is not exhaustive and a list should be produced on a ship-by-ship basis to identify enclosed spaces.

The atmosphere in any enclosed space may be oxygen-deficient or oxygen-enriched and/or contain flammable and/or toxic gases or vapours. Such unsafe atmospheres could also subsequently occur in a space previously found to be safe. Unsafe atmospheres may also be present in spaces adjacent to those spaces where a hazard is known to be present.

Resolution A.1050(27), Adopted on 30 November 2011. REVISED RECOMMENDATIONS FOR ENTERING ENCLOSED SPACES ABOARD SHIPS

Confined Space

The Health and Safety Authority, publishes the Code of Practice entitled “Code of Practice for Working in Confined Spaces”, in accordance with section 60 of the Safety, Health and Welfare at Work Act 2005 (No.10 of 2005).

The term CONFINED SPACE means any place, including any vessel, tank, container, vat, silo, hopper, pit, bund, trench, pipe, sewer, flue, well, chamber, compartment, cellar or other similar space which, by virtue of its enclosed nature creates conditions which give rise to a likelihood of accident, harm or injury of such a nature as to require emergency action due to:

(a) The presence or reasonably foreseeable presence of:

(i) flammable or explosive atmospheres,

(ii) harmful gas, fume or vapour,

(iii) free flowing solid or an increasing level of liquid,

(iv) excess of oxygen,

(v) excessively high temperature.

(b) The lack or reasonably foreseeable lack of oxygen.

Key Characteristics

The following are key characteristics of a 'confined space' for the purposes of this Code of Practice.

- The space must be substantially enclosed.
- There must be a risk of at least one hazard of the type, listed in the definition above, occurring within the space.
- The risk of serious injury from the hazard must be created by virtue of the enclosed nature of the space.
- The potential injury must be serious and be such as to require emergency action to rescue the person involved.

Report MCIB/320 published by the Marine Casualty Investigation Board.

29th February 2024.

CONTENTS

1. SUMMARY

1.1 At approximately 15.05 hours (hrs) on the 31 October 2022 the Fishing Vessel (FV) Ardent departed Port Oriel Harbour, Clogherhead, Co. Louth with four crew onboard, to commence fishing activities in the Irish Sea. The vessel had moored in the harbour on the 26 October after discharging its catch in Ardglass Co. Down the previous day (25 October).

1.2 At approximately 15.15 hrs the Skipper and Crewmember (A) commenced the tank washing and cleaning operation in preparation for refilling of the Refrigerated Sea Water (RSW) tanks with seawater. A small amount of seawater had remained within the centre tank. The Skipper then operated the tank discharge pump, expelling the water overboard.

1.3 Crewmember (A) entered the centre tank via the small deck hatch, to collect some fish remnants that had become entangled in the cooling system. While down in the tank he fell to the tank floor close to the ladder.

1.4 An attempt to provide assistance to Crewmember (A) by the other crewmembers was discussed and a potential recovery plan was agreed. One crewmember donned a safety harness and attached a recovery line that was manned by another crewmember. Crewmember (B) entered the tank by descending on the ladder. While trying to assess the condition of Crewmember (A), Crewmember (B) was affected by the atmosphere within the tank. He immediately attempted to climb the ladder to escape. When approximately halfway up the ladder he lost consciousness and was hauled aloft by Crewmember (C) via the line attached to the harness. The Skipper and Crewmember (C) recovered Crewmember (B) to the deck.

1.5 The vessel returned to Port Oriel and rescue services with breathing apparatus recovered Crewmember (A) from the tank. At approximately 16.40 hrs both injured crewmembers were taken to hospital where medical treatment was administered.

Note: Times are local time = UTC + 1 (Co-ordinated Universal Time + 1 hour).

FV Ardent

2. FACTUAL INFORMATION

2.1 Vessel Details

Name:	Ardent.
Licence No:	368485185 (see Appendix 7.1 - Fishing Vessel Licence).
Owner:	Orpen Fishing Company Ltd Derryminhan West Castletownbere Cork, P75 TK44.
Registration Number:	S23.
Port of Registration:	Skibbereen, Co.Cork.
Date of Registration:	14 August 2008.
Length Overall (LOA):	24.02 metres (m).
Registered Length:	19.83 m.
Beam:	8.20 m.
Depth:	6.45 m.
Gross Tonnage (GT):	224.
Engine Capacity:	749 kilowatts (kW).
Engine Make and Model:	Caterpillar 3512.
Build Year:	2007.
Builder:	RIGA Shipyard, Riga, Latvia. Fitted out at VEST VAERFTET ApS. Hvide Sande, Nordhavnskaj, Denmark, Yard No. 262.
Classification:	Bureau Veritas.
Call Sign:	EIBP5.
Common Fleet Register (CFR) Number:	IRL000I13750.
Unique Vessel Identifier (UVI) Number:	9456642.

Type of Vessel: Trawler.

Fleet Segment: Polyvalent (> 18m LOA).

Fishing Vessel Safety Certificate (FVSC) issued on 21 October 2022 by the Marine Survey Office (MSO), under the Merchant Shipping (Safety of Fishing Vessels) (15-24 Metres) Regulations 2007 Statutory Instrument (S.I.) No. 640 of 2007.

See Appendix 7.2 – Fishing Vessel Safety Certificate.

RSW Tanks Capacity: 182 Cubic metre (m^3).

- Centre Tank 73.13 m^3.
- Port Tank 54.15 m^3.
- Starboard Tank 54.66 m^3.

2.2 Crew Details

The crewmembers were all experienced fishers having fished onboard this vessel for some time prior to this trip. The tasks undertaken leading to the events detailed below had been completed numerous times without incident or event noted.

1. Owner/Skipper

   Basic Safety Training, Global Maritime Distress and Safety System (GMDSS) Long Range Certificate (LRC) and GMDSS General Operators Certificate (GOC).

2. Crewmember A

   Bord Iascaigh Mara (BIM) Safety Training Card

3. Crewmember B

   Skipper Certificate of Competency (CoC), BIM safety training Card

4. Crewmember C

   Skipper full CoC issued under the provisions of the Fishing Vessels (Certification of Deck Officers and Engineer Officers) Regulations, 1988. International Maritime Dangerous Goods Code (IMDG Code) Dangerous Goods by Sea Transport, Master near Coastal Area, Restricted to Cargo Vessels <500 GT, Shipboard Safety Officers Course.

Under S.I. No.673 of 2019 Fishing Vessels Certification of Deck Officers and Engineer Officers (Amendment) Regulations 2019 (in force at the time of this casualty). Vessels of 15 m LOA and over to less than 24 m in length require at least one deck officer to be carried onboard holding a minimum qualification of 2nd hand special (Skipper).

This regulation has since been superseded by the European Union (EU) (International Labour Organisation (ILO) Work in Fishing Convention) (Safe Manning) Regulations 2023, S.I. No.315 of 2023 (which came into operation on 1 July 2023) but the vessel complied with the Regulation in force at the time of the casualty.

2.3 Regulations Applicable

Merchant Shipping (Safety of Fishing Vessels) (15-24 Metres) Regulations 2007. S.I. No.640 of 2007.

Safety, Health and Welfare at Work Act 2005.

ILO Code of Practice (CoP) - Accident prevention onboard ship, at sea and in port.

Health and Safety Authority (HSA) Code of Practice for Working in Confined Spaces.

2.4 Safety Equipment (relevant to incident)

The onboard vessel safety statement was provided by the Skipper and an emergency muster list held onboard was posted in the wheelhouse where relevant details were recorded.

Training details were provided to the Marine Casualty Investigation Board (MCIB) by those onboard.

No record of confined or enclosed space training was provided, and the muster list emergency tasks and responsibilities did not include confined space entry details, rescue, and emergency roles/responsibilities.

Atmospheric monitoring systems and rescue equipment required for enclosed space entry and rescue was not provided.

2.5 Voyage Particulars

The FV Ardent paired with FV Cisemair departed from Port Oriel, Clogherhead at approximately 15.05 hrs on 31 October 2022, to commence operations on fishing grounds in the Irish Sea. Having departed the harbour and while underway, the watch was transferred from the Skipper to another crewmember (Crewmember C), allowing the Skipper to conduct the fish tank cleaning in preparation for the

filling and cooling of the seawater within the tanks.

At approximately 15.30 hrs the vessel was turned around to return to Port Oriel and the drive was disengaged by the crewmember on watch while the Skipper and crew dealt with the emergency situation onboard.

When the status of the Crewmember's condition was assessed and the need for assistance confirmed, the vessel reversed course and headed back to Port Oriel.

The vessel was under way at 15.44 hrs (Port Oriel high water (HW) + 30 minutes) and was proceeding at maximum speed of 9.4 knots (kt) in order to enter the harbour before tidal constraints restricted access*.

The vessel was brought alongside and secured with the aid of emergency services shore teams.

*Note: The closest non-tidal port was Drogheda, the straight-line distance to the Boyne river entrance (to access Drogheda port) is approximately 4.7 nautical miles (NM) south of Port Oriel.

2.6 Marine Incident Information

2.6.1 Type: Casualty within the meaning of S.I. No.276 of 2011 - European Communities (Merchant Shipping) (Investigation of Accidents) Regulations 2011 which apply to fishing vessels of greater than 15 m and where *""casualty" means an event, or a sequence of events, that has resulted in any of the following which has occurred directly in connection with the operations of a ship: (a) the death of, or serious injury to, a person;"*.

There was inhalation of toxic gases by two crewmembers causing loss of consciousness requiring hospital treatment.

Date: 31 October 2022.

Time: Circa 15.30 hrs.

Position: 53° 47.100' N, 006° 12.00' W.

Ship Operation: Underway to fishing grounds.

Location: Irish Sea - Ireland.

Human factors:

1. Lack of awareness in relation to confined/enclosed space working.

Physical factors:

1. Toxic gases present within the confines of the centre RSW tank.

2. Oxygen deficiency due to the presence of other gases such as carbon monoxide, hydrogen sulphide, methane, carbon dioxide or escaped refrigerant gas.

Consequences:

Hospitalisation of two crewmembers with one Crewmember remaining in hospital for a number of weeks.

2.6.2 Weather Observation:

Buoy M2 Observations 31-October-2022 Time: 15.00 hrs UTC (see Appendix 7.3 – Met Éireann Weather Report and Buoy M2 Observations).

Wind Direction:	151 degrees.
Mean Wind Speed:	21.4 kts.
Maximum Gust Speed:	27.1 kts.
Significant Wave Height:	2.1 m.
Maximum Observed Wave Height:	3.9 m.
Wave Direction:	175.8 m.
Significant Wave Period:	4.7 seconds.
Sea Temperature:	15°Celsius (C).

Dundalk Weather Station Data - Site ID: 53.9952, -6.3848.

See Appendix 7.4 – Dundalk Weather Station Report.

Air Temperature:	13.9°C.
Humidity:	83%.
Rainfall Accumulation:	0.8 millimetre (mm).
Pressure (at station height):	1004 hectopascals (hPa).

2.6.3 Tide:

Dublin (North Wall) – (see Appendix 7.5 – Tide Data)

High	03:25	@3.5m	Low	09:04	@1.3m
High	15:43	@3.6m	Low	21:52	@1.1m

Tide differences - River Boyne - Entrance.

See Appendix 7.5 – Tide Data.

Latitude N 53° 43’ Longitude W 6° 14’

TIME DIFFERENCES-

High Water: - 0015 – 0009 Low Water: -0001 +0005

HEIGHT DIFFERENCES (IN METRES) PLACE

MHWS	+0.9	MHWN	+0.6
MLWN	+0.2	MLWS	+0.1

2.6.4 Refrigerated Sea Water System:

In the RSW system, seawater is recirculated by pumps through the tanks and the chilling system. Before entering the tanks, the seawater is chilled by the refrigeration equipment. The seawater is distributed evenly over the complete bottom cross-section of the tanks through a set of perforated pipes distribution devices. The chilled seawater passes upwards through the tank and layers of fish, thus keeping the fish semi-floating and simultaneously cooling it. The water returns through suction screens in the top of the tanks to the chilling unit of the system and subsequently, the circulation process is repeated.

Details of the Vessel RSW Plant and Tanks:

- There were three fish tanks/holds (port, centre and starboard) immediately forward of the engine room.
- The system was installed in 2016.
- Two Transvac pumps were also fitted in 2016.
- The system was charged with 60 kilogram (kg) of R404A refrigerant.
- The system was last serviced by the manufacturer in 2021.
- The system was fitted with operational alarms and safety shutdown devices.

(The following details had been recorded by a third party while conducting an RSW Tank Calibration Tables and Survey on 14 September 2016 in Killybegs. Details have been taken directly from the subsequent report dated 19 September 2016).

The vessel is arranged for both wet and dry hold fishing, with bolted doors allowing access between the RSW tanks when the vessel is carrying boxed fish.

The port and starboard tanks are equipped with flush access hatches at the

forward ends, and hatches with raised coamings in the middle of the tank allow for sounding.

The fish suction system comprises of a single vacuum unit, with the fish discharge located on the shelter deck.

The enclosed volume of the seawater pipes, diffusers and the catch suction pipe in each tank have been calculated (but not included in the tank calibration data), these figures are separately below.

Recorded figures for all seawater pipes, catch suction pipes and diffusers within each tank:

	Port m^3	Centre m^3	Starboard m^3
Volume – m^3	0.843	0.929	0.767
% of Tank Volume	1.6	1.3	1.4

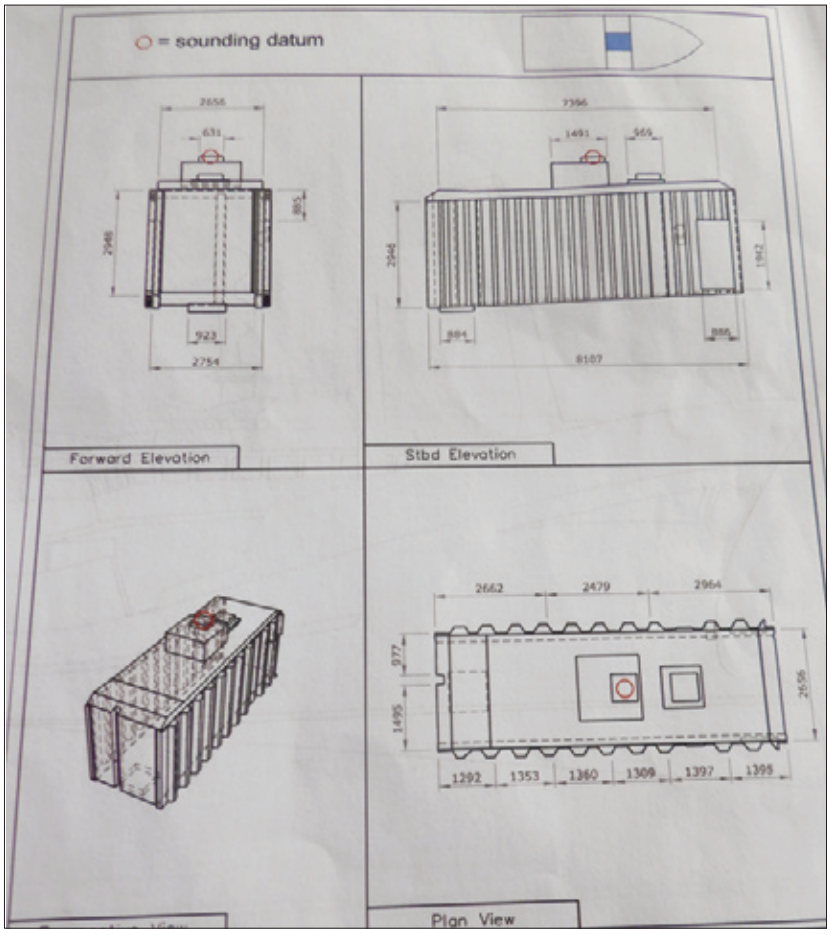


Figure 1- Centre Tank Dimensions and Details

2.6.5 Similar Incident Reports

The following is a list and summary details of similar incidents recorded over the past 25 years.

