Report on the investigation of the

capsize of the fishing vessel

Noordster Z122

with the loss of three crew

11.5nm south of Beachy Head

13 December 2005

Federal Public Service of
MOBILITY and TRANSPORT
Maritime Transport
Vooruitgangstraat 56
1210 Brussels
Belgium

Marine Accident Investigation Branch
Carlton House
Carlton Place
Southampton
United Kingdom
SO15 2DZ

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This is a joint investigation report between MAIB and the Belgian Maritime Administration.

The MAIB, on behalf of the flag state has taken the lead role pursuant to the IMO Code for the Investigation of Marine Casualties and Incidents (Resolution A.849(20)).

Extract from

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2005 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2005 shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

NOTE

This report is not written with litigation in mind and, pursuant to Regulation 13(9) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2005, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

ALB	-	All Weather Lifeboat
CNIS	-	Channel Navigation Information System
EN	-	Echo November
EPIRB	-	Emergency Position Indicating Radio Beacon
ETA	-	Estimated Time of Arrival
ETV	-	Emergency Towing Vessel
FPSMT	-	Federal Public Service of Mobility and Transport
FV	-	Fishing vessel
GA	-	General Arrangement
Hp	-	Horse power (1 HP = 0.746kW)
HRU	-	Hydrostatic Release Unit
IJ	-	India Juliet
IL	-	Inshore Lifeboat
kW	-	Kilowatt
LSA	-	Lifesaving Apparatus
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Notice
MHz	-	Megahertz
Mrad	-	Metre radian
MRCC	-	Marine Rescue Co-ordination Centre
MSN	-	Merchant Shipping Notice
ROV	-	Remotely operated vehicle
Rpm	-	Revolutions per minute
SAR	-	Search and Rescue
TSS	-	Traffic Separation Scheme
UKHO	-	United Kingdom Hydrographic Office
UTC	-	Universal Co-ordinated Time

VCG		Vertical Centre of Gravity
VHF		Very High Frequency
VTIS		Vessel Traffic Information Service

Fastener	-	A fishing term for a seabed obstruction that can trap fishing gear
GZ	-	A measure of the ability of a vessel to return to the upright when heeled
Metacentric height	-	A measure of a vessel's stability

Noordster

Figure 1

SYNOPSIS

At about 1630 UTC on 13 December 2005, the 23.78m steel hulled Belgian beam trawler, *Noordster,* caught her port trawl gear on a fastener while fishing 11.5nm south of Beachy Head. During the ensuing attempts to free the gear from the fastener, *Noordster* listed rapidly and capsized. There was only one survivor of the four crewmen on board.

After *Noordster* became fast, the starboard trawl gear was hauled first to the surface, and the derrick was raised and the net and beam brought clear of the water. The port gear, with its derrick in the normal horizontal towing position, was hauled until the warp was tight, causing the vessel to list to port. The three crewmen on deck moved to the starboard side of the vessel as water came through the freeing ports and then over the port bulwark.

In the wheelhouse, the skipper attempted to call another Belgian beam trawler at about the same time as the main engine stopped. He then shouted to the crewmen through an open window, that he was unable to do anything more. The starboard trawl gear, hanging from the derrick head, probably then swung inboard and *Noordster* rapidly capsized to port. The crew then found themselves in the water. None of them were wearing lifejackets.

The youngest member of the crew swam to the upturned hull and managed to climb on to it. He saw the other two deck crew float past, face up, but he was unable to pull them on board the hull, and they floated away. A short while later, he heard knocking noises from within the hull, and assumed that the skipper was still inside the vessel.

It soon got dark and the survivor saw a number of ships pass by, but he was unable to signal to them.

The following morning, a passing ship saw the upturned hull and the survivor and raised the alarm. An intensive search and rescue operation began immediately, coordinated by Dover MRCC. The survivor was rescued by a Coastguard helicopter and a search by military and civilian vessels located and recovered the bodies of the two crewmen. Navy divers entered the hull of the wreck to search for the skipper, but were unsuccessful. His body was located a short distance away by other search units. However, before it could be recovered, the skipper's body sank and he has not been seen since.

Noordster began to drift, and she sank 2 days later in the separation zone between the south-west and north-east lanes of the Traffic Separation Scheme.

MAIB organised an ROV and diver survey of the wreck to help determine the likely cause of the capsize. The survey confirmed that the starboard derrick and trawl gear had been topped while the port derrick was still deployed in its trawl position, and the warp length had been reduced to approximately that of the depth of water at the capsize location. The clock in the wheelhouse had stopped at approximately the time of the capsize.

Recommendations have been issued to The Federal Public Service of Mobility and Transport (FPSMT), Belgium, which are designed to provide Belgian fishermen on beam trawlers with a greater awareness of the inherent dangers of fasteners. Additionally, a recommendation has been made to the FPSMT which seeks to minimise the risk that EPIRBs and liferafts fitted to Belgian fishing vessels become entrapped in the event of capsize.

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *NOORDSTER* AND ACCIDENT

Vessel details (Figure 1)

Registered owner	:	BVBA Noordster
Port of registry	:	Zeebrugge
Flag	:	Belgian
Type	:	Beam trawler
Built	:	1985
Construction	:	Steel
Length overall	:	23.78m
Breadth	:	6.08m
Gross tonnage	:	84
Engine power and/or type	:	Mitsubishi 6 cylinder 220kW diesel
Other relevant info	:	Lengthened by 2.80m in 1998

Accident details

Time and date	:	Snagging followed by capsize at between 1635 and 1658 UTC, 13 December 2005
Location of incident	:	50º 35.14N 000º 07.58E 11.5 miles south of Beachy Head
Persons on board	:	Four
Injuries/fatalities	:	Three crew fatalities
Damage	:	Vessel lost

1.2 BACKGROUND

Noordster was a Belgian owned and registered beam trawler which fished regularly in the English Channel and the southern North Sea (along the UK South East Coast, Belgian Coast and Dutch Coast). She frequently fished in the area to the south of Beachy Head where the accident happened.

The duration of the fishing trips varied between 4 and 11 days. Tows lasted between 1 and 2 hours depending on the amount of fish in previous catches. *Noordster* usually operated with a four man crew, all of whom were required to operate the vessel at times of peak workload.

1.3 NARRATIVE - FINAL VOYAGE

All times UTC

At 0900 (UK 0800) on 9 December 2005, *Noordster* Z122 sailed from her home port of Zeebrugge with four crew on board. They planned to fish for Dover sole, lemon sole and plaice in the English Channel, for about 8 or 9 days. Her fuel bunkers were full, and she had 10 tonnes of water and 10 tonnes of ice on board.

The crew fished continuously over the next 4 days, and by the afternoon of 13 December they had caught about 3000kg of fish, which had been stowed in the hold.

At about 1552 on 13 December, the nets were shot away and the crew spent about 30 minutes gutting and stowing the previous catch. Meanwhile, the skipper took *Noordster* in a northerly direction across the separation zone between the Inshore Traffic Zone and the South West Traffic Lane to the south-south-west of Beachy Head **(Figure 2)**.

After the crew completed gutting and stowing the catch, in accordance with the usual practice, two of them went to bed expecting to get about 1 to 1½ hours rest. The third crew member, the trainee engineer/skipper, went to the wheelhouse to assist the skipper. The trawl speed was about 4 knots.

At approximately 1607, *Noordster'*s skipper spoke to the skipper of another Belgian beam trawler, *Alles Wisselt* Z431, as they passed very close to each other. They discussed whether to try fishing at the Falls off Ramsgate either that night or the following day. They tentatively agreed to do so the next day, and *Noordster*'s skipper indicated that he was going for a rest.

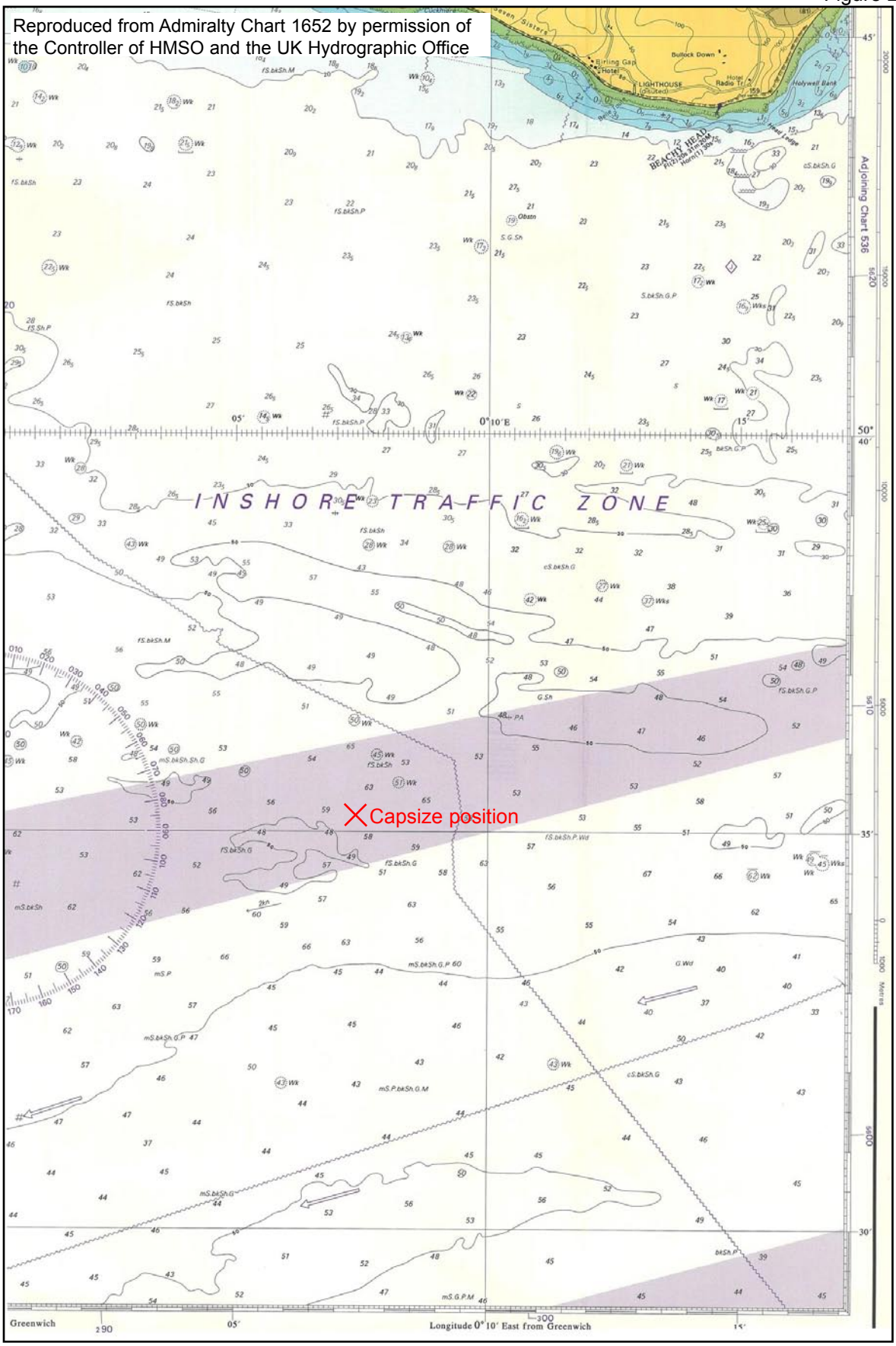
At about 1621, while still in the separation zone, *Noordster* turned slowly to starboard through about 180º and continued trawling on a near reciprocal heading.

At about 1630, *Noordster* swung rapidly to port on to an easterly heading, and abruptly stopped in the water. She had snagged her port trawl gear.

The skipper hauled in the starboard gear and left the derrick in the topped position. While trying to free the port gear the vessel began to heel and the three crewmen moved to the higher starboard side as the seawater flooded in through the freeing ports. The vessel continued to heel and water began coming over the port bulwark.

The main engine, which had previously been running at a normal 1800rpm, stopped.

Figure 2



Chartlet of Beachy Head and south west traffic lane of Dover Channel Traffic Separation Scheme

The skipper was heard trying to contact *Nele* Z87 on the VHF radio, but this was unsuccessful and, through an open bridge window, he shouted to the crewmen that there was nothing further he could do.

Within seconds, *Noordster* capsized to port and the three crewmen on deck were thrown in to the water. The men were wearing oilskins but no lifejackets. The youngest of them, the trainee skipper/engineer, managed to swim to the upturned hull and climb on to it.

The trainee saw the other two crewmen float past the hull, apparently unconscious, but face-up in the water. Although he attempted to pull them onto the hull, he was unsuccessful and they floated away.

The skipper was not seen, however the crewman on the hull heard knocking noises from within the hull and presumed that the skipper was trapped inside, but could do nothing to help him.

At 1658 *Noordster*'s radar target disappeared from the screens at the Channel Navigation Information Service (CNIS) station at Dover.