2.6.5.1 Marine Accident Investigation Board (MAIB) Report No. 19/2020 – Sunbeam

On the 14 August 2018, a second engineer working onboard the trawler, Sunbeam in Fraserburgh, Scotland was found collapsed inside a refrigerated saltwater tank.

The evidence available strongly indicated that the second engineer had entered the tank to sweep away residual water. When he was found, three of his crewmates went into the tank to help him; they all suffered breathing difficulties and one also collapsed. Two other crewmembers then donned breathing apparatus and rescued their struggling crewmates. When rescued from the tank the second engineer could not be resuscitated.

2.6.5.2 MCIB Report No.246/2016 - Oileán an Óir

On the 24 August 2015, two members of the crew from the fishing vessel Oileán an Óir were rescued from inside one of the vessel's RSW tanks, where they had been working to pump out water. Despite the attendance of the emergency services, neither of the crewmembers survived. The MCIB's report of the investigation into the incident concluded that both fatalities were attributed to the inhalation of lethal levels of hydrogen sulphide due to the presence of stagnant water and rotting fish.

2.6.5.3 MAIB Report dated 24 July 1997- Atlantic Princess

On the 25 July 1996, three crewmembers died and six were injured onboard the UK registered fishing vessel Atlantic Princess while attempting to flush and clean an RSW tank. The vessel was fishing of the coast of Mauritania and the accident occurred when the third engineer opened the side door to an RSW tank. Shortly after opening the side door, the third engineer collapsed. Unaware of the reason for the collapse, several of the engineer's colleagues went to his assistance. By the time the crew realised that toxic gases had escaped from the RSW tank, several other crewmembers were overcome. The situation was eventually brought under control but not before three crewmen had suffered fatal effects and six others injured.

2.7 Emergency Response and Shore Response Involvement

1544Z CISEMAIR- Coast Guard Radio (CGR)
Very High Frequency (VHF)
Relay distress message received. Unconscious crewmember.

1545 Marine Rescue Co-ordination Centre (MRCC)- National Emergency Operations Centre (NEOC)
Phone Assistance requested, ambulance to Clogherhead pier.

1548 MRCC – ARDENT
Phone Status update two men down, Clogherhead two NM, Estimated Time of Arrival (ETA) 15 minutes.

1549 MRCC- Coast Guard Unit (CGU)
Phone Task Clogherhead CGU

1551 MRCC- NEOC
Phone Additional ambulance requested and fire service for tank rescue.

1556 MRCC- CGU
Pager alert Task Clogherhead Royal National Lifeboat Institution (RNLI) (stood down 1602).

1601 MRCC- ARDENT
Phone 1200m from harbour, speed 9.4 kts. Ventilating space.

1605 MRCC- CGU
Phone CGU unit on site to assist Casualty vessel coming alongside at pier landing berth, ambulance on scene.

1615 CGU- NEOC
Phone 2nd ambulance on scene.

1617 MRCC- NEOC
Phone Fire service ETA ten minutes.

1707 CGU- MRCC
Phone Both casualties conscious and talking. They have been transferred to the care of the Health Service Executive (HSE).

3. NARRATIVE

3.1 Vessel Operations

The FV Ardent operates as a pair seine trawler with an additional similar/suitable vessel. Pair pelagic trawling is a method of towing a trawl in mid-water i.e., at any point in the water column between the surface and seabed. It is generally, used to target shoaling species such as mackerel, herring, and sprat. The net is towed by two vessels, one towing each side of the net. The net's horizontal opening being set by the distance between the two vessels. This is monitored using the vessels' monitoring systems. The net is opened vertically by the use of weights placed on each lower wing end and by the upward pull of the upper warp. Some pelagic trawls will have floats on the headline to assist with the vertical opening. Normally, in pelagic pair trawl, the vessels will tow the trawl on two warps from each boat, one going to the top (headline) of the net, the other to the footrope (bottom). By slight alterations in the length of the warp to the top of the net compared to that of the lower warp, the net can be made to alter shape, and move up or down in the water column to some degree. However, the general position within the water column is controlled by the towing speed. When the catch comes onboard, it will pass through a water separator, the surplus water flows directly back overboard, and the fish will be channelled into large RSW tanks for storage. The vessels will later pump their catch straight from the tanks to the shore-based transport.

3.2 Pre-departure

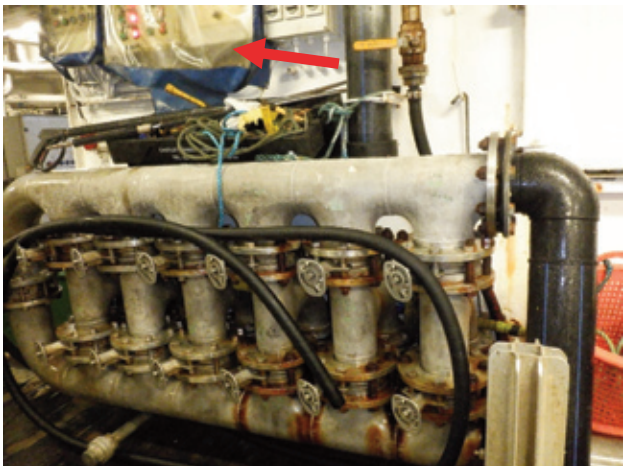
Earlier on the day of the incident Crewmember (A) had gone to collect provisions for the FV Ardent with the Skipper of the pair vessel. They returned at approximately 13.30 hrs and the provisions for the trip were placed onboard both vessels. At approximately 14.40 hrs the crew assembled onboard the FV Ardent and discussed the upcoming fishing trip. The crew of four then prepared the vessel for departure. At approximately 15.05 hrs the mooring lines were released and taken onboard and the FV Ardent departed Port Oriel for the fishing grounds 17 NM east of Clogherhead.

3.3 Incident - Casualty No. 1

3.3.1 At approximately 15.20 hrs Crewmember (C) took the helm and watchkeeping duties, allowing the Skipper to undertake preparation tasks. The Skipper departed the wheelhouse and went forward with Crewmember (A) to prepare the tanks in order to receive the catch.

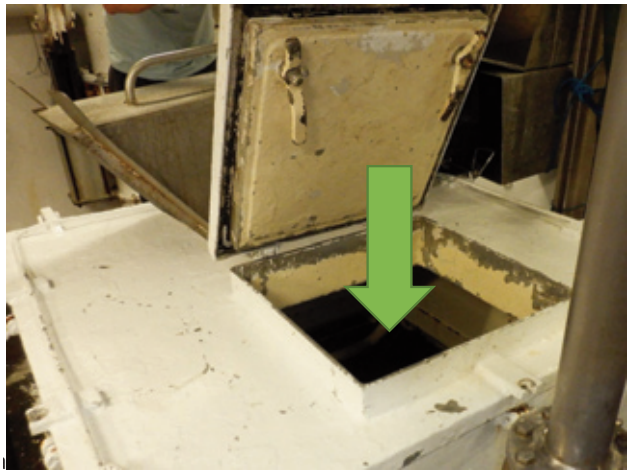
The standard procedure was to flush all tanks, prior to adding seawater, with the centre tank first to have the required quantity of seawater added (seawater temperature was 13°-14°C at the time of the incident). The water is then pumped through a heat exchanger mounted on the main deck, cooling the water down to -1°C/-4°C. When the seawater in the centre tank is chilled it will be used to store the initial catch.

The outboard tanks were first to be cleaned with the Skipper opening the required valves (Picture No.1) and operated the pump to flush water into the tanks. The flushing requires the pumping of water to the upper and then lower diffuser while discharging the water via a bilge pump fitted in the engine compartment but operated via the deck panel (red arrow Picture No.1).



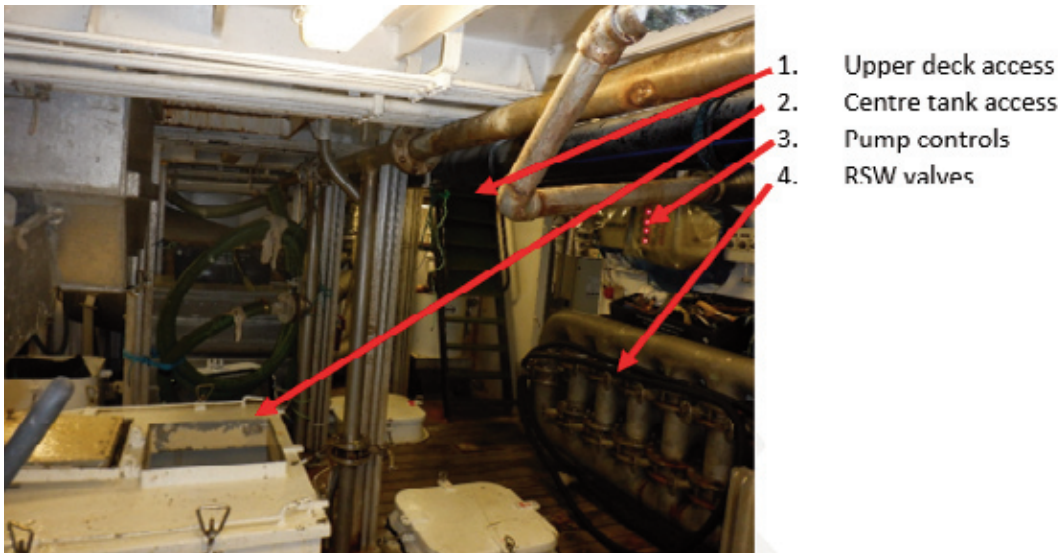
Picture No.1 Valve Chest

3.3.2 Noticing a number of fish that remained within the starboard tank. Crewmember (A) entered the tank via the ladder access hatch in order to remove these fish remnants that had become impaled or stuck on the refrigeration system pipes. Carrying a yellow bucket Crewmember (A) descended the ladder and collected the fish and other material and then exited the tank via the ladder. Crewmember (A) had to wait on deck with the Skipper while the remaining water was pumped from the centre tank. When the remaining water had been discharged by the Skipper who was standing on the deck just forward of the main deck hatch, Crewmember (A) then entered the centre tank via the ladder access hatch (as indicated by the green arrow in Picture No.2). Carrying the yellow bucket, he descended the ladder to remove a number of fish that remained.



Picture No.2 Centre Tank Access Hatch

3.3.3 Noticing a number of fish on the tank sump Crewmember (A) proceeded to the aft section of the tank passing below the internal tank boards to collect the remaining fish and material. Having collected three to five fish, Crewmember (A) then proceeded forward to exit via the tank ladder that is approximately five metres away from the tank aft bulkhead. While passing below the baffle boards in the centre of the tank Crewmember (A) placed the bucket on the tank floor. While maintaining contact with the bucket handle, he lowered his upper body and head towards the bucket, placing some weight on the handle for support while passing below the boards. Maintaining a hold on the bucket Crewmember(A) then stood upright. When standing upright Crewmember (A) immediately knew something was wrong and he was in trouble and noted *"feeling a burning sensation in his head"*. Crewmember (A) attempted to reach the ladder while calling for assistance from the Skipper on the deck above. At this point Crewmember (A) lost consciousness.



Picture No.3 RSW Tank Access and Valve Chest

3.3.4 The Skipper had gone forward to the refrigeration plant room/compartment to disengage the RSW pump via the controls panel (that is approximately 3.5 m from the tank access hatch). As the Skipper exited the refrigerated plant room, he heard a noise of something falling originating from the centre tank and he returned to the tank access hatch (see Picture No.3). Looking down the Skipper noted Crewmember (A) lying adjacent to the starboard side of the ladder (see Picture No.4). The Skipper then called for assistance from the other crewmembers, who joined him at the tank access hatch. Being aware there may be a lack of oxygen within the space and the possibility of gases, an attempt to ventilate the area was initiated. All three tank covers, and a number of deck hatches and vents were opened to increase the volume of air flowing below the shelter deck and into the tank space. Crewmember (C) advised against entering the tank due to the lack of appropriate Personal Protective Equipment (PPE) and

suitable recovery equipment but was overruled. Crewmembers (B) prepared to access the tank in order to assess the condition of Crewmember (A).

Picture No.4 Position of Crewmember (A)-Red arrow

3.3.5 The Skipper proceeded to the wheelhouse and requested that the partner vessel FV Cisemair contact the emergency service as he was dealing with the situation onboard.

3.4 Incident - Casualty No. 2

3.4.1 Crewmember (B) went to the stern of the vessel in order to collect a safety harness that is stowed there. Crewmember (B) then donned the harness and attached a safety line (rope) that would be manned by Crewmember (C). Crewmember (C) then secured the single purchase block and tackle to the lower inner face of the main upper deck hatch. Crewmember (B) entered the tank via the ladder with Crewmember (C) maintaining a hold of the recovery line. When standing on the tank floor, Crewmember (B) noted that Crewmember (A) was breathing, and Crewmember (B) bent down in order to attempt a recovery. When Crewmember (B) lowered his head he *"noted a sensation or smell"* and immediately attempted to exit the tank via the ladder close by. While climbing the ladder he collapsed, stating that *"the sensation was drifting off the ladder rather than falling"*. Crewmember (B) at that point believed that he had reached the hatch cover but looked up towards Crewmember (C) and noted that he was being held just below the hatch coaming. At this point Crewmember (B) lost consciousness. Crewmember (C) was holding the weight of Crewmember (B), but due to the single purchase on the recovery line he was unable to retrieve Crewmember (B) from the tank. Realising that Crewmember (B) was now in a precarious position within the safety harness and at risk of falling and

he alone would be unable to complete the recovery, Crewmember (C) called the Skipper to assist in the recovery. When the Skipper arrived back on deck, both he and Crewmember (C) recovered Crewmember (B) to the lower deck, placing him in the recovery position in an area of the deck that had a sufficient air flow from the open upper deck hatch.

3.4.2 The Skipper returned to the wheelhouse to helm the vessel into port. Crewmember (C) applied restraints to Crewmember (B) fearing that he may attempt to stand up or go to the aid of Crewmember (A). Crewmember (C) then communicated to Crewmembers (A and B) that they were entering the harbour. He then went onto the upper deck to prepare the lines for the vessel coming alongside the pier in Port Oriel.

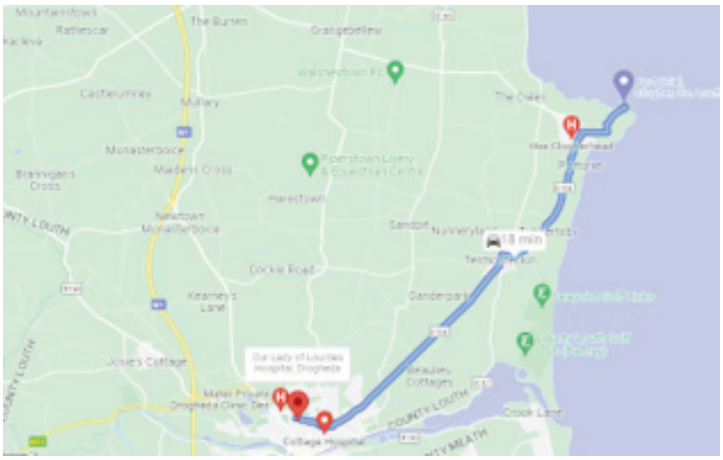
3.5 Recovery

3.5.1 The FV Ardent arrived in Port Oriel and was secured alongside at 16.05 hrs. The emergency services were waiting on the quay wall and included the ambulance, Coast Guard and RNLI personnel. The emergency service personnel that initially boarded the vessel were not equipped with suitable breathing apparatus to enter the tank space. Some wanted to attempt a recovery and enter the hold without breathing apparatus, but the emergency medical personnel advised against this. At this time, it was noted that Crewmember (A) was experiencing spasms while lying on the tank floor. While awaiting the arrival of the fire service, ropes were prepared, and a recovery stretcher was lowered in preparation for the recovery of the Crewmember from the tank. Crewmember (B) was assisted from the vessel; his skin was pale and had a blue hue at this time (as noted by Crewmember (C)). Oxygen was being administered and he was reassured by those who were assisting him ashore. He was then placed in the waiting ambulance in order to monitor his condition.