The crewman waited on the upturned hull, hoping to be seen and rescued. Daylight disappeared, and although he saw several vessels pass, he had no means by which to attract their attention.

1.4 NARRATIVE - SEARCH AND RESCUE

At 0836 on 14 December 2005, Dover Coastguard (MRCC) received a VHF call from the refrigerated cargo vessel *Toledo Carrier* reporting that they had sighted a sinking fishing vessel, 11.5 miles due south of Beachy Head. *Toledo Carrier* reported that two people could be seen and that she was preparing to turn and deploy her rescue boat.

At 0845, while rescue resources were being organised and tasked, a further report from *Toledo Carrier* clarified that a fishing vessel had capsized, that there was oil on the water and one man could be seen on the upturned hull **(Figure 3)**.

Eastbourne all weather lifeboat (ALB) and inshore lifeboat (ILB), Newhaven ALB and the coastguard helicopter India Juliet (IJ), based at Lee-on-Solent, were tasked initially. Several commercial vessels, a fishing vessel, the fishery patrol vessel *Watchful*, and the Royal Navy warship HMS *Severn* offered their assistance.

Photograph courtesy of the Maritime and Coastguard Agency Figure 3

Survivor on upturned hull

Most of the commercial vessels were asked to keep a sharp lookout while proceeding on their voyages, but the small general cargo vessel *Vanquish*, which had been following *Toledo Carrier*, launched her rescue boat at 0915. In addition, HMS *Severn*, with an ETA of 1 hour, made her way to the scene.

By 0920, the survivor had been winched on board the rescue helicopter and taken to Eastbourne Hospital. He told the helicopter crew that there had been four crew on board *Noordster*; one of the three missing crew was possibly inside the fishing boat and the other two were probably in the water.

At 0938, HMS *Severn* put a crewman on board *Noordster'*s upturned hull to listen for any man-made noises.

At 0949, as knocking noises could still be heard from within the hull, Dover MRCC organised Navy divers to be collected from Portsmouth and taken to the casualty by helicopter.

In the meantime, the Coastguard spotter plane, Echo November (EN), was tasked to assist with the search for the missing crewmen.

Two Belgian fishing vessels, *Alles Wisselt* Z431 and *Nele* Z87, advised Dover MRCC that they were proceeding to help with the search, and they confirmed that *Noordster* had been carrying four crewmen.

At 1014, Coastguard helicopter IJ told Dover MRCC that they would return to *Noordster* at 1100, with five Navy divers, and would need to lower the divers to HMS *Severn* for deployment on to the capsized hull.

At 1016, Newhaven ALB reported that they were attempting to recover a body from the water. At 1022 they reported that the body had sunk in position 50˚ 32.10N 000˚ 14.66E before it could be brought on board. They later reported that this casualty appeared to have been dressed in only thermal underwear.

At about 1112, Newhaven ALB recovered a body in position 50º 32.44N 000º 14.79E. The body was dressed in orange waterproof clothing.

At about 1140, the Navy diving team were transferred to *Noordster* using HMS *Severn*'s rescue boat. By 1216, a diver had completed a search of the accommodation, having found no-one, but continued to search for the source of the knocking noise.

At 1259, Dover MRCC was told that *Nele* Z87 had located another body. At 1310, Eastbourne ALB recovered the body that was clothed in foul weather gear.

In the meantime, the diver on board *Noordster* had carried out further searches of the bridge, accommodation, engine room and forward hold, without finding the source of the knocking. He was able to tell Dover MRCC that the vessel's nets were taut, and that she appeared to still be anchored to the seabed by whatever had caused the snagging.

At 1313, as all the crew members of *Noordster* had been accounted for, it was concluded that the knocking had been caused by equipment hitting the hull as it moved in the seaway. The diver search was abandoned.

At 1321, the rescue units were stood down and the Coastguard Emergency Towing Vessel (ETV) *Anglian Monarch* was designated as the safety vessel to standby *Noordster* **(Figure 4)**.

Several Belgian fishing vessels continued to search for the body which had been seen to sink earlier in the day.

Later that day, the Dutch salvage vessel *Multrasalvor* was contracted to assess the feasibility of salvaging *Noordster.*

During the morning of 15 December 2005, the wreck of *Noordster* was reported to be moving, with her fishing gear appearing to be bouncing on the seabed.

Multrasalvor arrived in the afternoon and attached a line to *Noordster*'s tail shaft. A diver was deployed to inspect the vessel at 1533. A light was also attached to the wreck.

At 1609, Falmouth MRCC received a 406MHz distress beacon alert from an Emergency Position Indicator Radio Beacon (EPIRB) registered to *Noordster* after the diver recovered it from the vessel.

By the early hours of 16 December 2005, the wreck had drifted into the Traffic Separation Zone at position 50º 28.9N 000º 17.34E. Later on that morning, the liferaft surfaced from the wreck. The wreck was also noted to be lower in the water, and was lying on its side with flotsam appearing from the hull.

At 1512, *Anglian Monarch* reported that *Noordster* had sunk in position 50º 27.39N 000º 17.43E in a charted depth of 42m.

The recovered bodies were identified as those of the two crew members. Despite the efforts of all those involved, the body of the skipper has not been found.

1.5 ENVIRONMENTAL CONDITIONS

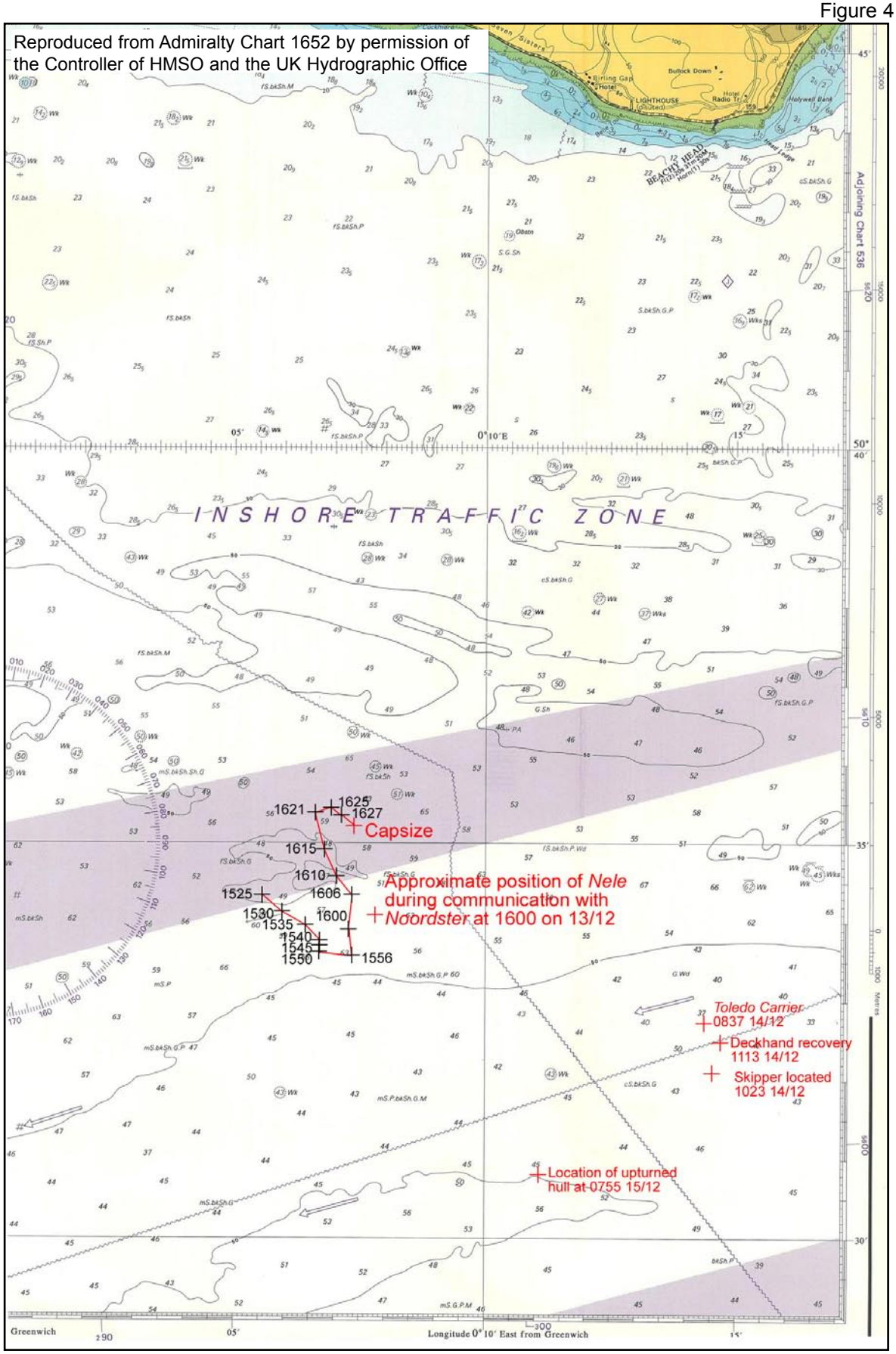
At the time of the accident, the wind was about force 3 to 4 from the north-west. The visibility was 11 nautical miles and the sea state was slight. High water at Dover occurred at 0908, and low water at 1629 that day. The tidal stream at the position of the accident would have been about 1 knot in a west-south-westerly direction. Sunset had occurred at about 1555 with civil twilight occurring at about 1633.

1.6 THE SKIPPER AND CREW

The skipper, Tom Vlietinck, was 35 years old and was also the owner of *Noordster.* He had worked on *Noordster* (as a fisherman) for more than 16 years. He served as a ship boy and seaman from 1986 until 1992. From the end of 1992 he had been the engineer/ skipper on board the vessel. He had gained his Belgian skipper's qualification in 1993 and his Belgian engineer's certificate in 1988.

Patrick Geryl was also 35 years old, and had worked as a fisherman for 9½ years, almost 5 of which were working on board *Noordster*. He had gained his Belgian watchkeeper's certificate in 1998.

Figure 4



Track of vessel from CNIS and search operation

Geert Meyers was 41 years old and had held his Belgian watchkeeper's certificate since 1999. He had sailed on board *Noordster* for almost 2 years, and had worked at sea for 10 years.

The survivor was the nephew of the skipper and was 19 years of age at the time of capsize. He had gained his Belgian certificate of competence as skipper trainee and engineer trainee in June 2005.

Four crew were required on board to meet the appropriate Belgian minimum manning requirement for *Noordster*. The requirement was for a skipper, two deckhands, and one crew member with limited experience. One of the four crew was required to hold an engineer's certificate.

1.7 BELGIAN FISHING INDUSTRY

In 2003, the Belgian fishing fleet consisted of a total of 125 motorised vessels with a gross registered tonnage of nearly 24000. The fleet consisted of mostly beam trawlers, with the remainder being otter trawlers. Approximately half of the beam trawlers were of small to medium size, up to 221kW (300hp).

The main fishing grounds of the fleet are the southern and central North Sea, with the English Channel fishing grounds accounting for about a quarter of the total fleet catch. There are three fishing harbours in Belgium; in order of importance they are: Zeebrugge, Oostende and Nieuwpoort.

1.8 *NOORDSTER*

Noordster was built in 1985 as a beam trawler, with an overall length of 21m, a breadth of 6m and a depth of 2.73m. The maximum draught at mid-length was 2.03m **(Figure 5)**.

Figure 5

Noordster prior to conversion

1.8.1 Structural modifications

In 1998, *Noordster* was lengthened by 2.80m, with the inclusion of a mid-section in the fuel tanks in order to give her a greater range. Her new overall length was 23.78m. Other modifications carried out at this time were the addition of an 11.85m ballast keel and a net drum aft of the wheelhouse for stern trawling. The gantry was moved 0.4m aft.

An inclining experiment was performed. This resulted in a new stability booklet, which was approved by the Belgian Maritime Authority. The booklet provided no specific advice or warnings regarding beam trawler operations, nor on the importance of retaining watertight integrity by keeping watertight openings closed at all times while at sea.

The vessel was approved and equipped to work as a beam trawler (including shrimp fishing using a different set of beams) and as a stern trawler. *Noordster* could carry up to 9 tonnes of fish.

General arrangement **(Figures 6, 7 and 8)**

Noordster's hull below main deck was divided into four main compartments. From aft these were: cabin, engine room, fish hold and net store. A forepeak tank was forward of the net store and a small aft peak tank aft of the cabin. Between the fish hold and the engine room were two 9000 litre fuel tanks arranged transversely across the hull. Below the net store were two 5100 litre fresh water tanks. Straddling the engine room and cabin was a galley/deckhouse structure with the wheelhouse above. Forward of the mess/galley, and above the engine room, were the electrically-driven winches.

Access to the wheelhouse from the working deck was via ladders on both port and starboard sides to the recessed weathertight doors. Each door was aft facing and hinged on its inboard side.

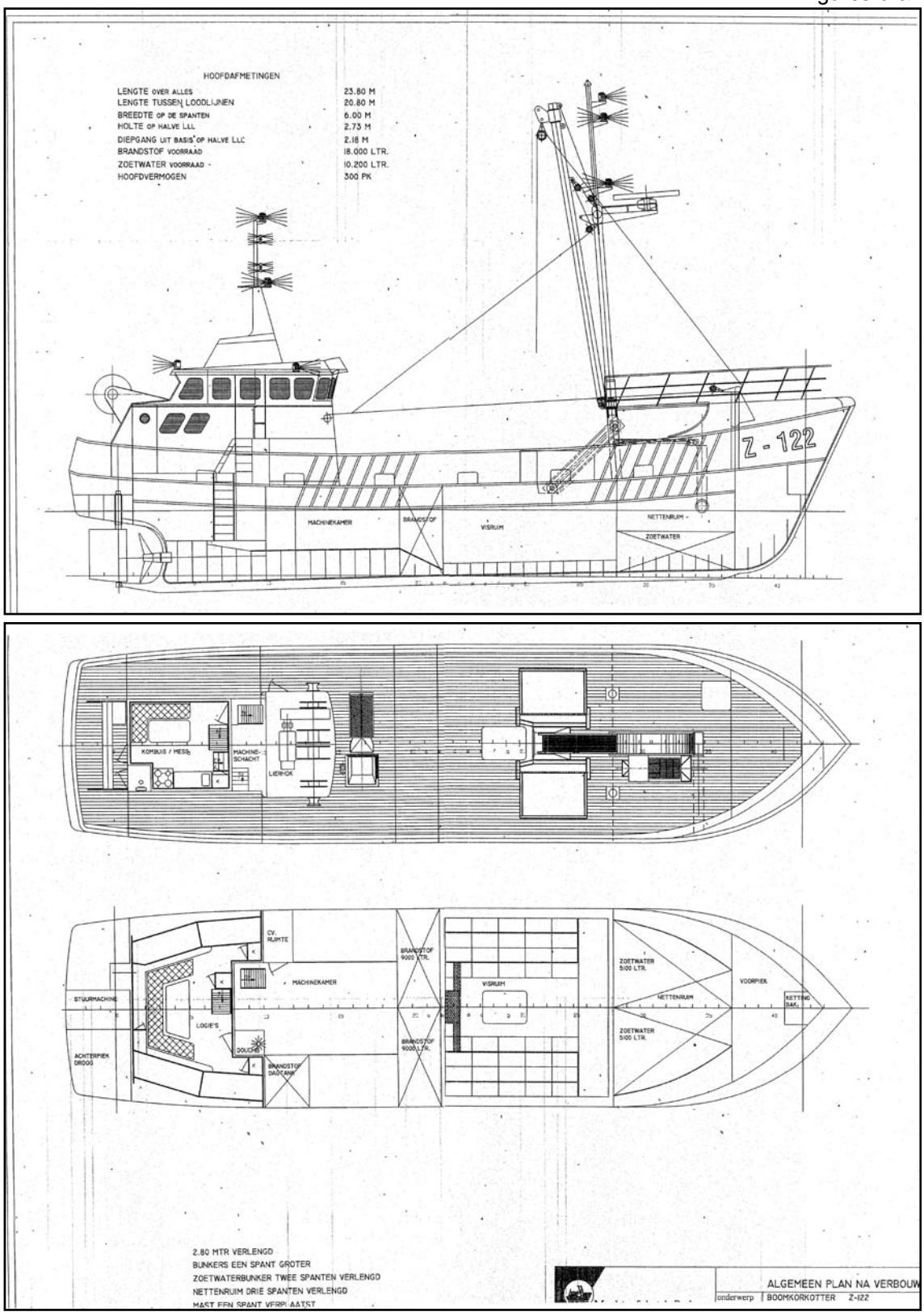
Internal access was by stairs on the starboard side in the wheelhouse leading to the galley/mess room. From there, the cabin was accessible via stairs at the port side.

The engine room could be accessed by a door at the port side on deck, and the winch room could also be accessed by a door on the port side at the working deck. Main propulsion was provided by a 220kW six cylinder Mitsubishi diesel engine. Engine protection devices included an oil level switch that would stop the engine if there was insufficient oil.

An oblong hatch in the main working deck, aft of the main gantry, provided access to the fish hold. Forward, and to port and starboard of this hatch, were the pounds where the catch was first landed on board. Between the pounds was the conveyor which took the catch forward and into the whaleback to the sorting table.

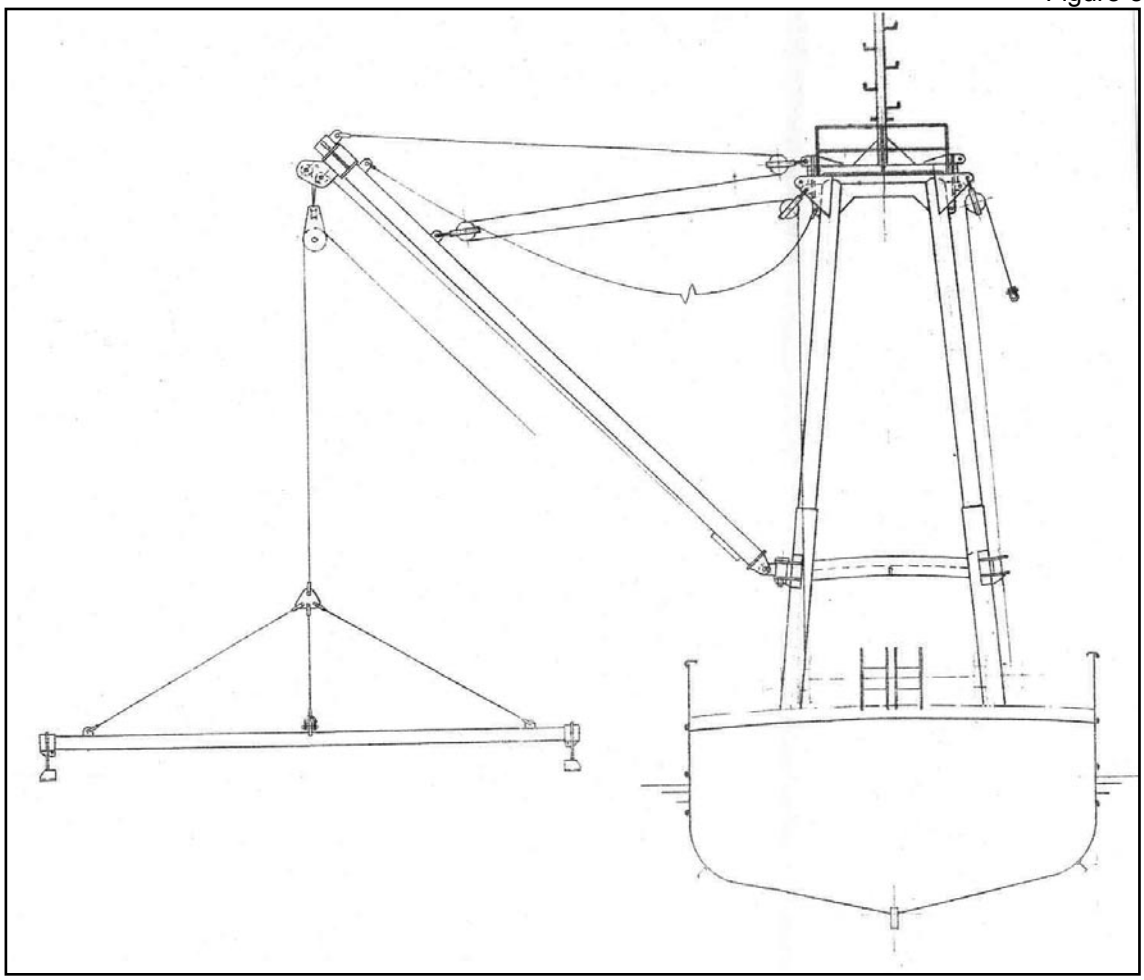
Within the whaleback, a hatch gave access to the net hold.

Figures 6 & 7



General arrangement

Figure 8



General arrangement

Gantry and derricks

The gantry and derricks were part of the vessel's original fitment, with the gantry being moved aft 0.4m during the 1998 conversion.

Noordster was equipped with a goalpost gantry just aft of the whaleback. The height of the gantry was 8m above the working deck. On the gantry crossbar a radar was fitted, and a lightweight mast to accommodate navigation lights. The gantry was secured by two spars which led forward and attached to the whaleback.

A pair of derricks, 9m in length, attached to the gantry uprights at a position approximately level with the aft leading edge of the whaleback. A pivot arrangement, between each derrick and gantry upright, allowed the derricks to swivel about the vertical and horizontal.

The beams being used at the time of the accident were 4.50m long. The GA drawing **(Figure 8)** depicts 8m beams which were used for shrimp fishing. Shrimp gear is longer but lighter than the bottom trawling gear that was being used. The length of the derricks was designed to be long enough to raise the shrimp gear sufficiently to bring the catch on board.

1.8.2 Towing winch

The towing winch on *Noordster* was a four drum electrically-powered unit, situated on the main deck within the forward part of the deck house structure. The winch characteristics are represented in the table below:

Layer	Diameter (m)	Length on drum (m)	Force (tons)	Velocity (m/min)	Force at stall (tons)
1	0.346	13	9.1	26.2	13.65
6	0.566	106	5.6	43	8.4
12	0.830	275	3.8	63	5.7

Underwater surveys of the wreck of *Noordster* indicated that she had 50m of fishing warp out on the port side at the time of the capsize. The evidence indicates that there would have been a maximum of 180m of line on the drum. Corresponding (estimated) values for force, and force at stall, are therefore 4.60tons and 6.90tons.

The drums were split into pairs, each serving the towing and topping wires for one side of the vessel. Each wire drum could be power-driven when clutched on to its respective drive shaft, or held stationary using a band type friction brake. The operation of the clutches and brakes was by levers in the wheelhouse.

Power supply

The winches were electrically-driven, with power coming from the main engine-driven generator. An auxiliary generator provided power for the magnetic field coils and general electrical requirements on board.

Drum selection and drive

The drum selection and drive was controlled by proportional winch control levers located on the port side of the wheelhouse.

Brakes and Clutch operation

The clutch and braking operation was carried out pneumatically through a reduced 30bar to 10bar air system **(Figure 9)**. This allowed the drums to be operated together or independently through the pneumatic system using electrically operated 220 volt solenoid valves for each drum.

1.8.3 Emergency releases

An emergency release arrangement was an integral part of the pneumatic control system for the towing winch brakes. The operating button for this system was situated on the wheelhouse console and was directly connected to a valve in the 10 bar compressed air line. Operating the button caused stored air from an air receiver in the engine room to pass via the lever-operated proportional valve to the brake pneumatic cylinders, which released the drum brakes and allowed the lines to run out at a rate dependent on the position of the lever.

There is no requirement for this emergency release mechanism to be checked or tested on a regular basis, and it is unknown when it might have been operated last.

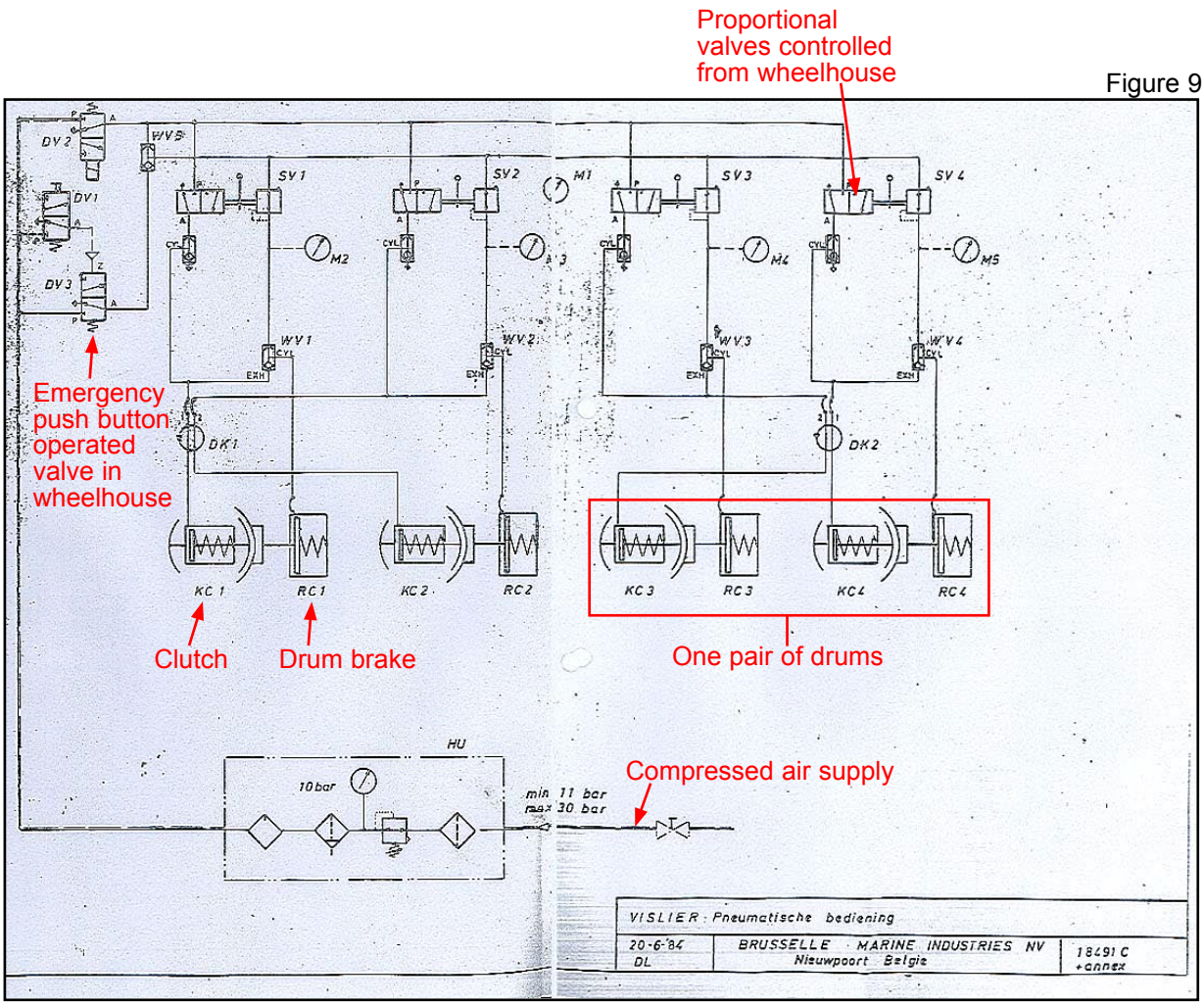
Additionally, each derrick was fitted with a mechanical release system **(Figure 10)** which was designed to release the derrick head block so that the point of suspension could be rapidly lowered and brought close to the ship's side in case of impending capsize.