3.5.2 At 16.17 hrs the fire brigade arrived on scene, and they were informed of the condition of Crewmember (A), and that he was still breathing. The fire brigade deployed two personnel with breathing apparatus and wearing safety harnesses with recovery lines attached and they entered the tank to conduct a “snatch” rescue. An oxygen kit supplied by the waiting ambulance was lowered into the tank space and the oxygen free flow mask placed on the Casualty. An additional member of the fire brigade was deployed into the tank, and the Casualty was rolled onto his back in preparation for placing him on the stretcher. Crewmember (A) was then placed on the stretcher by the fire service personnel and the oxygen bottle was secured. With ropes attached to each corner the available rescue services personnel on the deck then recovered the stretcher from the hold and onto the lower deck and then carried it to the upper (open) deck. While on the upper deck Crewmember (A) was checked by the emergency medical personnel prior to being placed in the ambulance.

3.5.3 At 16.42 hrs both ambulances departed from the pier and both casualties were

taken to the nearest accident and emergency department approximately 13.7 kilometre (km) (18 minutes) away, see below.



3.6 Site/Compartment Atmosphere

3.6.1 The station officer in charge of the fire service personnel on scene reported that a strong ammonia-type smell was noted during the rescue. This odour was also noted when they returned to the fire tender, and on return to station all the PPE donned during the recue was removed from use and sent for cleaning.

3.6.2 At 14.40 hrs on 1 November 2022 extensive compartment atmosphere testing was conducted by a competent consultant/contractor. This task was undertaken at the request and under the direction of the HSA. The HSA confirmed that the consultants carried out atmospheric testing onboard the vessel, including in the fish tanks and in the engine room. All measurements for hydrogen sulphide and carbon monoxide were zero. The oxygen levels were normal, and no adverse readings were observed by the consultants.

4. ANALYSIS

4.1 Safety Statement/Risk Assessment

Under the Safety, Health and Welfare at Work Act 2005 there is a requirement on the vessel owner to review and provide details of any foreseeable hazards and the associated risks posed to their employee/crew. On the 6 November 2022 a safety statement was provided to the MCIB. It was dated the 17 March 2019 and had been signed by the Owner/Skipper. A copy of the relevant details from the vessel risk assessment have been attached.

See Appendix 7.6 – Vessel Risk Assessment Document.

Many sections of the generic risk assessment have been addressed with control measures detailing the specific onboard risks. Whilst the risks were identified, relating to the section "Gases/Chemicals" on page six of the Risk Assessment Document, the controls and actions required to mitigate the risk within this section of the document had not been completed with the necessary details and remained blank.

Also on page six, under the heading "Types of Hazards" the document contains the section "Enclosed unventilated spaces" that lists some example risks including – poisoning/suffocation. Again, the hazard details and control measures had not been recorded and this section was found to be blank.

4.2 Refrigeration System Monitoring and Alarms

The vessel was fitted with a gas monitoring/alarm system with sensors fitted in the spaces containing refrigeration equipment. The alarm panel in the wheelhouse contained audio/visual alarms for the cooler and RSW room (see Appendix 7.9 – Additional Photographs Picture No.7).

The RSW refrigeration system was monitored and fitted with alarms to indicate system failure or operational alarm status state. On review of the refrigeration system data logger page on the status screen, no alarm status or fault was noted on the 31 October 2022 (see Appendix 7.9 – Additional Photographs Picture No.5 and No.6).

Failure due to gas leakage or loss would trigger the system operational protection controls requiring manual by-pass leading to machinery failure or damage.

4.3 Safety, Health and Welfare at Work Act 2005

Section 19 requires that employers and *"those who control workplaces to any extent"* must identify the hazards in the workplaces under their control and

assess the risks to safety and health at work presented by these hazards.

Section 20 of the Safety, Health and Welfare at Work Act 2005 requires that an organisation produce a written programme to safeguard the safety and health of employees while they work and also the safety and health of other people who might be at the workplace, including customers, visitors and members of the public.

The Act also specifies the information that must be given to employees. The Safety Statement must be accessible to all employees and the sections of the Safety Statement relevant to the employees must be brought to their attention, with particular regard to the specific hazards, risks and prevention measures concerning their particular job.

4.4 Safety Regime

4.4.1 Enclosed/Confined Space

Due to the configuration and location of the tanks with the limited access and egress points and inadequate ventilation, the term enclosed space would be applicable to these areas.

The incident occurred when the Skipper and Crewmember were removing fish/waste product trapped in various locations within the fish hold/tank with limited airflow via the deck coaming access hatch.

Gas/vapours that are heavier than air may accumulate in enclosed spaces, particularly at or below deck level.

4.4.2 The Safety, Health and Welfare at Work (General Application) Regulations 2007 state that:

"Ventilation of enclosed places of work.

6. An employer shall ensure that—

(a) sufficient fresh air is provided in enclosed places of work, having regard to the working methods used and the physical demands placed on the employer's employees,

(d) any deposit or dirt likely to create an immediate danger to the safety and health of employees by polluting the atmosphere is removed without delay."

This incident occurred when the Skipper and Crewmember were removing waste product trapped in various locations within the fish hold/tank.

4.4.3 The HSA "Code of Practice for Working in Confined Spaces" states that:

"The term CONFINED SPACE means any place, including any vessel, tank, container, vat, silo, hopper, pit, bund, trench, pipe, sewer, flue, well, chamber, compartment, cellar or other similar space which, by virtue of its enclosed nature creates conditions which give rise to a likelihood of accident, harm or injury of such a nature as to require emergency action due to:

(a) The presence or reasonably foreseeable presence of:

(i) flammable or explosive atmospheres,

(ii) harmful gas, fume or vapour,

(iii) free flowing solid or an increasing level of liquid,

(iv) excess of oxygen,

(v) excessively high temperature.

(b) The lack or reasonably foreseeable lack of oxygen.

The following are key characteristics of a 'confined space' for the purposes of this Code of Practice.

- *The space must be substantially enclosed.*
- *There must be a risk of at least one hazard of the type, listed in the definition above, occurring within the space.*
- *The risk of serious injury from the hazard must be created by virtue of the enclosed nature of the space.*
- *The potential injury must be serious and be such as to require emergency action to rescue the person involved.*

Types of Injury

The types of injury relevant to this Code of Practice include:

(a) Injury arising from fire and explosion.

(b) Loss of consciousness or asphyxiation arising from harmful gas, fume, vapour, free flowing solids or the lack of oxygen.

(c) Drowning arising from an increase in the level of a liquid.

(d) Loss of consciousness arising from an increase in body temperature."

4.4.4 The Merchant Shipping (Safety of Fishing Vessels) (15-24 Metres) Regulations 2007. S.I. No.640 of 2007 apply to this vessel as the FVSC issued by the MSO is

based on the registered length (the Fishing Licence issued by BIM is based on the LOA 24.02 m). Regulation 62 of the 2007 Regulations provides as follows:

"62 Refrigeration systems for the preservation of the catch

(4) (b) Any space containing the refrigerating machinery including condensers and gas tanks shall be fitted with a leak detection system having an indicator outside the space adjacent to the entrance and shall be provided with an independent ventilation system and a water spray system.

(6) (a) Where any refrigerant harmful to persons is used in a refrigeration system, at least 2 sets of breathing apparatus shall be provided, one of which shall be placed in a position not likely to become inaccessible in the event of leakage of refrigerant.

(b) Breathing apparatus provided as part of the vessel's fire-fighting equipment may be considered as meeting all or part of this provision provided its location meets both purposes.

(c) Where self-contained breathing apparatus is used, a spare cylinder shall be provided for each apparatus.

(7) At least one crew member, but preferably 2, shall be trained in the use of breathing apparatus.

(8) Adequate guidance for the safe operation and emergency procedures for the refrigeration system shall be provided by suitable notices displayed on board the vessel."

Note: There is no statutory requirement for this size of vessel to be provided with breathing apparatus as part of the vessel's firefighting equipment. R-404A is low in acute toxicity and is not regarded as harmful to persons unless released into an enclosed/confined space when oxygen levels in air are reduced to 12-14% by displacement.

"PART 6 PROTECTION OF THE CREW

General protective measures.

102. (1) Owners shall ensure that their vessels are operated without endangering the safety and health of the crew.

(2) The crew shall be given training and instructions on health and safety matters on board fishing vessels, and in particular, on accident prevention.

Dangerous areas.

(3) Any working area, designated by the skipper as dangerous or requiring extra care, shall be brought to the attention of the crew at regular briefing sessions on safety and to each new crew member on joining a vessel.

Miscellaneous.

(3) (a) A portable gas detector shall be carried on board all fishing vessels that carry fish in bulk in their holds to enable the crew to ascertain whether it is safe to enter the fish-holds.

b) A portable gas detector to test for leakage of refrigerant shall also be carried in a fishing vessel fitted with refrigeration machinery.

4) (a) All members of the crew shall be informed of all measures to be taken regarding health and safety on board the vessel."

4.5 Enclosed Space Atmosphere/Possible Conditions

As stated in section 3.5.1 during the rescue recovery operation, those fire personnel entering the tank were not equipped with gas monitors. The subsequent follow-up testing carried out by the HSA on 1 November 2022 resulted in no established indication in relation to possible toxic gas or oxygen level present at that time.

The following list contains the gases that feasibly could be present in RSW tanks:

4.5.1 Hydrogen Sulfide *(H2S)*

Sources Hydrogen Sulfide *(H2S)* is a colourless gas, soluble in various liquids including water and alcohol. It can be formed under conditions of deficient oxygen, in the presence of organic material and sulfate. Most of the atmospheric hydrogen sulfide has natural origins.

Routes of Exposure: The respiratory system is the main route of human exposure to hydrogen sulfide both in workplaces and in the ambient air.

Effects on Humans

In its acute form, hydrogen sulfide intoxication is mainly the result of action on the nervous system. At concentrations of 15 milligrams (mg)/m^3 and above, hydrogen sulfide causes conjunctival irritation, because sulfide and hydrogen sulfide anions are strong bases. Hydrogen sulfide affects the sensory nerves in the conjunctivae, so that pain is diminished rapidly, and the tissue damage is greater. Serious eye damage is caused by a concentration of 70 mg/m^3. At higher concentrations (above 225 mg/m^3, or 150 parts per million (PPM)), hydrogen sulfide has a paralysing effect on the olfactory perception, so that the odour can no longer be recognised as a warning signal. At higher concentrations, respiratory irritation is the predominant symptom, and at a concentration of

around 400 mg/m^3 there is a risk of pulmonary oedema. At even higher concentrations there is strong stimulation of the central nervous system, with hyperpnoea leading to apnoea, convulsions, unconsciousness, and death. At concentrations of over 1400 mg/m^3 there is immediate collapse. In fatal human intoxication cases, brain oedema, degeneration and necrosis of the cerebral cortex and the basal ganglia have been observed.

Dose-effect and Dose-response Relationship

The first noticeable effect of hydrogen sulfide at low concentrations is its unpleasant odour. Conjunctival irritation is the next subjective symptom and can cause so-called "gas eye" at hydrogen sulfide concentrations of 70-140 mg/m^3. Table 1 shows the established dose-effect relationships for hydrogen sulfide.

Table Hydrogen sulfide: established dose-effect relationships

Hydrogen sulfide concentration		Effect
mg/m^3	ppm	
1400-2800	1000-2000	Immediate collapse with paralysis of respiration
750-1400	530-1000	Strong CNS stimulation, hyperpnoea followed by respiratory arrest
450-750	320-530	Pulmonary oedema with risk of death
210-350	150-250	Loss of olfactory sense
70-140	50-100	Serious eye damage
15-30	10-20	Threshold for eye irritation

Source – © WHO Regional Office for Europe, Copenhagen, Denmark, 2000

Also - Hydrogen Sulphide Brief Profile – European Chemicals Agency (ECHA).

See Appendix 7.7 – Hydrogen Sulphide Brief Profile – ECHA (section only).

4.5.2 Ammonia (NH3)

Ammonia is a colourless, reactive gas that is lighter than air (approximately half as heavy) which dissolves readily in water. Ammonia has a strong smell, similar to urine, which can be detected by most people even in small amounts.

Ammonia in the environment can occur naturally at low levels when released from the breakdown of organic waste matter. Local concentrations may be elevated where there is a lot of animal waste/product. When compressed ammonia gas escapes and comes into contact with moisture in the air it may form an ammonia fog. This fog is likely to remain low to the floor and could prevent ammonia gas from rising in the air.

Routes of Exposure: Exposed to ammonia by breathing or ingesting the substance, or by skin or eye contact with it.

Effect of Ammonia: Breathing in low levels of ammonia may cause irritation to the eyes, nose and throat. High levels of ammonia may cause burns and swelling in the airways, lung damage and can be fatal. The adverse health effects depend on several factors, including the exposure level/amount, the method of exposure, the duration of exposure, the form of the chemical.

4.5.3 Carbon Monoxide (CO)

Carbon monoxide is a poisonous, colourless, odourless and tasteless gas. It is a non-irritant gas that is lighter than air and is very slightly soluble in water.

Routes of Exposure: The respiratory system is the main route of human exposure to carbon monoxide, and it is quickly absorbed into the bloodstream from the lungs.

Effect of Carbon Monoxide: It combines with haemoglobin in the blood to form carboxyhaemoglobin. This reduces the ability of the blood to carry oxygen around your body and it robs the heart, brain and other vital organs of oxygen. Effects depend on factors including concentration levels and how long you are exposed. Carbon monoxide poisoning can be reversed if it is caught in time. Long term exposure to low levels of carbon monoxide may produce heart disease and damage to the nervous system. Carbon monoxide is a category 1 reproductive toxin. This means that the substance is known to be toxic for human reproduction.

4.5.4 Freon 404/A -Refrigerant

Freon™ 404A (R-404A) is a blended hydrofluorocarbon (HFC) refrigerant comprised of R-125, R-134a, and R-143a. It is used in commercial refrigerator equipment for low and medium temperature ranges. Its properties make it ideal for use in display cases, refrigerated vehicles, ice makers, and other applications.

Freon™ 404A is a non-flammable, low toxicity refrigerant that carries an ASHRAE A1 safety classification.

Freon™ 404A is a gas that is colourless and has a slight, ether-like odour.

Routes of Exposure: Inhalation via the respiratory system is the main route of human exposure.

Effect of Freon: Chronic effects, systemic toxicity- accidental or intentional inhalation may cause death without warning symptoms, due to cardiac effects. Other symptoms potentially related due to accidental inhalation or abuse are: anaesthetic effects, light-headedness, dizziness, confusion, incoordination, drowsiness, or unconsciousness, irregular heartbeat with a strange sensation in

the chest, heart thumping, apprehension, feeling of fainting, dizziness or weakness.

Freon™ 404A SDS (safety data sheet):

"Section 6: Accidental release measures

6.1 Personal precautions, protective equipment, and emergency procedures

Personal precautions: Evacuate personnel to safe areas. Avoid skin contact with leaking liquid (danger of frostbite). Ventilate the area. Follow safe handling advice and personal protective equipment recommendations.

6.2 Environmental precautions

Environmental precautions: Avoid release to the environment. Prevent further leakage or spillage if safe to do so. Retain and dispose of contaminated wash water.

6.3 Methods and material for containment and cleaning up.

Methods for cleaning up: Ventilate the area. Local or national regulations may apply to releases and disposal of this material, as well as those materials and items employed in the clean-up of releases. You will need to determine which regulations are applicable."

See Appendix 7.8 – Freon 404A Safety Data Sheet – SDS (sections only).

4.5.5 Hydrogen Cyanide

Hydrogen cyanide is a colourless or light blue liquid or gas and is extremely flammable. It has a faint bitter almond odour, though not everyone is able to detect this. Other names for hydrogen cyanide include prussic acid and hydrocyanic acid.

Exposure to hydrogen cyanide can be by breathing, eating, or drinking the substance or by skin or eye contact with it. Following exposure to any chemical, the adverse health effects a person may encounter depend on several factors, including the amount to which you are exposed (dose), the way you are exposed, the duration of exposure, the form of the chemical and if you were exposed to any other chemicals.

Effect of Hydrogen Cyanide: It prevents the body from using oxygen properly. Early signs of exposure to hydrogen cyanide include headache, a feeling of sickness, dizziness, confusion and drowsiness. Substantial exposure may rapidly lead to unconsciousness, fits, coma and possibly death. If a substantial exposure is survived, there may be long-term effects from damage to the brain and other nervous system damage.

4.5.6 Oxygen Deficiency

Low oxygen levels (oxygen deficiency) and the associated hazards can arise within any enclosed compartment or spaces.

Oxygen deprivation can cause instant loss of consciousness.

Certain chemical reaction can cause low oxygen levels or dangerous gases to build up, for example the decay of waste product or other organic material, one common source is corrosion or rusting, which can significantly reduce the oxygen content in a compart or space. Released organic gases may replace the oxygen at different levels depending on its density.

4.6 International Labour Organization and Health and Safety Authority Codes of Practice

4.6.1 ILO Code of Practice -Accident Prevention on Board Ship at Sea and in Port.

Section 10. Entering and working in enclosed or confined spaces, states:

"10.1.3. Any enclosed or confined space may have an atmosphere deficient in oxygen, and/or contain flammable or toxic fumes, gases, or vapours, thus presenting a major risk to health or life for anyone entering it.

10.4.4. The space should be thoroughly ventilated by natural or mechanical means, to ensure that all harmful gases are removed, and no pockets of oxygen-deficient atmosphere remain.

10.5. Testing the atmosphere of confined and enclosed spaces.

10.5.1. Only persons trained in the use of the equipment should test the atmosphere of a space.

10.5.2. Equipment should be properly calibrated before use.

10.5.3. Testing of the atmosphere should be carried out before entry and at regular intervals thereafter.

10.5.6. Personal monitoring equipment designed purely to provide a warning against oxygen deficiency and hydrocarbon concentrations should not be used as a means of determining whether a dangerous space is safe to enter."

4.6.2 Health and Safety Authority Code of Practice for Working in Confined Spaces

In relation to the emergency and rescue procedures the CoP states the following:

"7.2 Training

Any person, who has a role to play in carrying out emergency arrangements, must have received appropriate instruction and training to enable him or her to perform that role effectively. The level of training required, whether basic or advanced, formal or informal, will vary according to the complexity and skill content of the role. Refresher training should be provided as often as necessary to maintain an acceptable level of competence."

4.7 International Maritime Organization - Atmosphere Testing

IMO MSC.1/Circ.1477 provides guidelines for the selection of portable atmosphere testing equipment capable of testing and displaying concentrations of oxygen, flammable gases or vapours (% of LFL – lower flammable limit), Carbon Monoxide, and Hydrogen Sulphide.

Once other risks are discounted, a steady reading of at least 20% oxygen by volume should be obtained before entry is permitted.

The following four conditions should be tested as a minimum in all spaces.

Oxygen (O2) content	At least 20% by volume
Flammable gas content	Nil NB: Where readings have been steady for some time, up to 1% of the lower flammable limit (LFL) may be acceptable in conjunction with a 20% oxygen level but ZERO is preferrable
Carbon Monoxide	Content is less than: **100ppm** short-term exposure limit (STEL): maximum exposure is 15 minutes **20ppm** time weighted: maximum exposure is 8 hours
Hydrogen Sulphide	Content is less than: **10ppm** STEL: maximum exposure is 15 minutes* **5ppm** time weighted: maximum exposure is 8 hours*
Toxic gases	Less than 50% of the WEL*

4.8 Marine Notices

4.8.1 In MCIB investigation No.246, published on 1 September 2016, the MCIB made the following two Safety Recommendations:

"6.1. It is recommended that the Minister for Transport, Tourism and Sport issue a Marine Notice warning crews on fishing vessels of the hazards associated with toxic gas generation and retention in RSW systems and that a notice highlighting these dangers be displayed on vessels fitted with RSW systems. It is recommended that the Marine Notice may include details on enclosed space entry techniques, raising awareness of calibrated atmospheric monitoring systems, either permanent or hand held and rescue techniques.

6.2. It is recommended that the Minister for Transport, Tourism and Sport considers mechanisms to address the safety in respect of design, construction and operation of RSW systems and the generation of toxic gases as in this case."

As a result, Marine Notice (MN) No. 43 of 2016 was issued (which followed MN No. 24 of 2009). A further reminder about this MN was issued as part of MN No. 49 of 2019 on Fishing Vessel Safety.

4.8.2 MN No.43 of 2016 and MN No.24 of 2009 advise that:

- Entry into enclosed or unventilated spaces should only occur after the space has been tested for toxic or suffocating gases. *"Owners and Skippers of vessels fitted with Refrigerated Sea Water Systems should ensure that notices are displayed onboard highlighting the dangers."*

4.8.3 The IMO published Resolution A.1050(27) "REVISED RECOMMENDATIONS FOR ENTERING ENCLOSED SPACES ABOARD SHIPS", adopted on 30 November 2011, which specifically refers to "Safety Management for entry into enclosed spaces" and "Assessment of Risk". As a result of these recommendations, when related to fishing vessels:

- *"The Owner and Skipper should ensure that the procedures for entering enclosed spaces are included among the key shipboard operations concerning the safety of the personnel and the vessel."*

4.8.4 The IMO practice is provided for in IMO Resolution MSC.350(92) (adopted on 21 June 2013) which deals with New Drills Requirements from 1 January 2015. These require that:

Crewmembers with enclosed space entry or rescue responsibilities will be required to participate in an appropriate drill to be held onboard the ship at least once every two months.

Each enclosed space entry and rescue drill must include:

Checking and use of:

- PPE required for entry
- communication equipment and procedures
- instruments for measuring the atmosphere in enclosed spaces
- rescue equipment and procedures; and
- instructions in first aid and resuscitation techniques.

4.8.5 The MNs do not refer to 2015 best practice set out in IMO Resolution MSC.350(92).

5. CONCLUSIONS

5.1 The FV Ardent discharged fish on the 25 October 2022 in Ardglass, Co. Down and system flushing was carried out on the 25 and 26 October. It appears that some product/material remained within the RSW system piping or tanks.

5.2 Additional tank cleaning and preparation was conducted on the 31 October and during this process a mixture of fish product and seawater containing soluble gas was released into the centre tank space. The liquid surface area and agitation of the material that remained in the system aided the release of gases into the tank space.

5.3 Hydrogen sulphide occurs as a gas in water, it can be released by cascading or bubbling. The circulation of seawater within the tank while flushing allowed the water to flow from the diffusers at various heights.

5.4 In order to enter enclosed spaces, the appropriate planning and control measures must be implemented and recorded to ensure all crew are aware of the hazards within these areas or compartments.

5.5 The relevant precautions, actions and emergency equipment needed, must be prepared prior to entering or undertaking work within any compartments that may be viewed as an enclosed space. The space must be properly ventilated by means of a fan or air hose.

Standard procedures and controls should include:

5.5.1 Space to be properly ventilated with fresh air. Effective ventilation including mechanical ventilation to be used as necessary.

5.5.2 Atmospheric monitoring to be carried out prior to entering and while personnel are in the compartment or space.

5.5.3 Procedures and arrangements for rescue and the wearing of suitable recovery apparatus.

5.5.4 Awareness and training for persons who may enter the compartment or space.

5.6 The MAIB commissioned research into the toxic gases produced by fish as they decay, the study revealed that:

5.6.1 Temperature influences the level of toxic gases produced by decaying fish in seawater.

5.6.2 At 45°C, a “half and half” mix of rotting fish and seawater produced dangerous levels of hydrogen cyanide, hydrogen sulphide and carbon dioxide after only 24 hours.

5.6.3 At 35°C, similar results to 45°C were obtained.

5.6.4 At 20°C, a "half and half" mix of rotting fish and seawater produced dangerous levels of hydrogen cyanide, hydrogen sulphide and carbon dioxide after just 64 hours.

5.6.5 At 5°C, only traces of the three gases were measured after ten days.

- Source Maritime and Coastguard Agency - MGN 663 (F) Enclosed space entry on fishing vessels. Published 21 March 2023.

  https://www.gov.uk/government/publications/mgn663-f-enclosed-space-entry-on-fishing-vessels/mgn663-f-enclosed-space-entry-on-fishing-vessels

5.7 Probable Source of Asphyxiation

A mixture of rotting fish and seawater was held within sections of the RSW system piping, cooler and valve chest below the shelter-deck over a prolonged period (approximately 150 hrs), at a temperature of approximately 15°C. This produced dangerous levels of toxic gases that may have included: hydrogen sulphide, ammonia, hydrogen cyanide or carbon dioxide.

When the mixture was released during the system cleaning and preparation, via the RSW system upper & lower diffuser, the soluble gas within the liquid was released due to the liquid cascading.

The remaining water was discharged overboard, trapping the released gases that were heavier than air, at lower levels within the tank.

Both Casualties were overcome by the toxic atmosphere when they lowered their heads into the toxic pool. The first Casualty was overcome while passing below the tank centre boards. The second Casualty was overcome while checking the condition of the first Casualty who was lying on the tank floor.

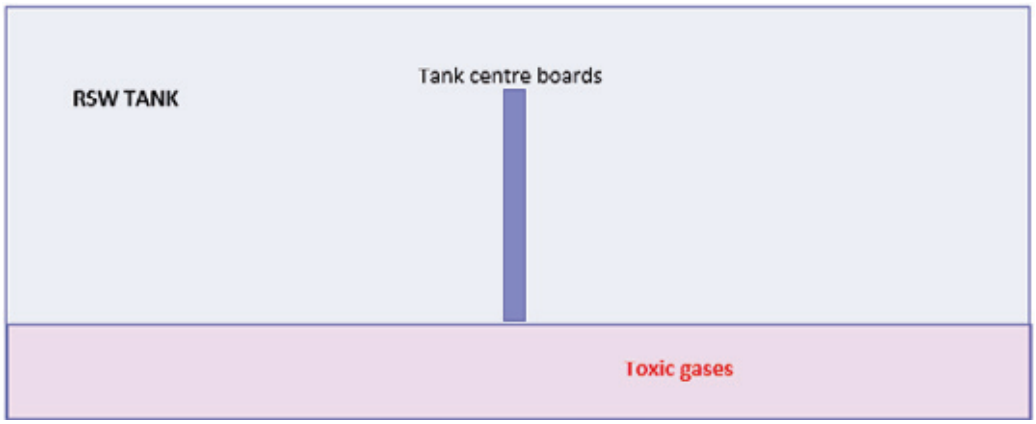


Figure 2 Gas Pooling Within a RSW Tank (for illustration only)

The actions taken by the crewmembers including the opening of additional hatches and vents would have provided additional ventilation below decks (see Appendix 7.9 – Additional Photographs Picture No.8 and No.9).

The vessel did not carry any enclosed space rescue equipment or breathing apparatus.

An attempted recue/recovery was initiated, and a safety harness was donned by a crewmember, and he was attached to a recovery rope manned on deck. While this aided his recovery from within the tank, the condition and suitability of the harness in use was suspect.

This incident could have had far more serious outcome but for proximity and response of the emergency services, the short distance to the accident and emergency department along with some of the actions taken by the crew onboard.

During the visit to the vessel on the 6 November 2022, the investigator was shown a new personal gas monitor that had been placed onboard along with a suitable safety harness that was inspected and tagged as valid for six months.

6. SAFETY RECOMMENDATIONS

6.1 a) It is recommended that the Minister for Transport should review the content of Marine Notice No.43 of 2016 and Marine Notice No.24 of 2009 and issue an updated Marine Notice warning crews on fishing vessels of the hazards associated with toxic gas generation and retention in Refrigerated Sea Water systems and that a notice highlighting these dangers be displayed on vessels fitted with Refrigerated Sea Water systems.

b) It is recommended that the Marine Notice should include details on enclosed space entry techniques, raising awareness of the correct use, maintenance and calibration of personal atmospheric monitoring systems, rescue equipment and recovery techniques. Crewmembers to participate in an appropriate drill and relevant codes of practice.

6.2 It is recommended that the Minister for Transport should carry out a review of the Merchant Shipping (Safety of Fishing Vessels) (15-24 Metres) Regulations 2007 S.I. No. 640 of 2007 with regard to the requirement and application for onboard rescue breathing apparatus and training for confined spaces. A breathing apparatus requirement should also apply to vessels with Refrigerated Sea Water systems installed.

Part 4 machinery installations,

Regulation (6)(a) and (7) of Regulation 62: Refrigeration systems for the preservation of the catch

"(6) (a) Where any refrigerant harmful to persons is used in a refrigeration system, at least 2 sets of breathing apparatus shall be provided, one of which shall be placed in a position not likely to become inaccessible in the event of leakage of refrigerant."

"(7) At least one crew member, but preferably 2, shall be trained in the use of breathing apparatus."

6.3 It is recommended that the Minister for Transport should issue a Marine Notice and any other steps as considered appropriate be taken to communicate to employers, owners, and skippers of fishing vessels equipped with Refrigerated Sea Water systems that they should:

- Supply and maintain atmosphere monitoring equipment onboard, ensuring that crewmembers are trained and practised in its correct use.
- Ensure that those entering a confined/enclosed space wear the required harness/recovery system and be monitored at all times by another crewmember stationed in a safe location outside the space.

- Ensure that Emergency Life Support Apparatus sets are carried onboard. Such Emergency Life Support Apparatus sets should form part of enclosed space entry procedures, and crewmembers should be properly trained in their use.

- Ensure that all refrigerated processing and storage systems are thoroughly cleaned and operated in different configurations immediately after use to ensure that no residual fish or organic matter is left within the system to decay.

- Fully ventilate all fish storage tanks and associated spaces with outside air, where a mixture of fish/organic matter and seawater is likely to remain for more than a few hours.

7. APPENDICES

Appendix 7.1 Vessel Fishing Licence

FISHERIES ACTS 1959 TO 2006
SEA – FISHING BOAT LICENCE

LICENCE NO. 368485185

The boat being a sea–fishing boat particulars of which are set out in the Schedule hereto is hereby licensed for the purposes of section 4 of the Fisheries (Amendment) Act 2003 (as inserted by section 97 of the Sea-Fisheries and Maritime Jurisdiction Act 2006) for the period commencing on 1 November 2023 and ending on 30 September 2024 in the name of:

[redacted]

SCHEDULE

Name of Boat to which the Licence relates: **ARDENT**

Country of Registration: **IRELAND**

Registration Number: **S23**

Port of Registration: **Skibbereen**

Length Overall: **24.02 metres**

Gross Tonnage: **224 Tonnes**

Engine Capacity: **749 kilowatts**

International Radio code or Call Sign: **EIBP5**

CFR Number: **IRL000I13750** UVI Number: **9456642**

Type of Vessel: **Trawler**

Type of Gear: **SPR - Pair seines, PTB - Bottom Pair Trawls, OTM - Mid-water Otter Trawls, PTM - Mid-water Pair Trawls, GNS - Gillnets (Set)**

Fleet Segment: **Polyvalent [>=18m LOA]**

Other Information:

Date: 1 November 2023

[redacted]

Licensing Authority pursuant to Section3 of Fisheries (Amendment) Act 2003 (No. 21)

Appendix 7.1 Vessel Fishing Licence

CONDITIONS OF LICENCE

The following conditions are attached to this licence:

General obligation to comply with EU and National law: The owner and/or master of the boat to which this licence relates shall ensure that the boat and all persons on board shall comply with any requirements, for the time being in force, under EU Law and National Law applicable to the operation of fishing boats and their technical characteristics.

Percentage EEA Crew: The boat to which this licence relates shall not be used for sea-fishing, whether within the exclusive fishery limits of the State or otherwise, unless at least **50 per cent** of the members of the crew are nationals of any of the Member States of the European Union or a State belonging to the European Economic Area.