1.9 SAFETY EQUIPMENT AND CERTIFICATION

Noordster carried a liferaft, which was located on top of the wheelhouse at the port aft end behind the funnel. The two lifebuoys were situated at the port and starboard aft quarters on the wheelhouse deck. The vessel's lifejackets were probably stored in the cabin below the main deck, although they are required to be stored in the wheelhouse. The EPIRB was located at the port side of the funnel. The liferaft and EPIRB were fitted with Hydrostatic Release Units (HRUs).

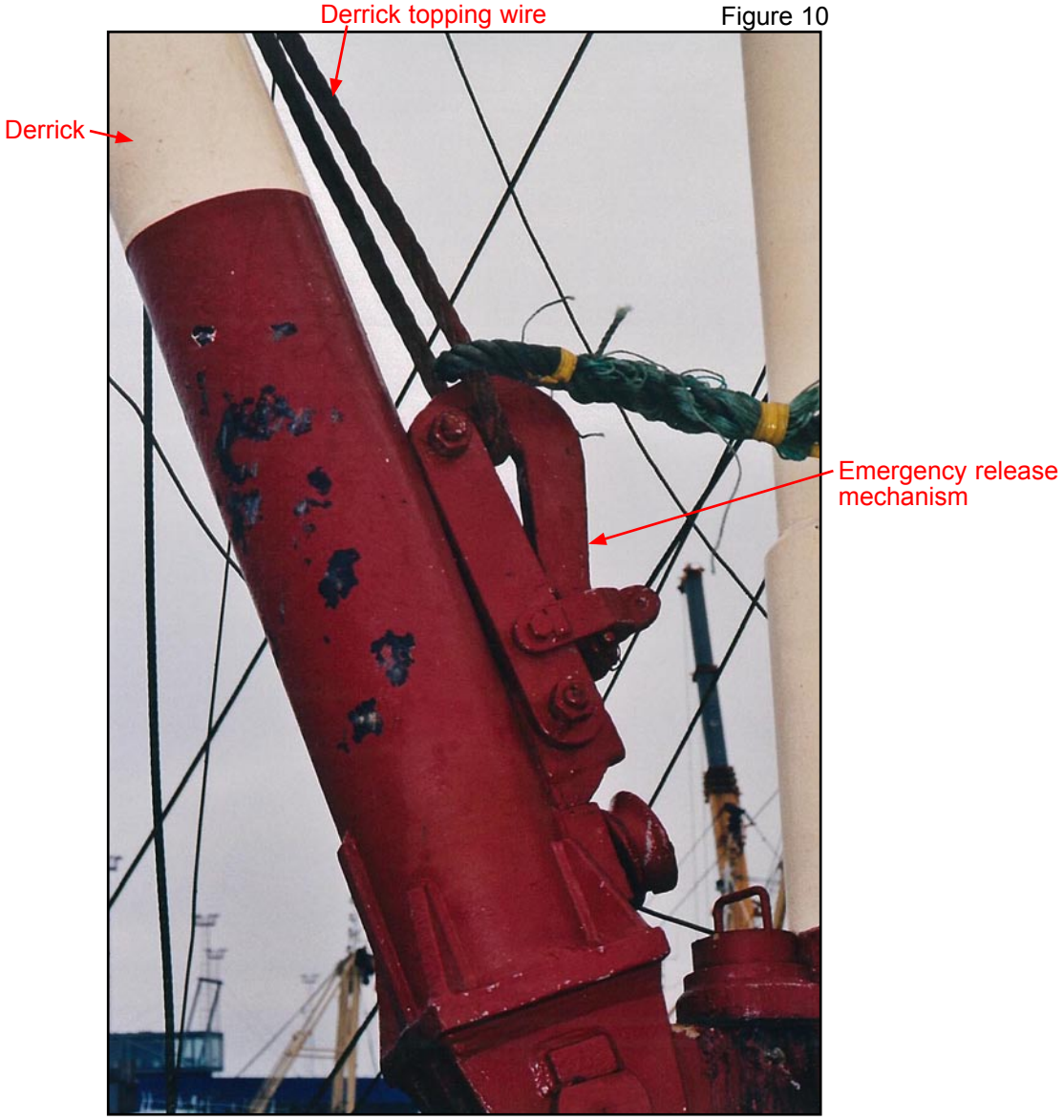
The vessel held a valid Belgian Certificate of Seaworthiness, and she had passed annual surveys on 12 May and 6 June 2005.

Figure 9



Pneumatic system

Figure 10



Emergency release arrangement similar to that of *Noordster*

1.10 FISHING OPERATIONS

Noordster was a twin beam trawler with the ability to operate as a stern trawler. When operating as a beam trawler, she employed heavy steel beams and derricks to tow the nets along the seabed. The derricks could be extended over each side of the vessel and, with the use of towing warps, support a steel beam each side. The derricks could be lowered and raised using controls sited in the wheelhouse.

In the towing condition, each derrick was horizontal, with two stays (fore and aft) attached to the derrick head to keep the derrick perpendicular to the vessel. The foremost stay was secured to the whaleback, while the after stay was secured to the vessel's quarter.

Each set of gear comprising a beam, chain mat and net, was towed by a wire passing from a towing drum on the winch, out to a block at the derrick head via blocks on the whaleback and then to a towing bridle. Three chains used in the bridle were attached to the beam and to the shoes at the ends of the beam. The total weight of one set of fishing gear on *Noordster,* comprising a beam, net and mats was approximately 2.5 tonnes.

The shoes enabled the beam to slide easily over the seabed and were able to pivot at the ends of the beam. They were usually fitted with chain preventers to minimise the chance of them being lost.

Foot ropes connected the beam to the net. The length of the footropes could be adjusted to suit different seabed types and topography.

One end of a line, known as a 'lazy deckie', was clipped to the inboard shoe. The other end of the line led to the entrance of the cod end and to a line encircling its throat. The 'lazy deckie' enabled the cod end to be lifted to a position over the deck and release the catch without the need to lift the entire trawl gear on board. When the gear arrived at the surface, the 'lazy deckie' was unclipped from the shoe and connected to a gilson rope. Using a warping drum, the weight was taken on the gilson and the cod end was lifted on board over the fish pound. The cod end was opened on deck to release the fish into the pound.

While towing, the nets remained in contact with the seabed, their mouths kept open by the heavy beam and floats. Between each beam and its net was a chain mat which was intended to disturb and encourage fish to rise and swim into the net. Within the net's mouth, the fish migrate through the belly of the net, a converging section leading toward the closed cod end.

Beam trawlers normally tow using warp lengths that are three times the water depth. *Noordster*, therefore, was likely to have had about 175m (3 x 58m) of warp out on each side when she came fast.

Some Belgian beam trawlers operate with a "weak link" encircling the net near the cod end, which is designed to fail if an excessive load is lifted, and will thus prevent the loss of the complete fishing gear. Previous cases have shown that this can be dangerous if both trawls are laden and only one trawl "weak link" fails, when sudden capsize can result. *Noordster* probably did have "weak links" fitted in her trawl gear, but the evidence indicates that these had not operated.

1.11 STABILITY

1.11.1 Minimum stability criteria

All Belgian fishing vessels must meet the following stability criteria:

1. The righting lever GZ should be at least 0.20m at an angle of heel equal to or greater than 30º;
2. The maximum righting arm should occur at an angle of heel preferably exceeding 30º but not less than 25º;
3. The area under the righting lever curve should not be less than:
    1. 0.055 metre-radians up to an angle of heel of 30º;
    2. 0.090 metre-radians up to an angle of heel of 40º or the angle of flooding, if the latter is less than 40º;
    3. 0.030 metre-radians between the angles of heel of 30º and 40º (or angle of flooding).
4. The initial metacentric height should be not less than 0.35m.

5. If the vessel is a beam trawler:
    a. The initial metacentric height should be not less than 0.50m;
    b. The values for righting lever and dynamic areas should be increased by 20%;
    c. The values for righting lever and dynamic areas should be increased by the following factor: horse power/(freeboard length)².

The vessel should be compliant with the above criteria in the following sailing conditions:

1. Departure;
2. Leaving fishing grounds;
3. Arrival;
4. Arrival with only 10% catch.

Noordster's stability book provided stability information for the above four sailing conditions for three different types of fishing operation. These fishing types were:

- shrimp fishing (long beams);
- bottom trawling (short beams);
- stern trawling.

Noordster met the required minimum stability criteria in all 12 combinations of sailing condition and fishing type.

1.11.2 Freeboard

The vessel had a minimum freeboard of 0.55m for each of the specified conditions. This is in accordance with the minimum freeboard required by the Belgian authorities for fishing vessels like *Noordster* which have been modified.

Since 1995, new fishing vessels have been required to have a minimum freeboard of 0.6m. The increased freeboard requirement was introduced as a consequence of a number of capsizes within the Belgian fleet.

1.12 THE SEABED IN THE VICINITY OF THE CAPSIZE

Noordster came fast and capsized in position 50º 32.7N 000º 14.45E. Current Admiralty Decca charts of the area indicate an area of foul ground in this position but, later, non-Decca Admiralty charts overlapping this area have had this foul ground notation deleted.

United Kingdom Hydrographic Office (UKHO) records show that a fisherman's fastener was reported close by this location in 1976. A note was entered into the contemporary charts to indicate the area as foul ground. A 1985 hydrographic survey of the area could find no evidence of the fastener. The notes of the survey record "*no wreck found in this position, but a rock ridge probably provides the fastener."* In 1987, a subsequent hydrographic survey found nothing other than *"a small gravely ridge"* in the area, and the area of foul ground was therefore deleted from navigational charts. There have been no further hydrographic surveys of the location since that time.

The seabed in the area of the capsize is not generally known by fishermen to have any wrecks or "hangers" (eg anchors). It is thought to comprise shingle, and the ground is described as flat. The area is heavily fished by trawlers.

1.13 SURVEY OF WRECK

MAIB organised an underwater survey of the wreck of *Noordster* with the objective of collecting further evidence that might help explain the sinking. Unsuitable weather conditions prevented an early attempt to carry out the survey, which was eventually conducted on 22 April 2006. The survey was attended by two MAIB inspectors, a naval architect of the Belgian Maritime authorities and a beam trawler expert.

The survey was carried out by contractors using, initially, a Falcon Remotely Operated Vehicle (ROV) to provide video images of the wreck. The ROV survey was supplemented on 9 June 2006 by a diver survey of the wheelhouse.

Detailed analysis of the results of these surveys, and those undertaken during the search and rescue operation, are at Section 2.3 of this report.

1.14 LESSONS LEARNED FROM OTHER BEAM TRAWLER ACCIDENTS

MAIB has investigated a number of other accidents involving beam trawlers that have capsized, often with loss of life.

1. In February 1991, the Plymouth registered *Pescado* was lost off the south coast of Cornwall, with all six crew, when her gear became snagged on the seabed.

   After the initial snagging, the two sets of gear probably became entangled, and the vessel heeled very heavily to starboard because of the weight of both sets of fishing gear coming on to the starboard derrick. She sank due to downflooding through openings which were not securely closed.

2. In November 1997, the Brixham registered *Margaretha Maria* was lost south-west of Lizard Point with the loss of all four crew.

   In an attempt to discover the cause of her loss, two underwater surveys on the wreck were carried out. Snagging was considered but, as her fishing gear had apparently been at the surface at the time she was lost, it was discounted.

   During the underwater surveys, the port net was found with a quantity of sand and shells, estimated to have weighed about 3.75 tonnes in water. The starboard net was found empty, and showed signs of serious damage. It was also found to be partly wrapped around the beam.

   Stability calculations showed that capsize to port would have been certain, immediate, and rapid had the starboard net failed with 3.75 tonnes in the port net.

   However, an alternative explanation was that the derricks had been raised to gain access to the lazy deckies, and reduced the stability of the vessel to a negligible amount. This would have resulted in even the slightest movement in the water being sufficient to turn the vessel over.

   As a result of the investigation into the capsize of *Margaretha Maria*, the MCA produced a video for operators of beam trawlers, entitled “Level Headed”. The video focused on stability issues. The video, together with a working model of a beam trawler, was used by the MCA to demonstrate stability problems during road shows in fishing communities around the UK. This initiative appears to have been successful, as there have been no further accidents of this type within the UK beam trawler fleet since. There is no similar training scheme in operation in Belgium.

3. In July 2002, the Zeebrugge registered Belgian beam trawler *Flamingo* capsized just inside UK waters to the east of Harwich. All four crew were lost while they were cleaning the nets prior to bringing the catch on board.

Although there were indications that the vessel did not capsize immediately, but remained at a large angle of heel to starboard for a short period of time, the bodies of the two crew members which were found were not wearing lifejackets.

The wreck of *Flamingo* was recovered, and the investigation revealed that both derricks had been topped, the starboard net was intact with about 250 - 500kg of stones in it, and the port net was empty with the lower 6 metres of the net missing.

The break in the port net had occurred at the “weak link”, designed to break first in the event of excess weight. This failure had caused a large heeling moment, leading to capsize.

The following recommendations were made as a consequence of the MAIB’s investigation into the loss of *Flamingo*:

To the UK, Belgian and Dutch authorities responsible for the safety of fishing vessels:

Advise operators and skippers of beam trawlers of the inherent dangers of the design of the “weak link” connecting the cod end to the trawl net;

Additionally, the Belgian and Dutch authorities:

Bring to the notice of operators and skippers of fishing vessels engaged in twin beam trawling:

a. Specific advice on the associated risks to stability when operating;
b. The importance of wearing lifejackets when working on the deck of fishing vessels.

The Maritime and Coastguard Agency (MCA) has issued various notices over the years regarding beam trawler operations as a result of beam trawler accidents.

Marine Guidance Notice (MGN) 265 (F) - *Fishing Vessels: The Hazards Associated with Trawling, Including Beam Trawling and Scallop Dredging, Notice to all Owners, Operators , Skippers, Crews, Managers, Gear Fitters, Ship Builders and Designers* is attached as **Annex 1** and was published in April 2004.

SECTION 2 - ANALYSIS

2.1 AIM

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

2.2 TRACK OF *NOORDSTER* AND TIME OF CAPSIZE

The Channel Navigation Information Service (CNIS) radar recorded the track of *Noordster* and other fishing vessels in her vicinity over the period of the accident. Although *Noordster*'s radar target was not identified and flagged on the system, it was possible to positively identify it by comparing times and positions with those automatically reported to the Belgian Authorities by the vessel's satellite monitoring equipment. All vessels of *Noordster*'s size and type must carry a satellite tracking device, which automatically sends her position to her flag state authority every 2 hours.

The following detailed information has been derived from analysis of the CNIS recorded information:

At 1520 on 13 December, *Noordster* was towing her gear at roughly 128º across the Separation Zone between the Inshore Traffic Zone and the South West Traffic Lane, about 10 miles south-south-west of Beachy Head. *Nele* Z87, another Belgian beam trawler, was also operating in the vicinity. At 1525, *Noordster* crossed into the South West Traffic Lane **(Figure 11)**.

At 1538, she began to slow down and, at 1542, with her speed reduced to about 1½ knots, she made a brief change of course to about 230º. Her speed dropped further to about 0.5 knot and then, at about 1552, she altered course back to about 110º. Her speed quickly recovered to about 5.0 knots. It is probable that she had hauled her nets, emptied the catch on deck, and shot the nets away again during this time.

At about 1555, she began a turn to port to a new heading of about north-north-west, while her speed reduced slightly to about 4½ knots. In the meantime, *Nele* was heading in an easterly direction on the port beam of *Noordster* **(Figure 12)** and, at about 1607 they passed very close to one another in position 50º 34.3 North and 000º 07.4 East, sufficient to cause a target swap on the radar. At 1610, *Noordster* re-entered the Separation Zone.

Noordster continued on approximately the same heading and speed until 1621, when she started a slow turn to starboard. By 1627, she had completed an alteration of course of nearly 180º, and she was heading about south-south-east. Her speed had not substantially altered. The presence of a number of vessels in the inshore traffic zone heading south-east indicated that this alteration was probably made for collision avoidance purposes.

At 1630, in position 50º 34.19 North and 000º 06.34 East, *Noordster* came rapidly to port to a heading of about north-east, and her speed dropped quickly **(Figure 13)**. By 1635, she was stopped.

The radar target of *Noordster* remained nearly in the same position until 1658, when it disappeared from the CNIS radar recording **(Figure 14)**. Her position at that time was 50º 35.14 North and 000º 07.56 East.

CNIS radar track of *Noordster*

Target data for *Noordster*

Figure 11

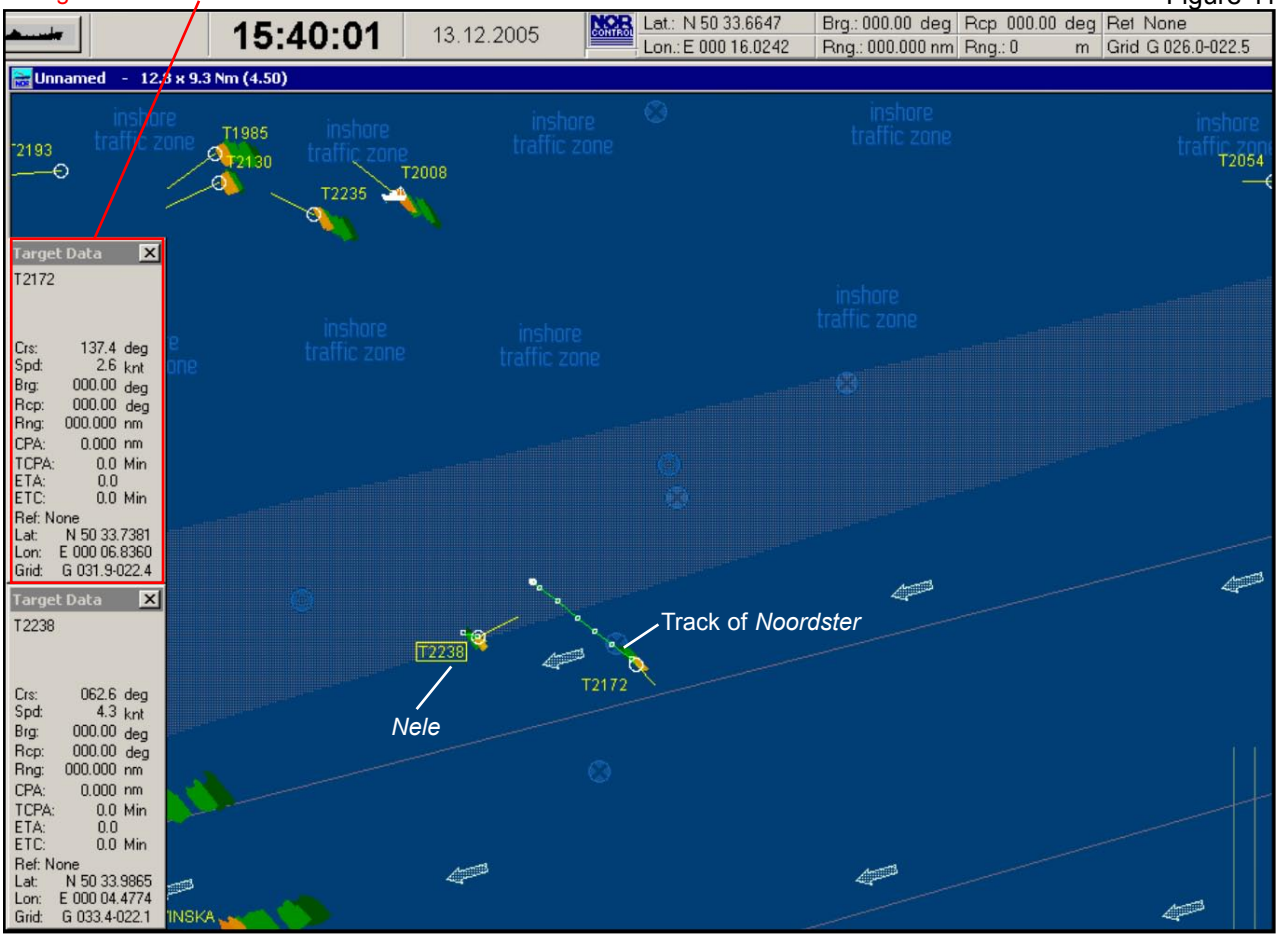
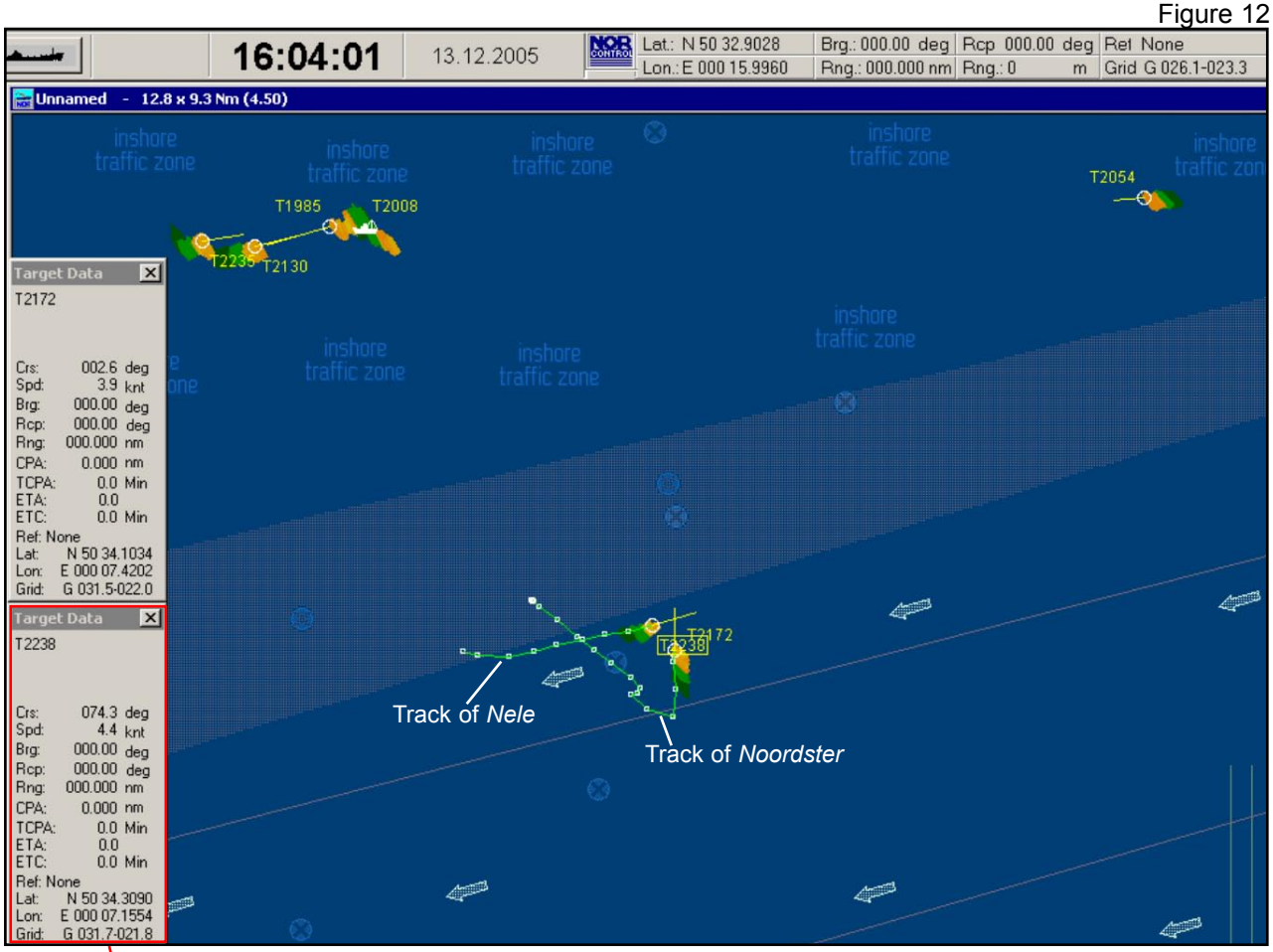
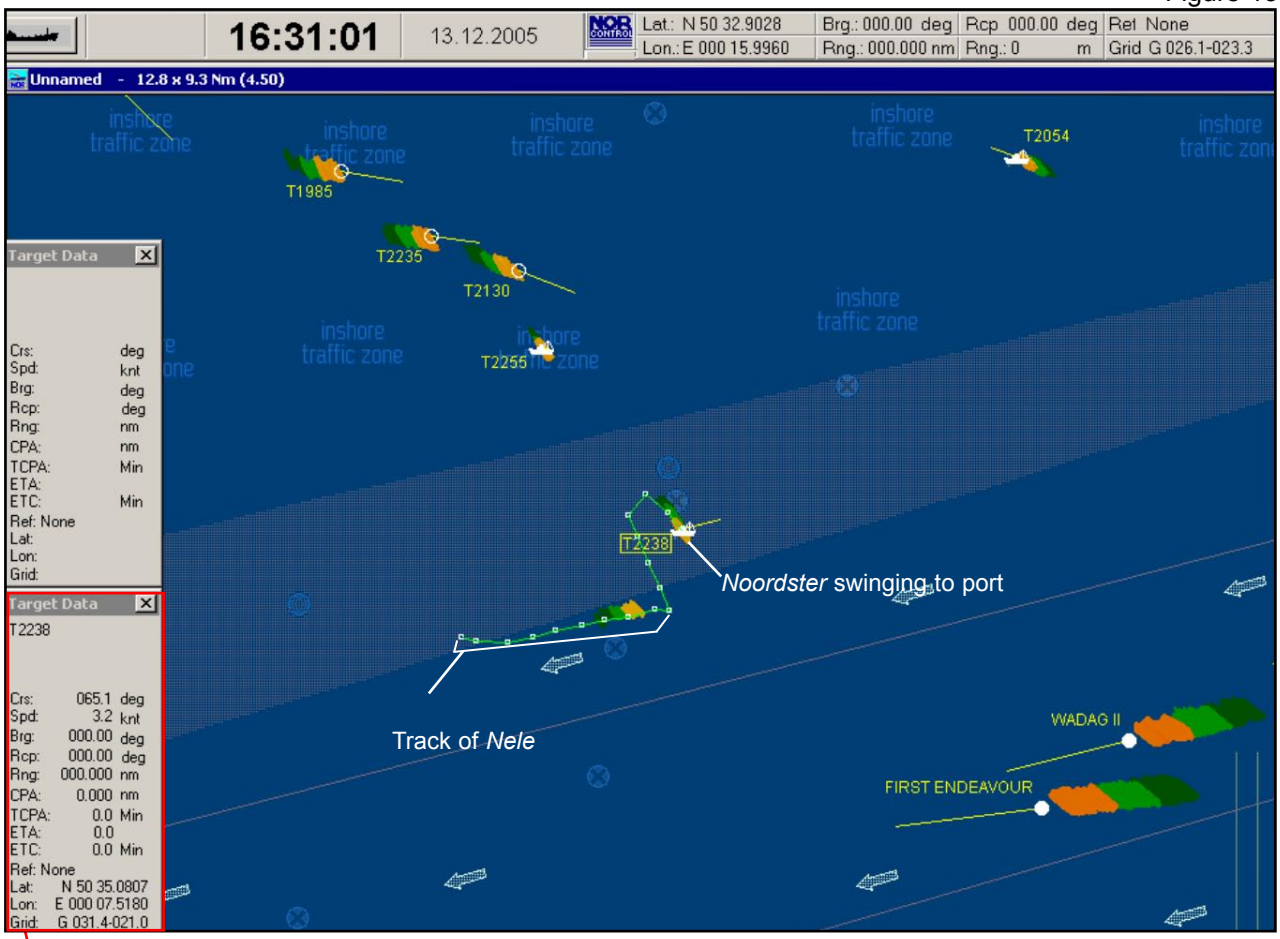