Safety & Seaworthiness: The owners and/or masters of the boat to which this licence relates shall ensure that the boat and its crew shall comply with any requirements for the time being in force in relation to the safety of fishing boats (safety requirements should be taken to include any requirements in relation to radio installations, equipment and crew training), and shall maintain the fishing boat in a safe and sea-worthy condition.

Manning: The boat must carry the stipulated number of qualified crew as required under the Fishing Vessels (Certification of Deck Officers and Engineer Officers) Regulations 1988, as amended.

Ownership and Registration: This licence is valid for so long, and only for so long, as the person to whom it is granted is the owner of the boat to which it relates and the boat is entered on the Register of Fishing Boats.

Licence to be carried on Boat: During the period of its validity this licence shall be carried on board the boat to which it relates and the master or other person for the time being in charge of the boat shall produce it for inspection on demand by a Sea Fisheries Protection Officer.

Beam Trawl Preclusion: The boat to which this licence relates shall not be used for sea-fishing by means of beam trawls.

Boat Monitoring (VMS), Electronic Recording/Reporting (ERS) & Automatic Identification System (AIS): The boat must have on board a fully functional satellite-based position monitoring terminal, a fully functional electronic recording and reporting system and a fully functional automatic identification system in accordance with EU Regulations 1224/2009 and 404/2011 or any Regulations amending or replacing these Regulations, and shall comply with all relevant position monitoring requirements and with all relevant recording and reporting requirements for the time being in force.

Vessel Modifications: Any proposed structural modifications to the vessel, including changes to the vessel's engine, **must** be approved **in advance** by the Licensing Authority. Such modifications can have significant implications in terms of the licensing of the vessel, including replacement capacity requirements. The vessel may be required to be re-measured and a new licence application may be required to be submitted.

Scallops Preclusion: The vessel will be precluded from fishing for scallops (Pecten maximus). However by way of derogation and to allow for a by-catch, a quantity of scallop that is no greater than 10% by live weight of the total quantity of all species of fish may be retained on board or landed on any occasion.

Power to suspend or revoke Licence: The Licensing Authority may suspend or revoke this licence, pursuant to section 4 of the Fisheries (Amendment) Act 2003 (as inserted by section 97 of the Sea-Fisheries and Maritime Jurisdiction Act 2006), for a breach of any condition of the licence. In that event, the licence shall be surrendered to the Licensing Authority for Sea-fishing Boats, Clogheen, Clonakilty, Co. Cork, or risk a Court fine of not more than €500.

Cesser of Licence: Should any information or evidence come to the attention of the Licensing Authority that casts doubt on the veracity of the information or documentation submitted in support of the application for this licence, the licence shall cease to be in force.

Social and Economic benefits: The Licensing Authority, in deciding whether or not to renew the licence, will require the owner of the boat to provide such information as will demonstrate the extent of the social and economic benefit accruing to the local coastal communities arising from the operation of the boat.

MFV "ARDENT"

Appendix 7.2 Fishing Vessel Safety Certificate

MSO 1006 Fishing Vessel Safety Certificate (15-24m) DECLARATION OF SURVEY (Rev 2.0)(02/20)

INTERIM

FISHING VESSEL

SAFETY CERTIFICATE

This certificate of compliance shall be supplemented by a record of equipment

Issued under the Merchant Shipping (Safety of Fishing Vessels)
(15-24 Metres) Regulations 2007 (S.I. No. 640 of 2007)

under the authority of the Government of Ireland

Name of Ship	Fishing Letters & Numbers	Official & IMO Numbers	Port of Registry	Length (L)	Length Overall (Loa)	Sea areas in which ship is certified to operate
Ardent	S23	404214	Skibbereen	19.80	23.20	A1, A2

Date on which the keel was laid or ship was at a similar stage of construction [3] 05 2007

THIS IS TO CERTIFY:

1. that the ship has been surveyed in accordance with Regulation 7 of the Merchant Shipping (Safety of Fishing Vessels) Regulations 2007

2. that the survey showed that:
   1. the conditions of the hull, machinery and equipment, as defined in the above Regulations was in all respects satisfactory and that the vessel complied with the applicable requirements;
   2. the maximum permissible operating draught associated with each operating condition for the vessel is contained in the stability booklet dated 13/11/2009.
3. that an Exemption Certificate has been issued.

This Certificate is valid until **31 March 2023** subject to surveys in accordance with Regulation 7(1)(b)(ii), (b)(iii) and (c).

Issued at Dublin (place of issue of Certificate) 21/10/2022 (date of issue)

[redacted]

(signed) .....

(seal or stamp of issuing authority)

Name of Vessel	Ardent	Date of Issue:	**Error! Reference source not found.**

Appendix 7.2 Fishing Vessel Safety Certificate

MSO 1006 Fishing Vessel Safety Certificate (15-24m) DECLARATION OF SURVEY (Rev 2.0)(02/20)

INTERIM

FISHING VESSEL SAFETY RECORD OF EQUIPMENT

for the Fishing Vessel Safety Certificate

This record shall be permanently attached to the certificate of compliance

Record of equipment for compliance with the Merchant Shipping (Safety of Fishing Vessels) (15-24 Metres) Regulations 2007 (S.I. No. 640 of 2007)

1. Particulars of the vessel:

Name of Ship	Fishing Letters & Numbers	Official & IMO Numbers	Port of Registry	Length (L)	Length Overall (Loa)	Sea areas in which ship is certified to operate
Ardent	S23	404214	Skibbereen	19.80	23.20	A1, A2

2. Details of life-saving appliances:

1.	Total number of persons for whom life-saving appliances are approved	8	
		Port	Starboard
2.	Total number of lifeboats	-	-
2.1	Total number of persons accommodated by them	-	-
3.	Number of rescue boats	-	
3.1	Total number of persons accommodated by them	-	
4.	Liferafts:		
4.1	Those for which approved launching appliances are required		
4.1.1	Number of liferafts	-	
4.1.2	Number of persons accommodated by them	-	
4.2	Those for which approved launching appliances are not required:		
4.2.1	Number of liferafts	2	
4.2.2	Number of persons accommodated by them	20	
5.	Number of lifebuoys	4	
6.	Number of lifejackets	10	
7.	Immersion suits:		
7.1	Total number	8	
7.2	Number of suits complying with the requirements for lifejackets	-	
8.	Radio installations used in life-saving appliances:		
8.1	Number of radar transponders	1	
8.2	Number of two-way VHF radiotelephone apparatus	2	

Name of Vessel	Ardent	Date of Issue:	**Error! Reference source not found.**

Appendix 7.2 Fishing Vessel Safety Certificate

3. Details of radio facilities:

	Item	Actual provision
1.1	VHF radio installation:	
1.1.1	DSC encoder	Provided
1.1.2	DSC watch receiver	Provided
1.1.3	Radiotelephony	-
1.2	MF radio installation:	
1.2.1	DSC encoder	Provided
1.2.2	DSC watch receiver	Provided
1.2.3	Radiotelephony	Provided
1.3	MF/HF radio installation:	
1.3.1	DSC encoder	-
1.3.2	DSC watch receiver	-
1.3.3	Radiotelephony	-
1.3.4	Direct-printing radiotelegraphy	-
1.4	Inmarsat ship earth station	-
2.	Facilities for reception of maritime safety information:	
2.1	NAVTEX receiver	Provided
2.2	EGC receiver	-
2.3	HF direct-printing radiotelegraph receiver	-
3.	Satellite EPIRB:	
3.1	COSPAS-SARSAT	-
4.	Vessel's radar transponder	-

4. Details of navigational equipment:

	Item	Actual provision
1.	Standard magnetic compass	Provided
2.1	Nautical Charts/ECDIS[1]: {select}	Provided
2.2	Backup arrangements for ECDIS (if applicable)	-
2.3	Nautical Publications	Provided
3.	9GHz Radar	Provided
4.	Echo sounding device	Provided
5.	Communication between wheelhouse and machinery space	Provided
6.	Rudder, Propeller, Thrust, Pitch and Operational Mode Indicator	Provided
7.	Daylight Signalling Lamp	Provided
8.	Radar Reflector	-
9.	International Code of Signals	Provided

THIS IS TO CERTIFY that this Record is correct in all respects

Issued at Dublin (place of issue of Certificate) 21/10/2022 (date of issue)

(signed) [redacted]

An authorised officer.

(seal or stamp of issuing authority)

[1] ECDIS - Electronic chart display and information system

Appendix 7.2 Fishing Vessel Safety Certificate

MSO 1006 Fishing Vessel Safety Certificate (15-24m) DECLARATION OF SURVEY (Rev 2.0)(02/20)

CONDITIONS AND RESTRICTIONS

Stability

The skipper shall take precautionary measures necessary to maintain the stability of the vessel in accordance with the approved stability information book.

Crew members on watch shall fully observe instructions supplied in the approved stability information book.

Bulk loading of the catch is not permitted.

The vessel is not permitted to operate in regions where ice accretion is likely to occur – refer to Schedule 3, Paragraph 17 of the *Merchant Shipping (Safety of Fishing Vessels)(15-24 metres) Regulations 2007*.

The maximum permitted operating draught is 5.10 metres. At no time shall the loading mark on the side of the vessel be submerged.

Any alterations made to the vessel affecting its stability, revised stability calculations shall be undertaken to the satisfaction of the Minister.

Catch on deck is not permitted to be stowed on deck.

Medical equipment

The vessel carries category B medical equipment.

Abandon ship training and drills

Abandon ship training and drills to be conducted in accordance with Part 8 of the *Merchant Shipping (Safety of Fishing Vessels)(15-24 metres) Regulations 2007*.

Surveys

Owner/skipper shall ensure surveys in accordance with Part 1, Regulation 7 of the *Merchant Shipping (Safety of Fishing Vessels)(15-24 metres) Regulations 2007* are carried out on the vessel.

Additional Conditions and Restrictions

1) An exemption has been provided from Regulation 41(2) of the above referenced regulations concerning the minimum freeboard for existing fishing vessels.

2) Until further notice, the vessel is restricted to demersal fishing only, with catch being stored as boxed fish and ice.

Name of Vessel	Ardent	Date of Issue:	**Error! Reference source not found.**

Appendix 7.3 Met Éireann Weather Report and Buoy M2 Observations

Met Éireann
The Irish Meteorological Service
Climate Services
Glasnevin Hill
Dublin 9
Seirbhísí Aeráide
Cnoc Ghlas Naíon
Baile Átha Cliath 9
Tel: +353-1-8064260
Email: legal@met.ie

Our Ref: WS1730/2305_38
Your Ref: MCIB/12/320

WEATHER REPORT

31-October-2022	
Meteorological Synopsis:	A moderate to fresh southerly airflow covered Ireland on 31-October-2022 with a shallow low pressure system (996 hPa) off the south coast. An active waving front (occlusion) was slow-moving.
Estimated weather and sea state conditions in the offshore sea area east of Clogherhead Co Louth (approximate 53.797, -6.059) on Monday 31-October-2022 between 2pm and 7pm	
Wind:	Southeasterly winds decreased from Fresh Force 5 to Moderate Force 4 (mean wind speed 14 – 21 knots) occasional gusts up to 30 knots occurred at the start of the period.
Weather:	Rain with occasional heavy downpours and isolated embedded thunderstorms affected the area between 2pm and 6pm; it was mostly dry for a period between 6pm and 10pm. Heavy rain affected the area again after 10pm. The daily total rainfall amount (from midnight to midnight) is estimated at 10 to 17 mm.
Visibility:	Visibility was moderate to poor (0.5 to 5 nautical miles) in rain otherwise visibility was good (greater than 5 nautical miles).
Temperature:	Air temperature was 13 to 15 degrees Celsius. Sea temperature 15 degrees Celsius.
Sea State (offshore):	The estimated sea state decreased from moderate to slight (significant wave height 1 to 2 meters) on a southerly swell. Observed maximum individual wave height at weather buoy M2 was 3.9 meters at the start of the period.

This report was issued on: 29 May 2023
Met Éireann | Climate Services Division | Enquiries Legal Unit | Email: legal@met.ie

Appendix 7.3 Met Éireann Weather Report and Buoy M2 Observations

Appendix 1b Buoy M2 Observations 31-October-2022

Station Identifyer (stno)	Date / hour UTC	wind direction (degrees from north)	Mean Wind Speed (knots)	Maximum gust (knots)	Significant Wave Height (meters)	Maximum Observed Individual Wave height (meters)	Wave direction (degrees from north)	Significant Wave Period (seconds)	Sea Temperature (degrees Celsius)
62091	31/10/2022 00:00	188	21.6	28.8	2.3	3.3	182.8	4.9	15
62091	31/10/2022 01:00	199	22.9	30.4	2.3	3.6	182.8	4.9	15
62091	31/10/2022 02:00	189	23.9	30.8	2.4	4.2	187	4.9	15
62091	31/10/2022 03:00	183	21.3	27.6	2.7	4.1	184.2	5.2	15
62091	31/10/2022 04:00	173	25.2	33.1	2.4	3.9	181.4	5.4	15
62091	31/10/2022 05:00	178	25.1	32.8	2.4	4.1	182.8	5.4	15
62091	31/10/2022 06:00	170	22.4	32.2	2.5	3.8	177.2	5.9	15
62091	31/10/2022 07:00	170	22.8	30.2	2.5	3.6	178.6	6	15
62091	31/10/2022 08:00	177	24.4	31.5	2.7	4.4	177.2	5.9	15
62091	31/10/2022 09:00	176	26.8	36.2	2.9	4.7	178.6	5.9	15
62091	31/10/2022 10:00	177	27.1	35.5	2.7	5.3	181.4	5.4	15
62091	31/10/2022 11:00	172	24.1	30.1	3.3	4.5	181.4	5.5	15
62091	31/10/2022 12:00	170	20.7	27.6	2.7	5.5	182.8	5.2	15
62091	31/10/2022 13:00	162	22.2	28.4	2.3	4.1	178.6	4.9	15
62091	31/10/2022 14:00	155	22.7	28.6	2.4	3.8	181.4	4.9	15
62091	31/10/2022 15:00	151	21.4	27.1	2.1	3.9	175.8	4.7	15
62091	31/10/2022 16:00	155	17.7	22.4	2.1	3.4	171.6	4.8	15
62091	31/10/2022 17:00	145	14.2	17.7	2.2	3.6	175.8	5.3	15
62091	31/10/2022 18:00	129	14.6	17.9	1.7	3	174.4	5.4	15
62091	31/10/2022 19:00	126	14.8	18.7	1.4	2.3	168.8	5	15
62091	31/10/2022 20:00	105	13	16.6	1.3	2.2	171.6	5.2	14.9
62091	31/10/2022 21:00	86	11.3	13.6	1.3	2	167.3	4.9	14.9
62091	31/10/2022 22:00	106	11	14.1	1.2	2.2	167.3	4.8	14.9
62091	31/10/2022 23:00	120	10.1	12.6	1.2	2	165.9	4.5	14.9

Appendix 7.4 Dundalk Weather Station Report

Dundalk Weather

Site ID:
53.9952, -6.3848

Observation | Data Display

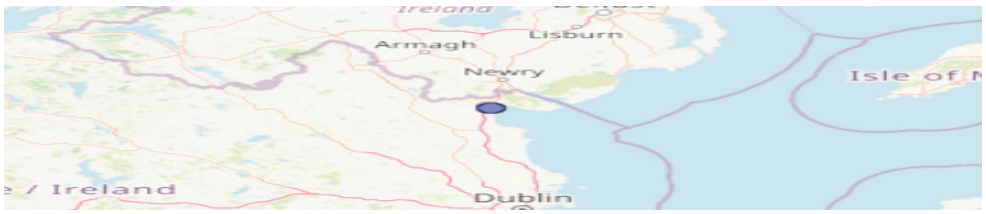
Weather Observation data at **Dundalk Weather**

13:55 (UTC)
31/10/2022

Temperature	**13.9**	°C
Humidity	**83**	%
Rainfall Accumulation	**0.8**	mm
Pressure (at station height)	**1004**	hPa
Wind Speed	**4**	knots
Wind Speed	**7**	km/h
Wind Gust Speed	**-**	knots
Wind Direction	**225**	deg
Dew-Point Temperature	**11.1**	°C
Soil Temperature 10cm	**-**	°C