Figure 12



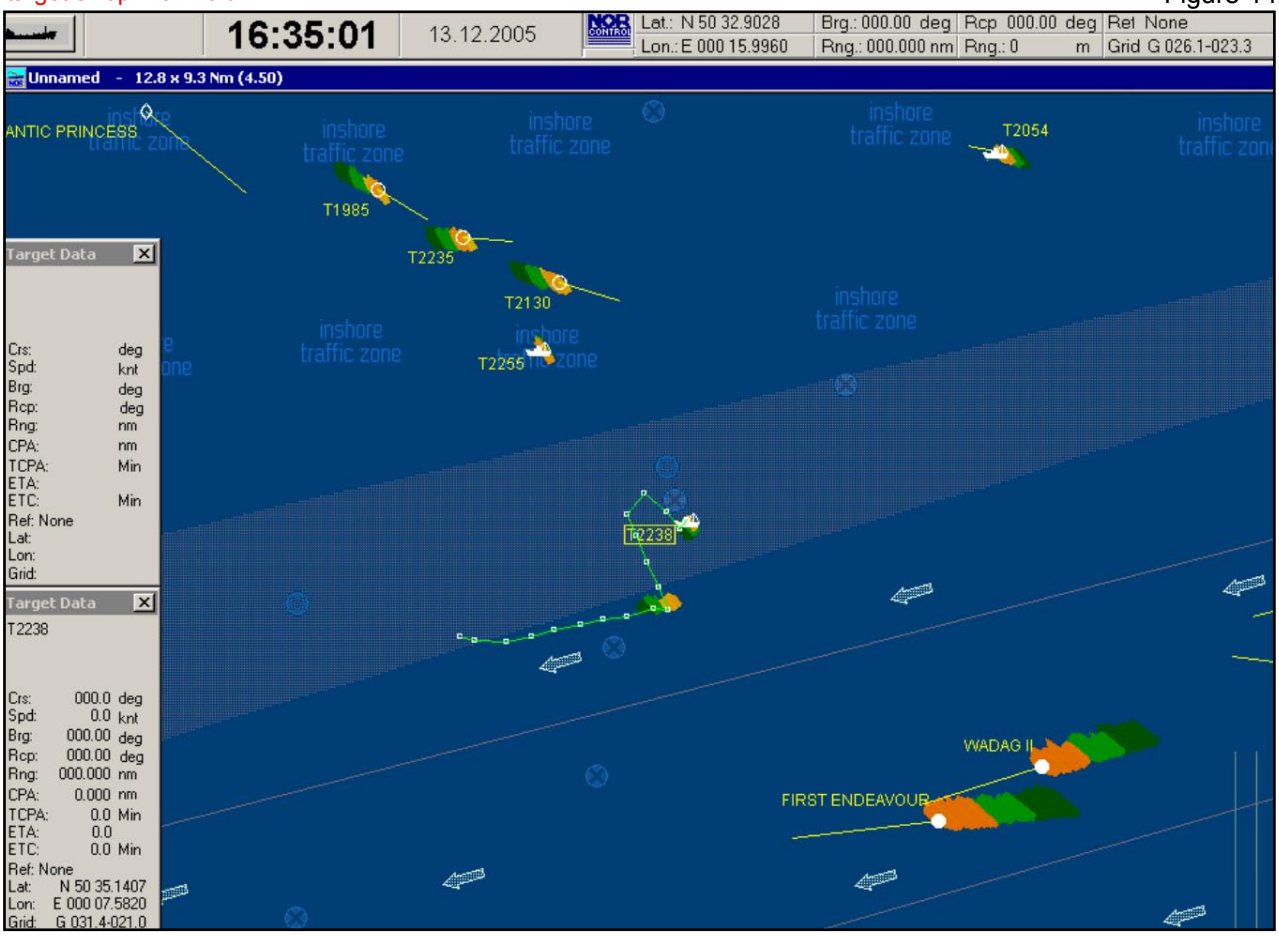
Target data for *Nele*

Figure 13



Revised target data for *Noordster* after target swop with *Nele*

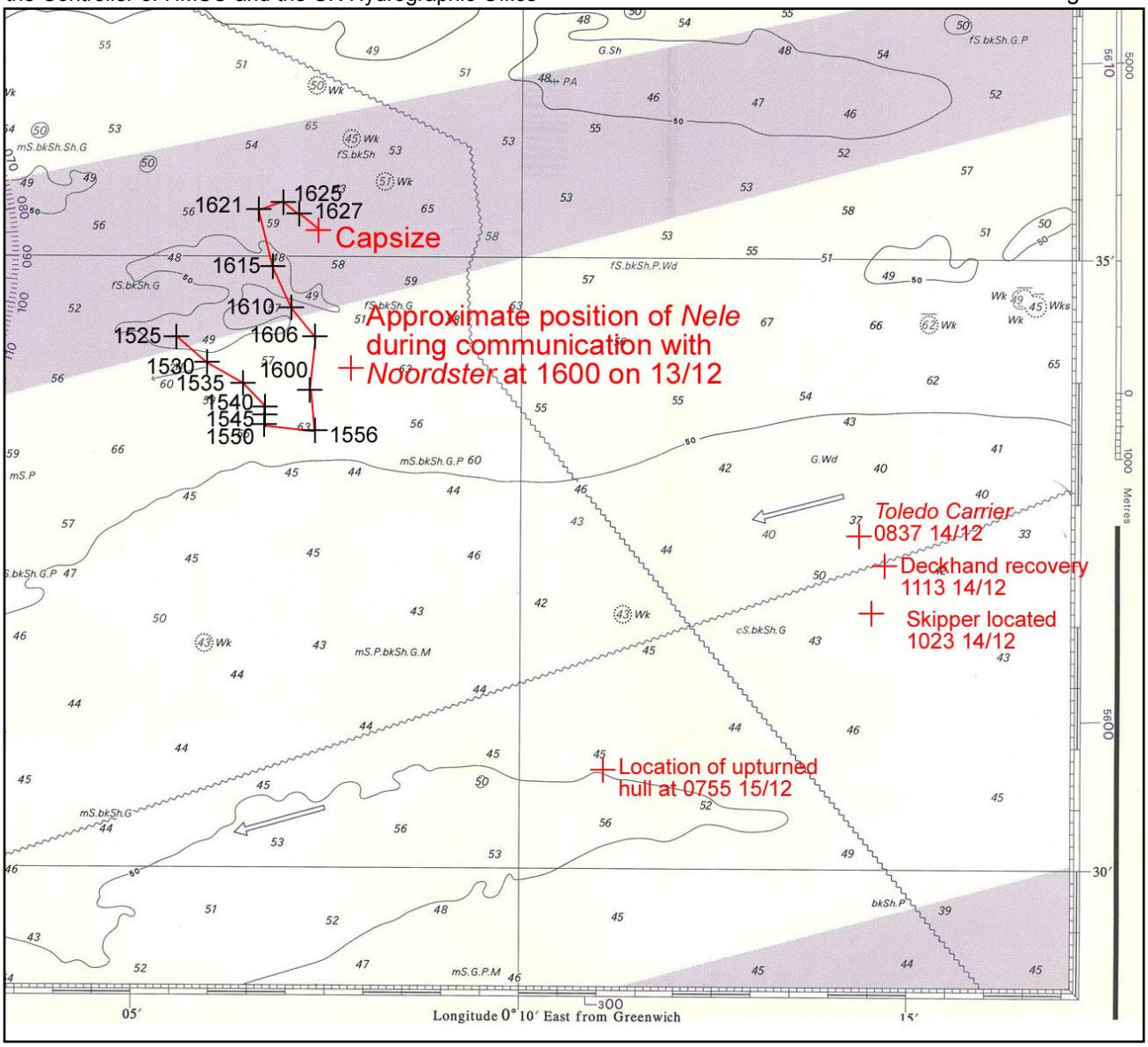
Figure 14



Noordster - Static in position 50° 35'N 000° 07'E

The analysis of *Noordster*'s track **(Figure 15)** and speed indicates clearly that her port gear probably came fast at about 1630. The fact that the vessel's radar target disappeared from the screens at 1658 might be indicative of the time of capsize. However, the elapsed time of 28 minutes does not accord with the survivor's evidence that everything happened very rapidly. Furthermore, the speed with which the gear could have been hauled, bearing in mind the amount of warp out and the speed and power of the winch, would indicate a likelihood that actual capsize happened earlier. It is possible that the upturned vessel offered a larger radar target initially which reduced as spaces began to flood and she settled further in the water.

Figure 15



Chartlet of vessel track

Wheelhouse clock **(Figure 16)**

During the underwater survey of the vessel's wheelhouse, it was determined that the wheelhouse clock had stopped at 1735. The clock would have been showing the local time on board (ie the time in Belgium), equivalent to 1635 UTC. Although there is no information available on the accuracy of the clock, its time of failure is too coincidental with the time at which *Noordster* appears to have come fast, for it to be ignored as an indicator of the time of capsize, although the time span of 5 minutes between coming fast and capsize, seems too short.