Share Observation

Site Information



Davis Vantage Vue

Site Details

Dundalk Weather	
Site ID	772450ab-9492-e811-b96f-0003ff5993a0
Site Position	53.9952, -6.3848
Offical Station	No
website	www.dundalkweather.net
Extra Information	Davis Vantage Vue mounted above roof.
Active Site	Yes
Data Download	Yes
timezone	GMT Standard Time
Start Date	2022-11-04T17:25:00Z

Appendix 7.5 Tide Data

Tides Dublin (North Wall)

Dublin (North Wall) - October 2022

01 Sat	03:37 3.9m 09:20 1.0m 15:58 3.7m 21:46 1.0m	**02** Sun	04:29 3.6m 10:16 1.3m 16:53 3.5m 22:54 1.2m	**03** Mon ◐	05:38 3.4m 11:29 1.5m 18:07 3.4m	**04** Tue	00:21 1.3m 07:08 3.3m 12:56 1.6m 19:32 3.4m
05 Wed	01:47 1.2m 08:36 3.4m 14:17 1.5m 20:53 3.6m	**06** Thu	03:00 1.0m 09:46 3.6m 15:20 1.2m 21:57 3.8m	**07** Fri	03:54 0.7m 10:42 3.8m 16:12 1.0m 22:52 4.1m	**08** Sat	04:41 0.5m 11:30 4.0m 16:56 0.7m 23:39 4.2m
09 Sun ○	05:21 0.4m 12:10 4.1m 17:35 0.6m	**10** Mon	00:20 4.3m 05:59 0.3m 12:48 4.2m 18:13 0.5m	**11** Tue	01:00 4.3m 06:36 0.4m 13:24 4.1m 18:51 0.5m	**12** Wed	01:36 4.2m 07:12 0.5m 13:57 4.0m 19:28 0.7m
13 Thu	02:11 4.1m 07:48 0.7m 14:28 3.9m 20:04 0.8m	**14** Fri	02:44 3.8m 08:24 1.0m 15:00 3.7m 20:44 1.0m	**15** Sat	03:21 3.6m 09:03 1.2m 15:36 3.5m 21:30 1.3m	**16** Sun	04:04 3.3m 09:49 1.5m 16:19 3.3m 22:25 1.5m
17 Mon ◑	04:59 3.1m 10:46 1.8m 17:16 3.2m 23:36 1.6m	**18** Tue	06:15 3.0m 12:03 1.9m 18:32 3.1m	**19** Wed	00:59 1.6m 07:40 3.0m 13:24 1.9m 19:49 3.2m	**20** Thu	02:11 1.5m 08:51 3.1m 14:30 1.7m 20:55 3.4m
21 Fri	03:04 1.3m 09:44 3.3m 15:19 1.5m 21:47 3.6m	**22** Sat	03:47 1.0m 10:28 3.6m 15:59 1.2m 22:31 3.8m	**23** Sun	04:23 0.8m 11:07 3.8m 16:35 1.0m 23:13 4.0m	**24** Mon	04:59 0.6m 11:45 3.9m 17:11 0.8m 23:54 4.2m
25 Tue ●	05:35 0.4m 12:22 4.1m 17:48 0.6m	**26** Wed	00:34 4.3m 06:11 0.4m 12:58 4.1m 18:26 0.5m	**27** Thu	01:13 4.3m 06:48 0.4m 13:35 4.2m 19:06 0.5m	**28** Fri	01:54 4.2m 07:29 0.6m 14:14 4.1m 19:52 0.6m
29 Sat	02:39 4.0m 08:14 0.8m 14:57 4.0m 20:43 0.7m	**30** Sun	02:28 3.8m 08:05 1.0m 14:45 3.8m 20:41 0.9m	**31** Mon	03:25 3.5m 09:04 1.3m 15:43 3.6m 21:52 1.1m		

Appendix 7.5 Tide Data

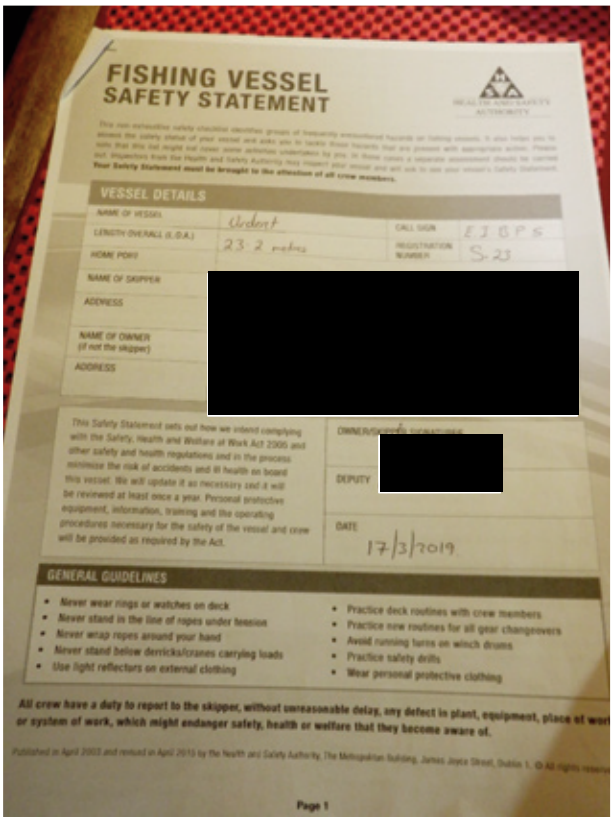
Tide difference Dublin (North Wall) - River Boyne (Entrance)

5621 - Updated to October 2023

TIME & HEIGHT DIFFERENCES FOR PREDICTING THE TIDE AT SECONDARY PORTS

PLACE	Lat N	Long W	TIME DIFFERENCES High Water		Low Water		HEIGHT DIFFERENCES (IN METRES) MHWS	MHWN	MLWN	MLWS
			Zone UT(GMT)							
HOLYHEAD	53 19	4 37	**0000 and 1200**	**0600 and 1800**	**0500 and 1700**	**1100 and 2300**	**5.6**	**4.4**	**2.0**	**0.7**
Menai Strait										
Fort Belan	53 07	4 20	-0040	-0015	-0025	-0005	-1.0	-0.9	-0.2	-0.1
Amlwch	53 25	4 20	+0020	+0010	+0035	+0025	+1.6	+1.3	+0.5	+0.2
Cemaes Bay	53 25	4 27	+0020	+0025	+0040	+0035	+1.0	+0.7	+0.3	+0.1
HOLYHEAD	53 19	4 37		STANDARD PORT						
Trearddur Bay	53 16	4 37	-0045	-0025	-0015	-0015	-0.4	-0.4	0.0	+0.1
Porth Trecastell	53 12	4 30	-0045	-0025	-0005	-0015	-0.6	-0.6	0.0	0.0
Llanddwyn Island	53 08	4 25	-0115	-0055	-0030	-0020	-0.7	-0.5	-0.1	0.0
Trefor	53 00	4 25	-0115	-0100	-0030	-0020	-0.8	-0.9	-0.2	-0.1
Porth Dinllaen	52 57	4 34	-0120	-0105	-0035	-0025	-1.0	-1.0	-0.2	-0.2
Porth Ysgaden	52 54	4 39	-0125	-0110	-0040	-0035	-1.1	-1.0	-0.1	-0.1
MILFORD HAVEN	51 42	5 03	**0100 and 1300**	**0800 and 2000**	**0100 and 1300**	**0700 and 1900**	**7.0**	**5.2**	**2.5**	**0.7**
Cardigan Bay										
Porthgain	51 57	5 11	+0055	+0045	+0045	+0100	-2.5	-1.8	-0.6	0.0
Ramsey Sound	51 53	5 19	+0030	+0030	+0030	+0030	-1.9	-1.3	-0.3	0.0
Solva	51 52	5 12	+0015	+0010	+0035	+0015	-1.5	-1.0	-0.2	0.0
Little Haven	51 46	5 07	+0010	+0010	+0025	+0015	-1.1	-0.8	-0.2	0.0
Martin's Haven	51 44	5 15	+0010	+0010	+0015	+0015	-0.8	-0.5	+0.1	+0.1
Skomer Island	51 44	5 17	-0005	-0005	+0005	+0005	-0.4	-0.1	0.0	0.0
Dale Roads	51 42	5 09	-0005	-0005	-0008	-0008	0.0	0.0	0.0	-0.1
MILFORD HAVEN	51 42	5 03		STANDARD PORT						
DUBLIN (NORTH WALL)	53 21	6 13	**0000 and 1200**	**0700 and 1900**	**0000 and 1200**	**0500 and 1700**	**4.1**	**3.4**	**1.5**	**0.7**
Ireland										
Courtown	52 39	6 13	-0328	-0242	-0158	-0138	-2.8	-2.4	-0.5	0.0
Arklow	52 48	6 08	-0315	-0201	-0140	-0134	-2.7	-2.2	-0.6	-0.1
Wicklow	52 59	6 02	-0019	-0019	-0024	-0026	-1.4	-1.1	-0.4	0.0
Greystones	53 09	6 04	-0008	-0008	-0008	-0008	-0.5	-0.4	⊙	⊙
Dun Laoghaire	53 18	6 08	+0000	+0000	+0002	+0003	0.0	+0.1	0.0	0.0
Dublin Bar	53 21	6 09	-0006	-0001	-0002	-0003	0.0	0.0	0.0	+0.1
DUBLIN (NORTH WALL)	53 21	6 13		STANDARD PORT						
Howth	53 23	6 04	-0007	-0005	+0001	+0005	0.0	-0.1	-0.2	-0.2
Malahide	53 27	6 09	+0002	+0003	+0009	+0009	+0.1	-0.2	-0.4	-0.2
Balbriggan	53 37	6 11	-0021	-0015	+0010	+0002	+0.3	+0.2	⊙	⊙
River Boyne										
Entrance	53 43	6 14	-0015	-0009	-0001	+0005	+0.9	+0.6	+0.2	+0.1
Dunany Point	53 52	6 14	-0028	-0018	-0008	-0006	+0.7	+0.9	⊙	⊙
Dundalk										
Soldiers Point	54 00	6 21	-0010	-0010	+0000	+0045	+1.0	+0.8	+0.1	-0.1
Carlingford Lough										
Cranfield Point	54 01	6 04	-0027	-0011	+0005	-0010	+0.7	+0.9	+0.3	+0.2
Warrenpoint	54 06	6 15	-0020	-0010	+0025	+0035	+1.0	+0.7	+0.2	0.0
BELFAST			**0100 and 1300**	**0700 and 1900**	**0000 and 1200**	**0600 and 1800**	**3.5**	**3.0**	**1.1**	**0.4**
Northern Ireland										
Kilkeel	54 03	5 59	+0040	+0030	+0010	+0010	+1.2	+1.1	+0.4	+0.4
COBH	51 51	8 18	**0500 and 1700**	**1100 and 2300**	**0500 and 1700**	**1100 and 2300**	**4.1**	**3.2**	**1.3**	**0.4**
Waterford Harbour										
Dunmore East	52 09	6 59	+0008	+0003	+0000	+0000	+0.1	0.0	+0.1	+0.2
Cheekpoint	52 16	7 00	+0026	+0021	+0019	+0022	+0.5	+0.4	+0.3	+0.2
Kilmokea Point	52 17	7 00	+0026	+0022	+0020	+0020	+0.2	+0.1	+0.1	+0.1
Waterford	52 16	7 06	+0053	+0032	+0015	+0100	+0.6	+0.6	+0.4	+0.2
New Ross	52 24	6 57	+0100	+0030	+0055	+0130	+0.3	+0.4	+0.3	+0.4
Baginbun Head	52 10	6 50	+0003	+0003	-0008	-0008	-0.2	-0.1	+0.2	+0.2
Great Saltee	52 07	6 37	+0019	+0009	-0004	+0006	-0.3	-0.4	⊙	⊙

Appendix 7.6 Vessel Risk Assessment Document



FISHING VESSEL
SAFETY STATEMENT

VESSEL DETAILS

NAME OF VESSEL: Ardent
LENGTH OVERALL (L.O.A.): 23.2 metres
CALL SIGN: EIBPS
REGISTRATION NUMBER: S-23
HOME PORT:
NAME OF SKIPPER:
ADDRESS:
NAME OF OWNER (if not the skipper):
ADDRESS:
DEPUTY:
DATE: 17/3/2019

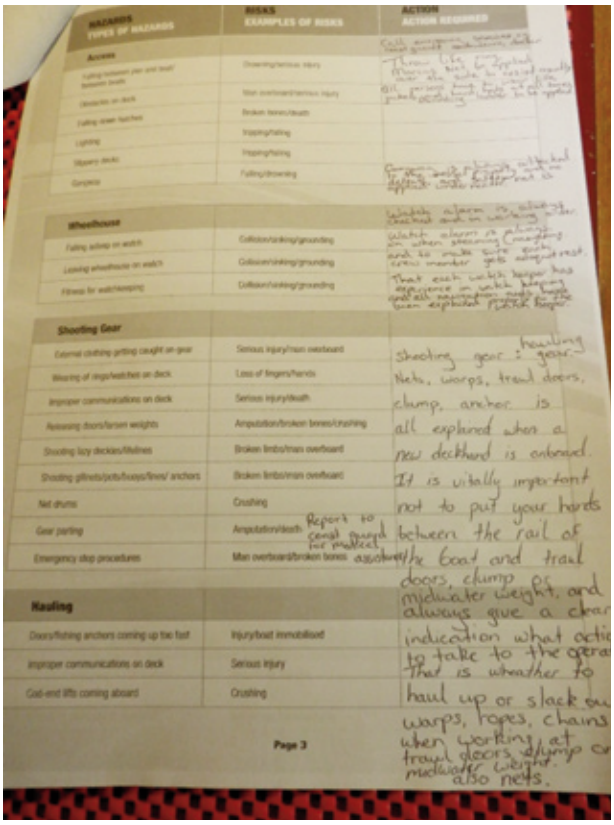
This Safety Statement sets out how we intend complying with the Safety, Health and Welfare at Work Act 2005 and other safety and health regulations and in the process minimise the risk of accidents and ill health on board this vessel. We will update it as necessary and it will be reviewed at least once a year. Personal protective equipment, information, training and the operating procedures necessary for the safety of the vessel and crew will be provided as required by the Act.

GENERAL GUIDELINES

- Never wear rings or watches on deck
- Never stand in the line of ropes under tension
- Never wrap ropes around your hand
- Never stand below derricks/cranes carrying loads
- Use light reflectors on external clothing
- Practice deck routines with crew members
- Practice new routines for all gear changeovers
- Avoid running turns on winch drums
- Practice safety drills
- Wear personal protective clothing

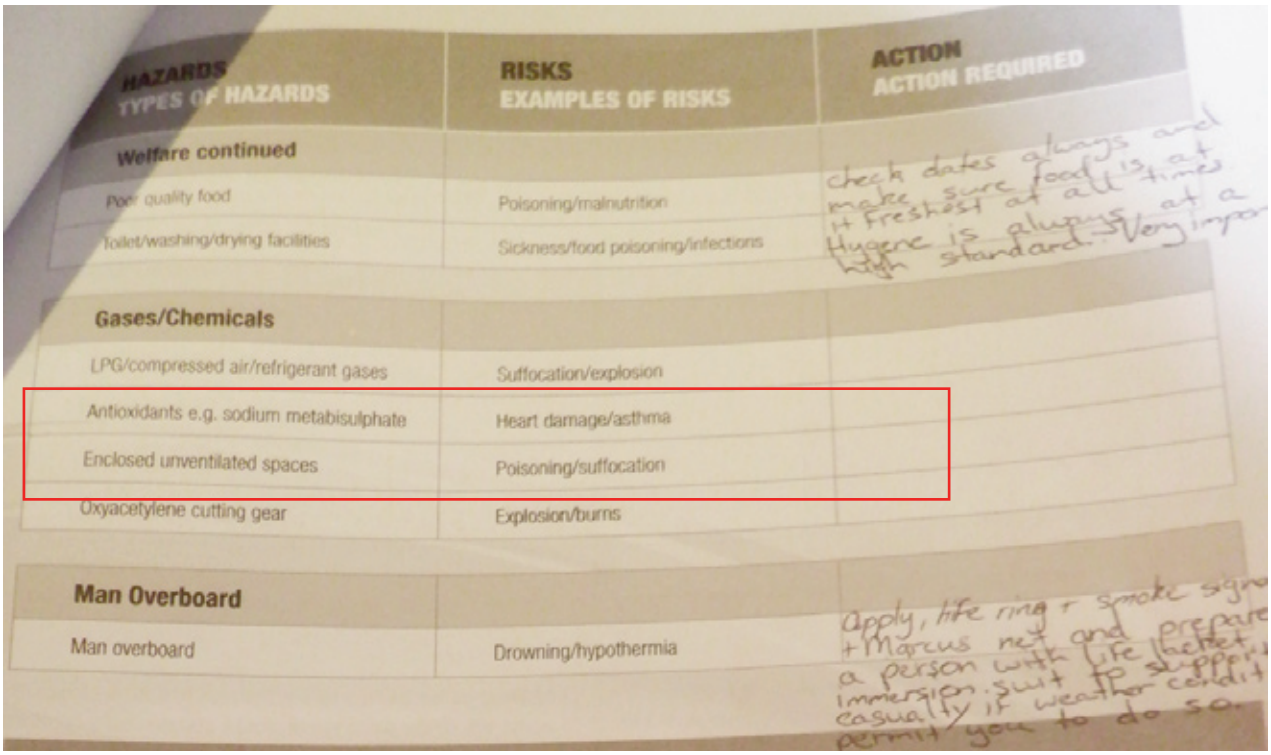
All crew have a duty to report to the skipper, without unreasonable delay, any defect in plant, equipment, place of work or system of work, which might endanger safety, health or welfare that they become aware of.

Page 1



HAZARDS TYPES OF HAZARDS	RISKS EXAMPLES OF RISKS	ACTION ACTION REQUIRED
Access		
Wheelhouse		
Fishing asleep on watch	Collision/sinking/grounding	
Leaving wheelhouse on watch	Collision/sinking/grounding	
Fitness for watchkeeping	Collision/sinking/grounding	
Shooting Gear		
External clothing getting caught on gear	Serious injury/man overboard	
Wearing of rings/watches on deck	Loss of fingers/hands	
Improper communications on deck	Serious injury/death	
Releasing doors/otter weights	Amputation/broken bones/crushing	
Shooting lazy deckies/lifelines	Broken limbs/man overboard	
Shooting gillnets/pots/buoys/lines/ anchors	Broken limbs/man overboard	
Net drums	Crushing	
Gear parting	Amputation/death	
Emergency stop procedures	Man overboard/broken bones	
Hauling		
Doors/fishing anchors coming up too fast	Injury/boat immobilised	
Improper communications on deck	Serious injury	
Cod-end lifts coming aboard	Crushing	

Page 3



HAZARDS TYPES OF HAZARDS	RISKS EXAMPLES OF RISKS	ACTION ACTION REQUIRED
Welfare continued		
Poor quality food	Poisoning/malnutrition	
Toilet/washing/drying facilities	Sickness/food poisoning/infections	
Gases/Chemicals		
LPG/compressed air/refrigerant gases	Suffocation/explosion	
Antioxidants e.g. sodium metabisulphate	Heart damage/asthma	
Enclosed unventilated spaces	Poisoning/suffocation	
Oxyacetylene cutting gear	Explosion/burns	
Man Overboard		
Man overboard	Drowning/hypothermia	

Appendix 7.7 Hydrogen Sulphide Brief Profile – ECHA (section only)

Hydrogen sulphide

Brief Profile - Last updated: 13/02/2023

Substance Description

Substance identity

EC / List name:

IUPAC name: hydrogen sulfide

Substance names and other identifiers

EC / List no.:	231-977-3
CAS no.:	7783-06-4
Index number:	016-001-00-4
Molecular formula:	H2S

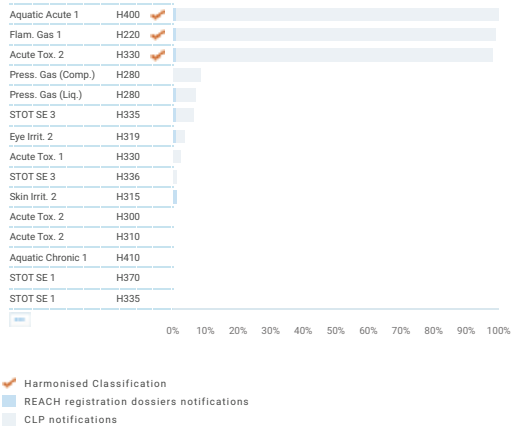
SMILES:	S
InChI:	InChI=1S/H2S/h1H2
Type of substance:	Mono constituent substance
Origin:	Inorganic
Registered compositions:	8
Of which contain:	0 impurities relevant for classification
	0 additives relevant for classification
Substance Listed:	EINECS (European INventory of Existing Commercial chemical Substances) List

Hazard classification & labelling

Danger! According to the **harmonised classification and labelling** (CLP00) approved by the European Union, this substance is fatal if inhaled, is very toxic to aquatic life and is an extremely flammable gas.

Additionally, the classification provided by companies to ECHA in **REACH registrations** identifies that this substance is fatal if swallowed, is fatal in contact with skin, causes serious eye irritation, contains gas under pressure and may explode if heated, causes skin irritation and may cause respiratory irritation.

Breakdown of all 2503 C&L notifications submitted to ECHA



Properties of concern

Regulatory context

Registration, Evaluation, Authorisation & Restriction of Chemicals (REACH)

Registration

Pre-registration:	Substance pre-registered under REACH.
Registration:	This substance has 3 active registrations under REACH, 2 Joint Submission(s) and 0 Individual Submission(s).

Evaluation

Dossier Evaluation:

Substance Evaluation:

Authorisation

Candidate List:

Annex XIV (Authorisation List):

Restriction

Annex XVII (Restriction List):

Persistent Organic Pollutants Regulation (POPs)

List of substances subject to the POPs Regulation:

List of substances proposed as POPs:

Classification Labelling & Packaging (CLP)

Harmonised C&L:	A European Union Harmonised Classification & Labelling has been assigned to this substance.
Seveso Annex I:	Industrial accident prevention and reporting requirements have been established for this substance.
Notified C&L:	Classification & Labelling has been notified by industry to ECHA for this substance.

Biocidal Products Regulation (BPR)

Active Substance:

Biocidal Products:

Prior Informed Consent (PIC)

Annex I:

Annex V:

European Union Observatory for Nanomaterials (EUON)

EUON:

Appendix 7.7 Hydrogen Sulphide Brief Profile – ECHA (section only)

About this substance

General

This substance is registered under the REACH Regulation and is manufactured in and / or imported to the European Economic Area, at ≥ 1 tonnes per annum.

This substance is used by consumers, by professional workers (widespread uses), in formulation or re-packing, at industrial sites and in manufacturing.

Consumer Uses

This substance is used in the following products: coating products, heat transfer fluids, washing & cleaning products and cosmetics and personal care products.

Other release to the environment of this substance is likely to occur from: indoor use as reactive substance, outdoor use as reactive substance, indoor use in close systems with minimal release (e.g. cooling liquids in refrigerators, oil-based electric heaters) and outdoor use in close systems with minimal release (e.g. hydraulic liquids in automotive suspension, lubricants in motor oil and break fluids).

Article service life

ECHA has no public registered data on the use of this substance in activities or processes at the workplace.

ECHA has no public registered data on the routes by which this substance is most likely to be released to the environment.

ECHA has no public registered data indicating whether or into which articles the substance might have been processed.

Widespread uses by professional workers

This substance is used in the following products: fertilisers, pH regulators and water treatment products, laboratory chemicals, extraction agents, coating products, metal surface treatment products, non-metal-surface treatment products, heat transfer fluids, pharmaceuticals, photo-chemicals, textile treatment products and dyes and water treatment chemicals. This substance has an industrial use resulting in manufacture of another substance (use of intermediates).

This substance is used in the following areas: agriculture, forestry and fishing, municipal supply (e.g. electricity, steam, gas, water) and sewage treatment, formulation of mixtures and/or re-packaging and scientific research and development. This substance is used for the manufacture of: chemicals, pulp, paper and paper products, food products, textile, leather or fur, wood and wood products, rubber products, plastic products, fabricated metal products, electrical, electronic and optical equipment and machinery and vehicles.

This substance is used in the following activities or processes at workplace: transfer of chemicals, closed, continuous processes with occasional controlled exposure, transfer of substance into small containers, closed processes with no likelihood of exposure, closed batch processing in synthesis or formulation, hand mixing with intimate contact only with personal protective equipment available, batch processing in synthesis or formulation with opportunity for exposure, roller or brushing applications, non-industrial spraying, treatment of articles by dipping and pouring, laboratory work, mixing in open batch processes and heat / pressure transfer fluids in closed systems.

Other release to the environment of this substance is likely to occur from: indoor use as reactive substance, outdoor use, indoor use in close systems with minimal release (e.g. cooling liquids in refrigerators, oil-based electric heaters) and outdoor use in close systems with minimal release (e.g. hydraulic liquids in automotive suspension, lubricants in motor oil and break fluids).

Formulation or re-packing

This substance is used in the following products: adhesives and sealants, coating products, fertilisers, metal surface treatment products, heat transfer fluids, inks and toners, pH regulators and water treatment products, laboratory chemicals, paper chemicals and dyes, pharmaceuticals, photo-chemicals, textile treatment products and dyes, washing & cleaning products, water treatment chemicals, cosmetics and personal care products and extraction agents. This substance has an industrial use resulting in manufacture of another substance (use of intermediates).

This substance is used in the following activities or processes at workplace: transfer of chemicals, closed processes with no likelihood of exposure, transfer of substance into small containers, closed, continuous processes with occasional controlled exposure, laboratory work, closed batch processing in synthesis or formulation, batch processing in synthesis or formulation with opportunity for exposure and mixing in open batch processes.

Release to the environment of this substance can occur from industrial use: formulation of mixtures.

Uses at industrial sites

This substance is used in the following products: metal surface treatment products, adsorbents, laboratory chemicals, semiconductors, adhesives and sealants, coating products, non-metal-surface treatment products, heat transfer fluids, pH regulators and water treatment products, paper chemicals and dyes, pharmaceuticals, photo-chemicals, textile treatment products and dyes, washing & cleaning products, water treatment chemicals, cosmetics and personal care products and extraction agents. This substance has an industrial use resulting in manufacture of another substance (use of intermediates).

This substance is used in the following areas: formulation of mixtures and/or re-packaging, municipal supply (e.g. electricity, steam, gas, water) and sewage treatment, scientific research and development and agriculture, forestry and fishing. This substance is used for the manufacture of: chemicals, food products, rubber products, fabricated metal products, electrical, electronic and optical equipment, textile, leather or fur, pulp, paper and paper products, wood and wood products, plastic products, mineral products (e.g. plasters, cement) and metals.

This substance is used in the following activities or processes at workplace: closed processes with no likelihood of exposure, transfer of substance into small containers, closed batch processing in synthesis or formulation, transfer of chemicals at dedicated facilities, closed, continuous processes with occasional controlled exposure, batch processing in synthesis or formulation with opportunity for exposure, hand mixing with intimate contact only with personal protective equipment available, laboratory work, industrial spraying, in materials as fuel sources, with limited exposure to unburned product to be expected, mixing in open batch processes, roller or brushing applications and treatment of articles by dipping and pouring.

Release to the environment of this substance can occur from industrial use: as processing aid, of substances in closed systems with minimal release, in processing aids at industrial sites, as an intermediate step in further manufacturing of another substance (use of intermediates) and in the production of articles.

Manufacture

This substance is used in the following activities or processes at workplace: transfer of chemicals at dedicated facilities, closed processes with no likelihood of exposure, laboratory work, closed, continuous processes with occasional controlled exposure and transfer of substance into small containers.

Release to the environment of this substance can occur from industrial use: manufacturing of the substance.

Precautionary Measures and safe use

Precautions for using this substance have been recommended by its registrants under REACH, as follows:

Prevention statements

When handling this substance: keep away from heat, sparks, open flames and/or hot surfaces – No smoking; avoid release to the environment; do not breathe the dust, fume, gas, mist, vapours or spray; wear respiratory protection.

Response statements

In case of incident: In case of leaking gas fire do not extinguish unless leak can be stopped safely. In case of leakage eliminate all ignition sources. Get immediate medical advice/attention. If inhaled: remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a poison center or doctor/physician.

Storage statements

Store this substance locked up; in a well-ventilated place; protected from sunlight and in a well-ventilated place.

Disposal statements

The substance must be disposed in accordance with local/regional/national/international regulation.

Guidance on the safe use of the substance provided by manufacturers and importers of this substance.

Registrants/suppliers

Active

- GHC Gerling, Holz & Co. Handels GmbH, Ruhrstraße 113 22761 Hamburg Hamburg Germany
- Quadrimex Sulfur Chemicals GmbH & Co. KG, Am Haupttor Bau 3651 06237 Leuna Sachsen-Anhalt Germany
- SLOVNAFT, a.s., Vlcie hrdlo 1 824 12 Bratislava Slovakia

Inactive

- Arcerion GmbH, Gabrielenstr. 15 80636 München Germany
- ARKEMA FRANCE, 420 rue d'Estienne d'Orves 92700 COLOMBES France
- PRO CHEMIKA SP. Z O. O. w Krakowie, Kunickiego 5 30-134 Kraków Poland
- Tessenderlo Group N.V., Troonstraat 130 BE-1050 Brussel Belgium

Appendix 7.8 Freon 404A Safety Data Sheet – SDS (sections only)

SAFETY DATA SHEET

Freon™ 404A (R-404A) Refrigerant

Version	Revision Date:	SDS Number:	Date of last issue: 18.04.2022
2.3	05.12.2022	1601651-00015	Date of first issue: 27.04.2017

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : Freon™ 404A (R-404A) Refrigerant

SDS-Identcode : 130000000494

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Refrigerant

Recommended restrictions on use : For professional users only.

1.3 Details of the supplier of the safety data sheet

Company : Chemours Netherlands B.V.
Baanhoekweg 22
3313 LA Dordrecht Netherlands

Telephone : +31-(0)-78-630-1011

Telefax : +31-78-6163737

E-mail address of person responsible for the SDS : sds-support@chemours.com

1.4 Emergency telephone number

+(44)-870-8200418 (CHEMTREC - Recommended)

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Gases under pressure, Liquefied gas — H280: Contains gas under pressure; may explode if heated.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :

Signal word : Warning

Hazard statements : H280 Contains gas under pressure; may explode if heated.

Appendix 7.8 Freon 404A Safety Data Sheet – SDS (sections only)

SAFETY DATA SHEET

Chemours

Freon™ 404A (R-404A) Refrigerant

Version	Revision Date:	SDS Number:	Date of last issue: 18.04.2022
2.3	05.12.2022	1601651-00015	Date of first issue: 27.04.2017

Precautionary statements : **Storage:**
P410 + P403 Protect from sunlight. Store in a well-ventilated place.

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
Misuse or intentional inhalation abuse may cause death without warning symptoms, due to cardiac effects.
Rapid evaporation of the product may cause frostbite.
May displace oxygen and cause rapid suffocation.

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Components

Chemical name	CAS-No. EC-No. Index-No. Registration number	Classification	Concentration (% w/w)
1,1,1-Trifluoroethane#	420-46-2 206-996-5 01-2119492869-13	Flam. Gas 1B; H221 Press. Gas Liquefied gas; H280	52
Pentafluoroethane#	354-33-6 206-557-8 01-2119485636-25	Press. Gas Liquefied gas; H280	44
1,1,1,2-Tetrafluoroethane#	811-97-2 212-377-0 01-2119459374-33	Press. Gas Liquefied gas; H280	4

For explanation of abbreviations see section 16.
#: Voluntarily-disclosed substance

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice : In the case of accident or if you feel unwell, seek medical advice immediately.
When symptoms persist or in all cases of doubt seek medical advice.