It is therefore concluded that the actual time of capsize cannot be determined with certainty, but it is believed to have happened between 1635 and 1658.

Figure 16

Wheelhouse clock indicating 1735 (or 0535)

2.3 UNDERWATER SURVEYS OF THE WRECK

2.3.1 Royal Navy dive team

The first search of the wreck of *Noordster* was carried out by a Royal Navy diving team during the search and rescue operation, which was commenced after the vessel and survivor had been discovered by *Toledo Carrier*. The divers were tasked to locate the source of the 'knocking' on board in case it had been made by a person trapped in the upturned hull.

It was concluded that the 'knocking' sound had been caused by floating debris contacting the hull. During the dive, the divers noted that the starboard fishing gear was hauled but the port gear was not.

2.3.2 *Multrasalvor* survey of the upturned hull

Multrasalvor, the appointed salvors for the vessel, deployed divers to inspect the upturned hull on 15 December 2005 for the purpose of determining its condition with respect to any future salvage effort. One of the divers had been a commercial fisherman earlier in his career.

The following information on the condition of the vessel was gleaned from this survey:

The wreck was found in an inverted condition with the bow about 20º lower than the stern.

At the port side, the engine room door was found open, with trapped air clearly visible under the top side of the stairwell. The diver secured the door with two of the locking dogs to ensure the air remained trapped.

The galley and accommodation were noted to have air within, and the access door was also open. This was also secured in the same way as the engine room door.

The divers found the starboard side door of the wheelhouse leading to the winch room closed, and the port side winch room access door open.

They noted the fishing gear suspended from the starboard derrick. They could see the beam and the opening of the net. The rest of the net appeared to be hanging and moving with a slow steady motion, which indicated to them that no weight was in the net. The 'lazy deckie' was found secured on a cleat on the forward starboard side of the wheelhouse.

The main fish hatch cover was found in an open position, leaving an opening of about 100mm. The divers were only able to secure the hatch with one dog on the port side, as the weight of fish from inside prevented it being closed further.

The fish chute was in an open position, and air bubbles were released occasionally with the motion of the vessel. The chute cover could not be closed, and it appeared to be jammed.

The divers found the port derrick out at an angle of about 45º from the vessel. The warp was under tension going into deeper water at an angle of about 30º.

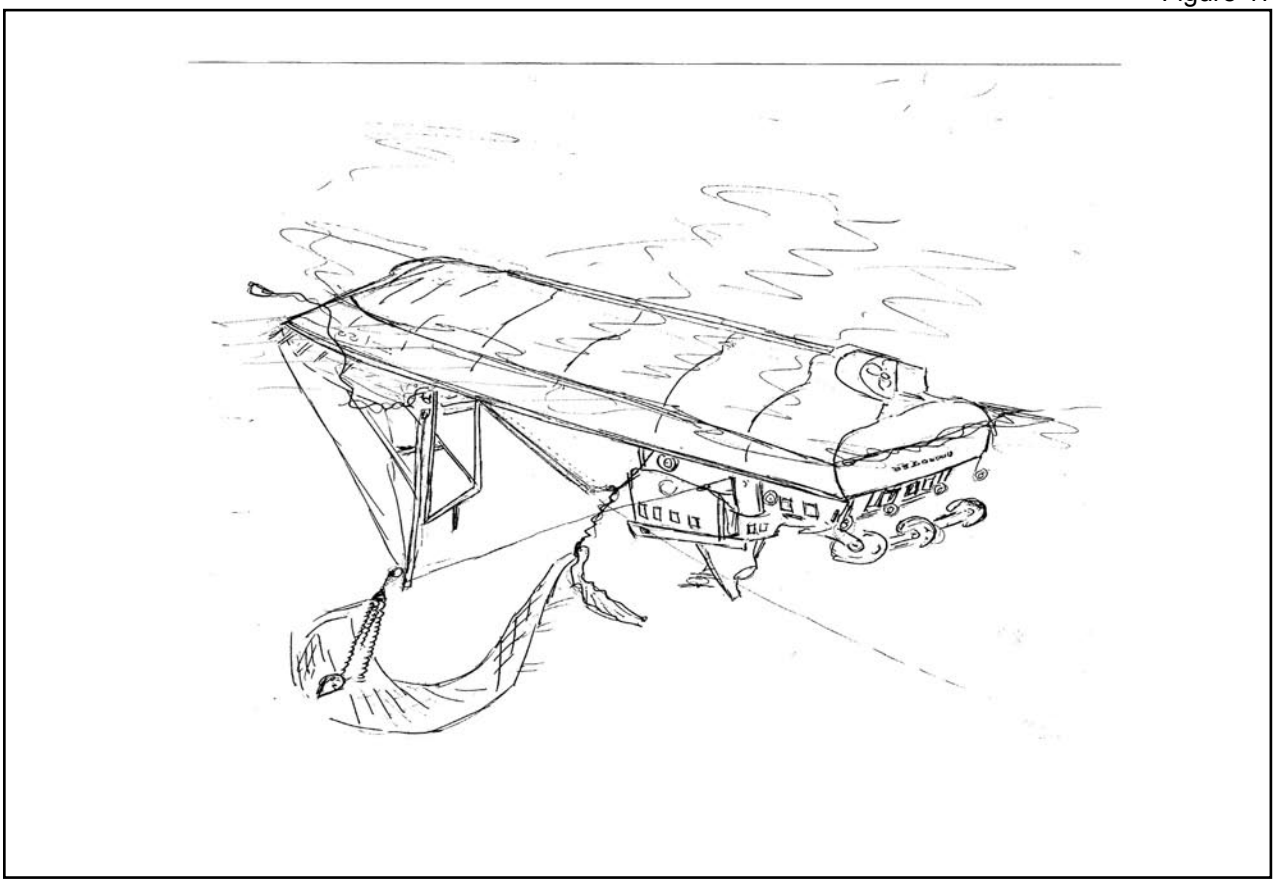
The port derrick stays had about 2 metres of slack in them, and the divers aborted further investigation of this area due to safety considerations.

On the starboard side of the wheelhouse, they found the EPIRB jammed in between a light bracket on the side of the superstructure in the galley/accommodation area. The EPIRB was found in the 'ON' position. The divers released it and brought it to the surface.

During the dive operation, the divers saw no damage which could have been caused by a collision.

The divers later produced a line drawing of their interpretation of the condition in which they found the wreck **(Figure 17)**.

Figure 17



Drawing produced by *Multrasalvor* diver while vessel was afloat and inverted

2.3.3 ROV survey of the wreck on the seabed

The results of the ROV survey which was carried out on behalf of the MAIB on 22 April were as follows **(Figures: 18 - 28)**.

The actual location of the wreck of *Noordster* was at position 50º 27.403N 000º 17.358E. It was found in a near upright condition with a list of about 10º to 15º to port, and lying on a shale bottom at 48 metres depth. The water conditions were good, with visibility of about 6 metres.

The rudder was found at an angle of approximately 15º to port, no damage was noted, and the sacrificial anodes appeared intact. A wire and shackle, attached to a towing rope, was attached to the rudder post, believed to be the rope the salvors used to steady the wreck. The propeller was not fouled and the kort nozzle was intact. The starboard hull was undamaged, but had accumulated a thin layer of marine growth.

The starboard derrick had been raised (topped) to about 60º or 70º from the horizontal. The towing bridle was hauled close up to the derrick head block. The beam was suspended by the three chain bridle, and the weight of the beam was putting strain on the topping lift, keeping the derrick in roughly the position it would have been just before the capsize. The empty starboard net hung from the beam and did not appear to be damaged. The trawl net hung just outside of the starboard gunwhale. The starboard backstay appeared tight, and the foot rope had been shortened.

The cod end had been hauled and emptied, although the cleat for the starboard 'lazy deckie', which is sited above the whipping drum, was bent and no longer retained the line. On the forward starboard side of the deckhouse, a floodlight from the wheelhouse top hung from its cable close to the deck. Also on the starboard forward corner of the deckhouse, was the dislodged radar scanner, still attached to its support bracket, which rested against the whipping drum.

On the port side of the wreck, the port derrick was fully out at a near horizontal angle, with the topping wire taut. The warp ran out from the wreck and the 50m mark could be seen on the warp near the derrick head. The warp was tight and was not fouled on any part of the wreck. The port trawl gear was laid out on the seabed so that the towing bridle, beam and chain mat could be clearly seen. The chain mat was intact. The net lay in a clump and the contents could not be seen.

The light mast at the top of the forward gantry had been bent over to starboard, and the lower section of the mast steelwork had fractured. A mooring rope had become entangled around the mast. The forward stay for the starboard derrick was taut.

The wheelhouse windows were intact, and the ROV was unable to video the inside.