Protection of first-aiders : No special precautions are necessary for first aid responders.

Appendix 7.8 Freon 404A Safety Data Sheet – SDS (sections only)

SAFETY DATA SHEET

Freon™ 404A (R-404A) Refrigerant

Chemours

Version	Revision Date:	SDS Number:	Date of last issue: 18.04.2022
2.3	05.12.2022	1601651-00015	Date of first issue: 27.04.2017

If inhaled	:	If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
In case of skin contact	:	Thaw frosted parts with lukewarm water. Do not rub affected area. Get medical attention immediately.
In case of eye contact	:	Get medical attention immediately.
If swallowed	:	Ingestion is not considered a potential route of exposure.

4.2 Most important symptoms and effects, both acute and delayed

Symptoms	:	May cause cardiac arrhythmia. Other symptoms potentially related to misuse or inhalation abuse are Cardiac sensitisation Anaesthetic effects Light-headedness Dizziness confusion Lack of coordination Drowsiness Unconsciousness
Risks	:	Gas reduces oxygen available for breathing. Contact with liquid or refrigerated gas can cause cold burns and frostbite.

4.3 Indication of any immediate medical attention and special treatment needed

Treatment	:	Because of possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, that may be used in situations of emergency life support should be used with special caution.

SECTION 5: Firefighting measures

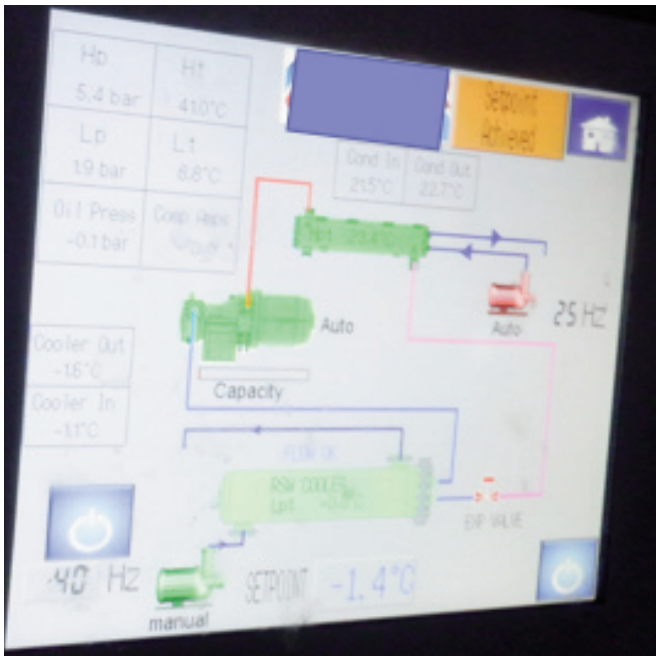
5.1 Extinguishing media

Suitable extinguishing media	:	Not applicable Will not burn
Unsuitable extinguishing media	:	Not applicable Will not burn

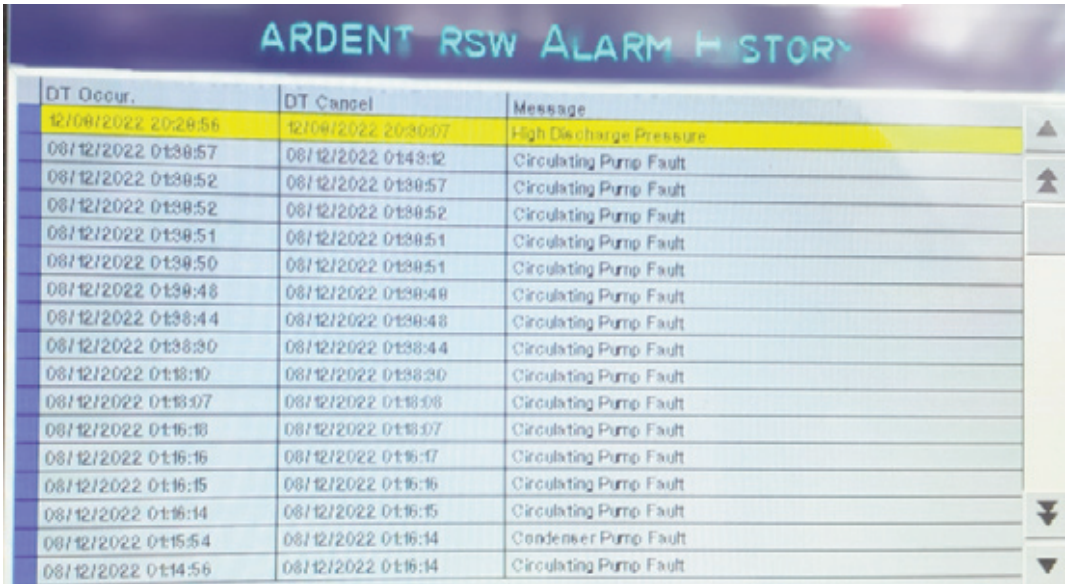
5.2 Special hazards arising from the substance or mixture

Specific hazards during fire-fighting	:	Exposure to combustion products may be a hazard to health. If the temperature rises there is danger of the vessels bursting due to the high vapor pressure.

Appendix 7.9 Additional Photographs



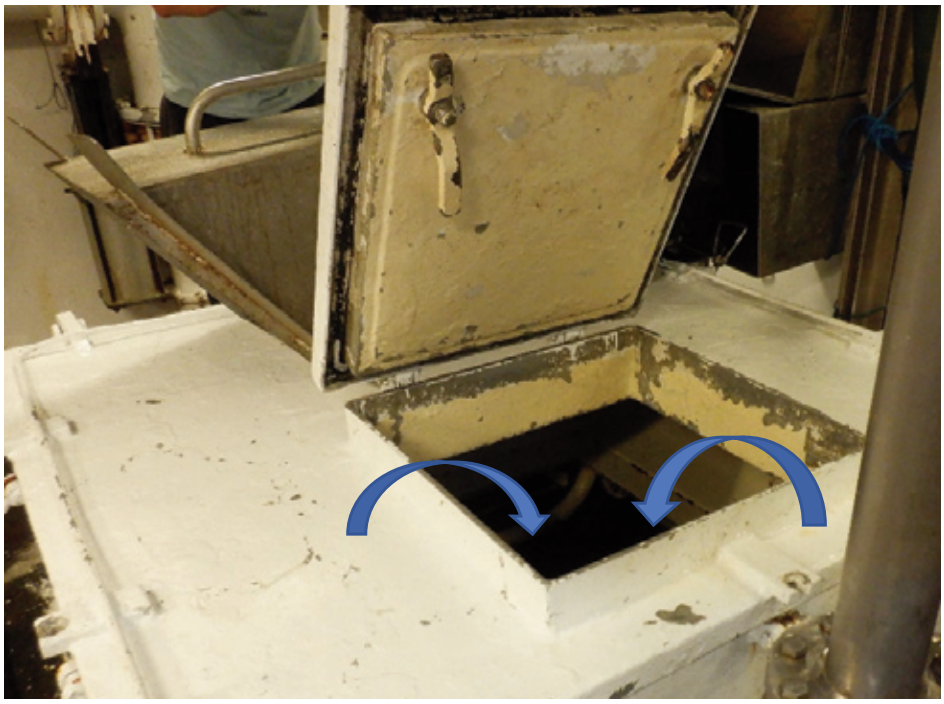
Picture No.5 RSW System Status Screen (during visit 6 November 2022)



Picture No.6 RSW System Alarm History Screen (31 March 2023)

Appendix 7.9 Additional Photographs

Picture No.7 Vessel Gas Alarm System



Picture No.8 Tank Ladder Access Hatch Opened as at Time of the Incident

Appendix 7.9 Additional Photographs

Picture No.9 Main Hatch Opened to Increase Air Flow

SECTION 36 PROCESS

Section 36 of the Merchant Shipping (Investigation of Marine Casualties) Act, 2000

It is a requirement under Section 36 that:

(1) Before publishing a report, the Board shall send a draft of the report or sections of the draft report to any person who, in its opinion, is likely to be adversely affected by the publishing of the report or sections or, if that person be deceased, then such person as appears to the Board best to represent that person's interest.

(2) A person to whom the Board sends a draft in accordance with subsection (1) may, within a period of 28 days commencing on the date on which the draft is sent to the person, or such further period not exceeding 28 days, as the Board in its absolute discretion thinks fit, submit to the Board in writing his or her observations on the draft.

(3) A person to whom a draft has been sent in accordance with subsection (1) may apply to the Board for an extension, in accordance with subsection (2), of the period in which to submit his or her observations on the draft.

(4) Observations submitted to the Board in accordance with subsection (2) shall be included in an appendix to the published report, unless the person submitting the observations requests in writing that the observations be not published.

(5) Where observations are submitted to the Board in accordance with subsection (2), the Board may, at its discretion -

(a) alter the draft before publication or decide not to do so, or

(b) include in the published report such comments on the observations as it thinks fit.

The Board reviews and considers all observations received whether published or not published in the final report. When the Board considers an observation requires amendments to the report, those amendments are made. When the Board is satisfied that the report has adequately addressed the issue in the observation, then no amendment is made to the report. The Board may also make comments on observations in the report.

Response(s) received following circulation of the draft report (excluding those where the Board has agreed to a request not to publish) are included in the following section.

The Board has noted the contents of all observations, and amendments have been made to the report where required.

8. MSA 2000 – SECTION 36 OBSERVATIONS RECEIVED

Note: The names and contact details of the individual respondents have been obscured for privacy reasons.

8.1 Correspondence from Crewmember and MCIB response

Hello [redacted]

My comments and observations as requested.

I will snip and sketch with comments underneath.

1.

Length Overall (LOA): 24.02 metres (m).

on page 7.

On Appendix 7.2- GA Drawing Title Block-Project 262 - FV Ardent, it shows the Length OA as 23.20m. This Appendix 7.2- GA Drawing Title Block-Project 262 - FV Ardent, seems to be incorrect and may be the older vessel the owner had had at one point.

2.

Engine Capacity: 749 kilowatts.

Engine Make & Model: Caterpillar 3512.

on page 7.

How many HP is a cat 3512?

Power Rating

Maximum Power	1500 HP 1119 kW
Maximum Torque	4580 lb-ft @ 1400 rpm 6210 Nm @ 1400 rpm
Rated Speed	1200-1800 rpm 1200-1800 rpm
Minimum Power	1020 HP 761 kW

How is it that the kWs are only 749kWs? when the Minimum Power stated on the website shows it to be 761kWs. this is not possible.

3.

RSW Tanks Capacity: 182 m3

- Centre Tank 73.13 m3.
- Port Tank 54.15 m3.
- Starboard Tank 54.66 m3.

on page 7.

On Appendix 7.2- GA Drawing Title Block-Project 262 - FV Ardent, it shows CAPACITY Fishold 143M3, and not 182M3 as shown on page 7. This Appendix 7.2- GA Drawing Title Block-Project 262 - FV Ardent, seems to be incorrect and may be the older vessel the owner had had at one point.

4.

2.5 Voyage Particulars

The FV Ardent and the pair FV Cisemair departed from Port Oriel, Clogherhead at approximately 15.05 hrs on 31 October 2022, to commence operations on fishing grounds in the Irish Sea. Having departed the harbour and while underway, the watch was transferred from the Skipper to the mate (Crewmember C), allowing the Skipper to conduct the fish tank cleaning in preparation for the filling and cooling of the seawater within the tanks.

on page 9.

It states that Crewmember C was mate onboard, I want to be clear I was not mate onboard, I was filling in for another crewmember and was not a full time crewmember.

5.

8.1 Correspondence from Crewmember and MCIB response

At approximately 15.30 hrs the vessel drive was disengaged by the crewmember on watch while the Skipper and crew dealt with the emergency situation onboard.

When the status of the crewmembers' condition was assessed and the need for assistance confirmed, the vessel reversed course and headed back to Port Oriel.

on page 9.

It states the vessel drive was disengaged by the crewmember on watch, this is inaccurate, the vessel was turned around straight away to Port Oriel, and the vessel drive was disengaged by the crewmember on watch.

6.

3.3 Incident -Casualty No. 1

3.3.01 At approximately 15.20 hrs Crewmember (C) took the helm and watch keeping duties, allowing the Skipper to undertake preparation tasks. The Skipper departed the wheelhouse and went forward with Crewmember (A) to prepare the tanks in order to receive the catch.
The standard procedure was to flush all tanks, prior to filling, with the centre tank first to be filled with sea water at 13-14 C (sea temperature at the time of the incident). The water is then pumped through a heat exchanger mounted on the main deck, cooling the water down to -1C /-4 C. When the sea water in the centre tank is chilled it will be used to store the initial catch.
The outboard tanks were first to be cleaned with the Skipper opening the required valves (Pic 1) and operated the pump to flush water into the tanks. The flushing requires the pumping of water to the upper and then lower diffuser while discharging the water via a bilge pump fitted in the engine compartment but operated via the deck panel (red arrow Pic 1).

on page 14.

I never once observed the tanks to be filled before the catch came onboard, they were only ever partially filled. 33% full at the very most.

7.

3.3.04 The Skipper had gone forward to the refrigeration plant room/compartment to disengage the RSW pump via the controls panel (that is approximately 3.5 m from the tank access hatch). As the Skipper exited the refrigerated plant room, he heard a noise of something falling originating from the centre tank and he returned to the tank access hatch (see Pic 3). Looking down the Skipper noted Crewmember (A) lying adjacent to the port side of the ladder (See Pic.4). The Skipper then called for assistance from the other crewmembers, who joined him at the tank access hatch. Being aware there may be a lack of oxygen within the space and the possibility of gases, an attempt to ventilate the area was initiated. All three tank covers, and a number of deck hatches and vents were opened to increase the volume of air flowing below the shelter deck and into the tank space. Crewmembers (B & C) prepared to access the tank in order to assess the condition of Crewmember (A)

on page 16.

Crewmember A was lying to the Starboard side of the ladder and NOT on the Port side as the DRAFT letter stated on page 16 or the report.
On another note, it stated that Crewmember B & C prepared to access the tank in order to assess the condition of Crewmember A, this is a bit shady as Crewmember C advised no one should go down the tank without BA bottles and proper PPE and to wait for the rescue services as we were only a short steam away from Port Oriel. Crewmember advised that we did not want to make one casualty turn into two. But crewmember C was overruled, and in turn there ended up being two casualties.

8.

3.4.02 The Skipper returned to the wheelhouse to helm the vessel into port. Crewmember (C) applied restraints to Crewmember (B) fearing that he may attempt to stand up or go to the aid of Crewmember (A). Crewmember (C) then communicated to Crewmember (A) that they were entering the harbour. He then went onto the upper deck to prepare the lines for the vessel coming alongside the pier in Port Oriel.

on page 17.

Crewmember C then communicated with both Crewmember A and B that we were going to be entering the harbour soon and to reassure them help was near.

9.

8.1 Correspondence from Crewmember and MCIB response

7 APPENDICES

7.1 Fishing Vessel Licence

7.2 GA Drawing Title Block, Project 262 – FV Ardent

on page 32.

These drawings in my opinion are different vessels as the specs do not match up.
Appendix 7.1- Vessel Fishing Licence seems to be more accurate but I would question the kWs as the model of engine cannot go below 761kWs, you can find that information online.
Appendix 7.2- GA Drawing Title Block-Project 262 - FV Ardent, seems to be incorrect and may be the older vessel the owner had had at one point.

That is pretty much it.

I hope this helps in the investigation going forward and here's hoping nothing like this happens in the future going forward.

Best Regards, [redacted]

MCIB RESPONSE: The MCIB notes the contents of this observation.

Leeson Lane, Dublin 2.
Telephone: 01-678 3485/86.
email: info@mcib.ie
www.mcib.ie