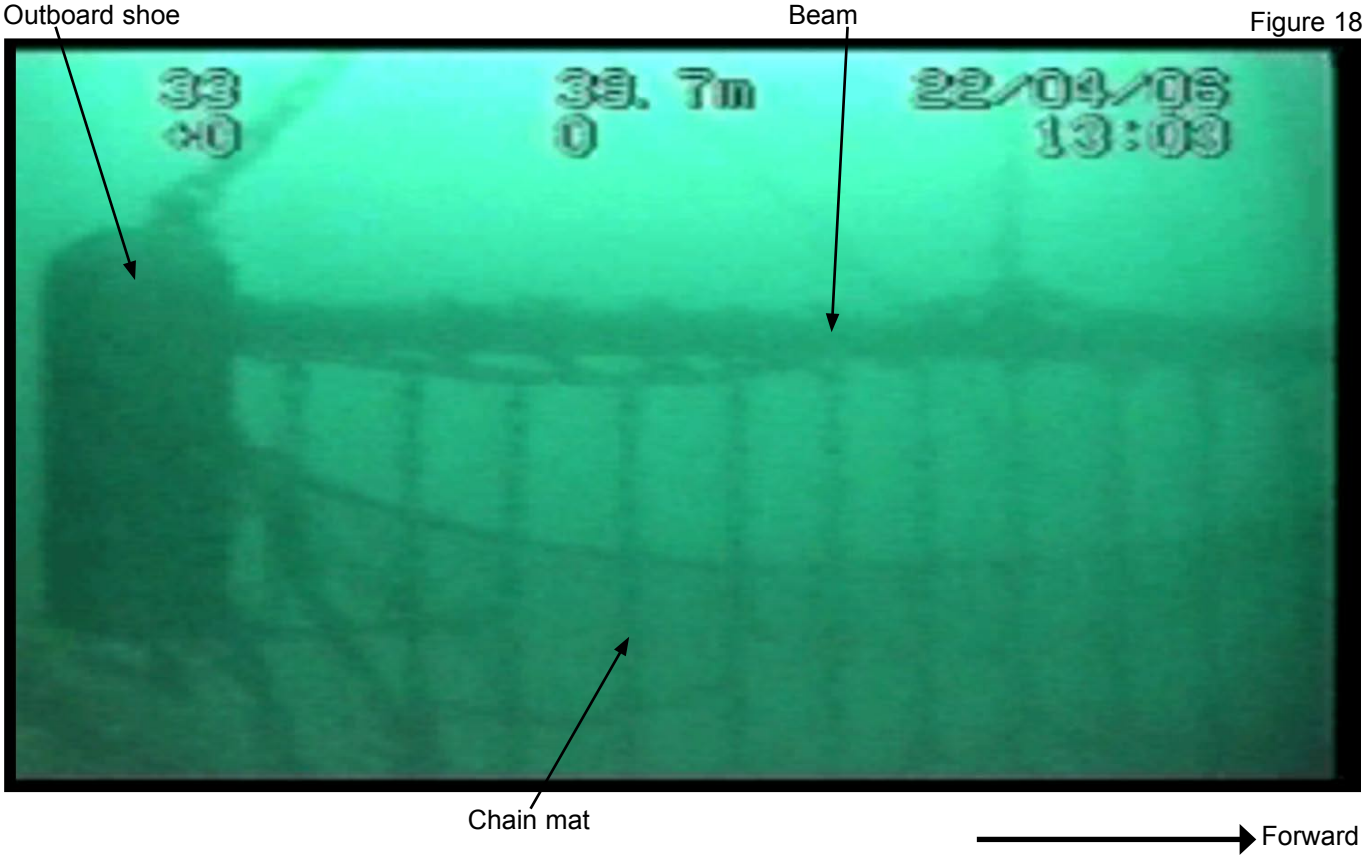


Figure 18

Starboard beam and chain mat

Figure 19

Figure 20

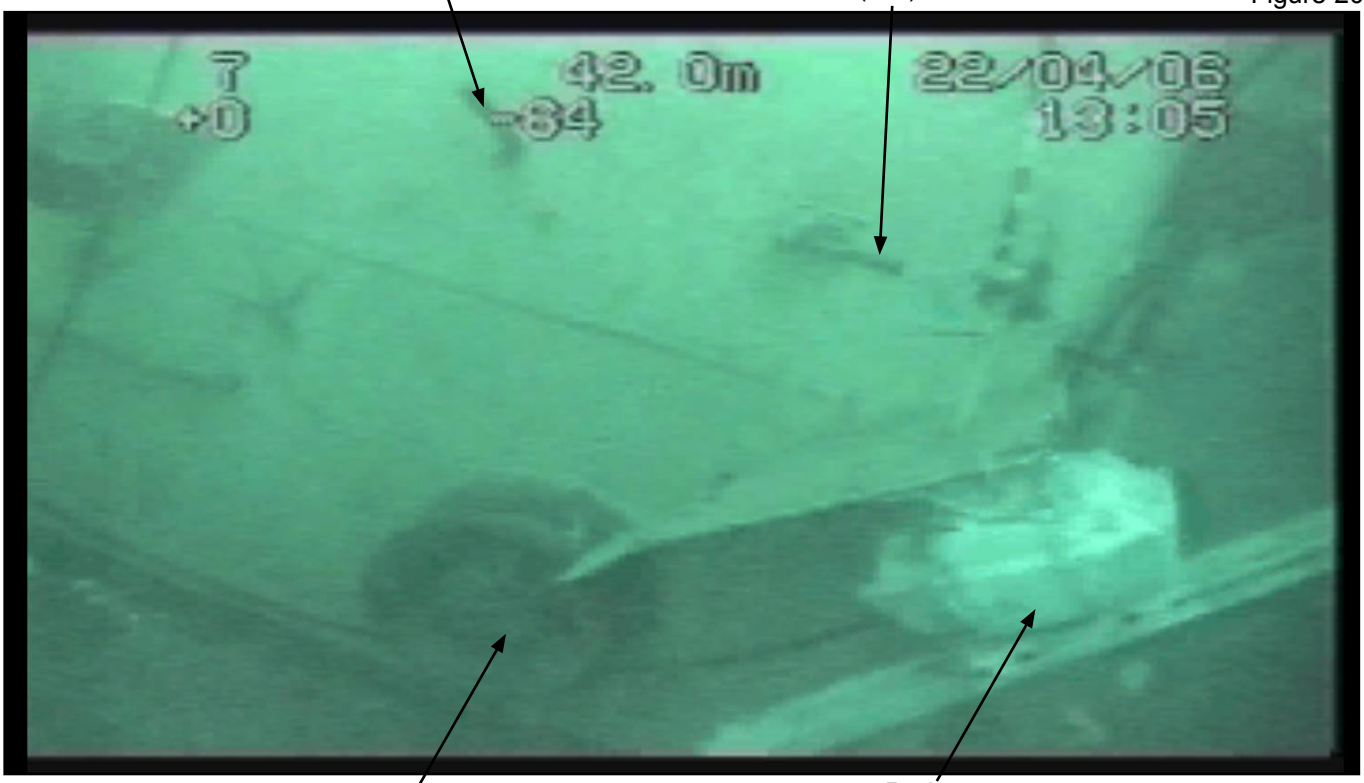
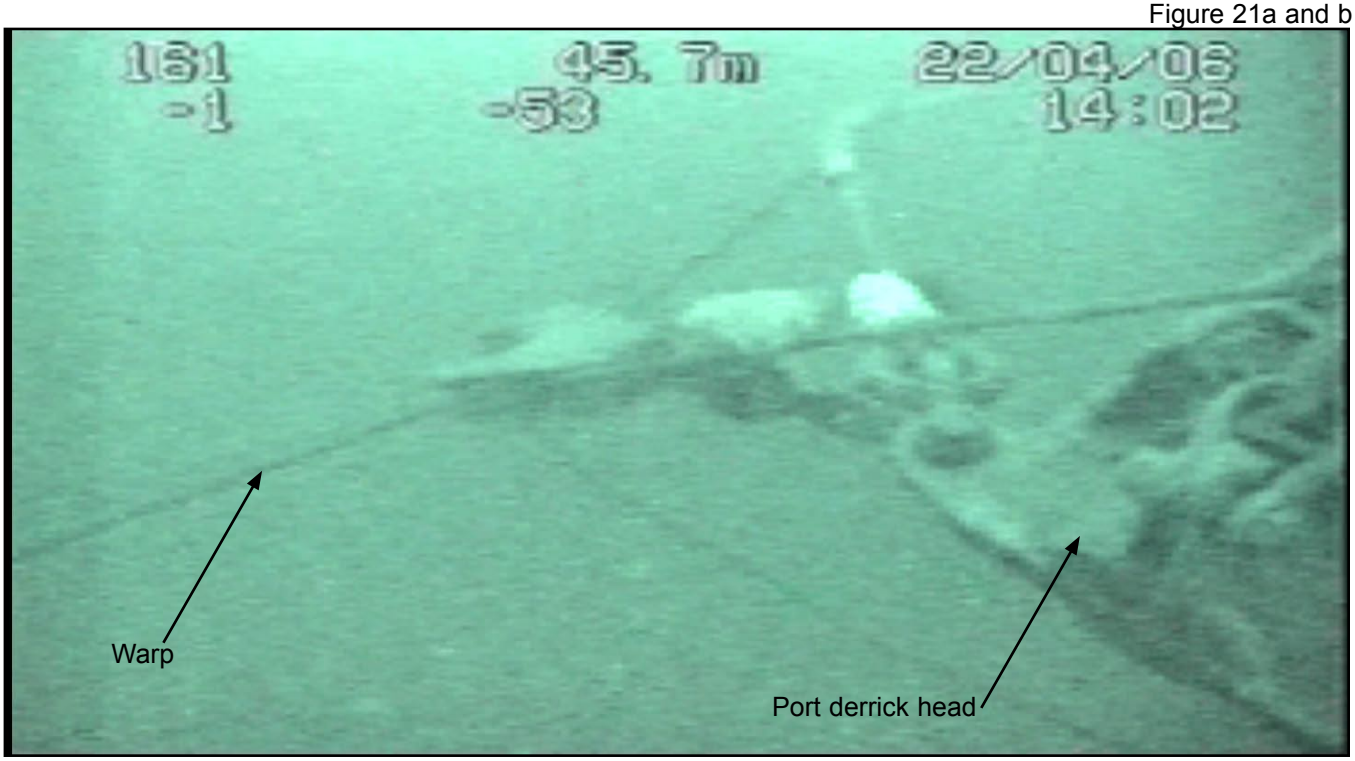
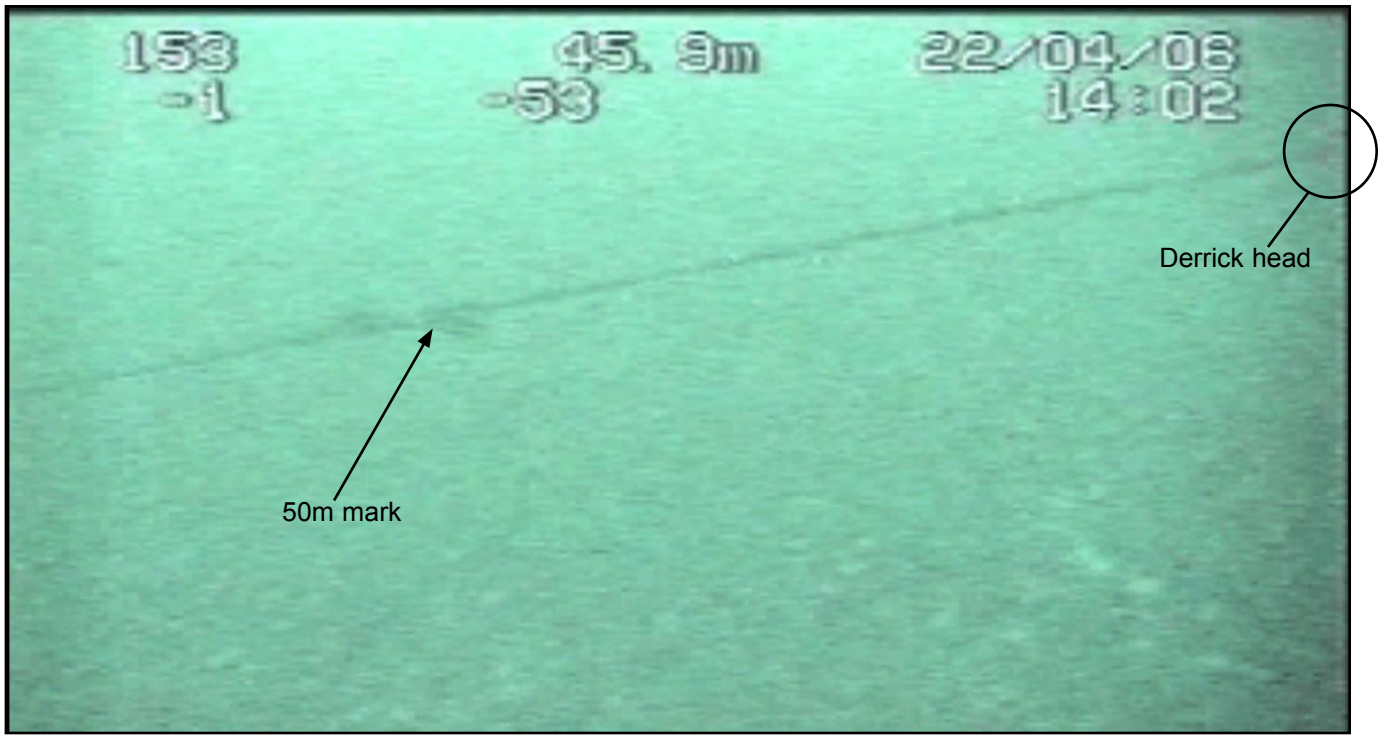


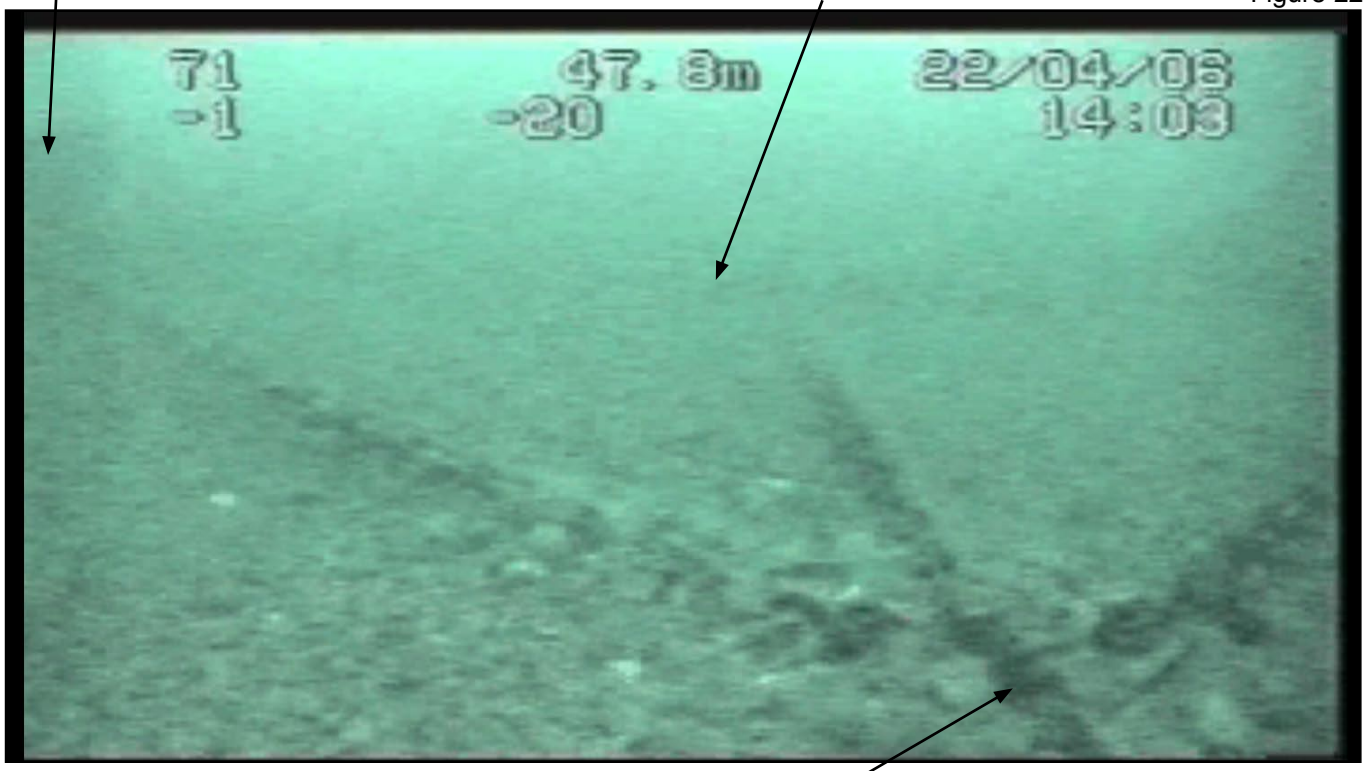
Figure 21a and b





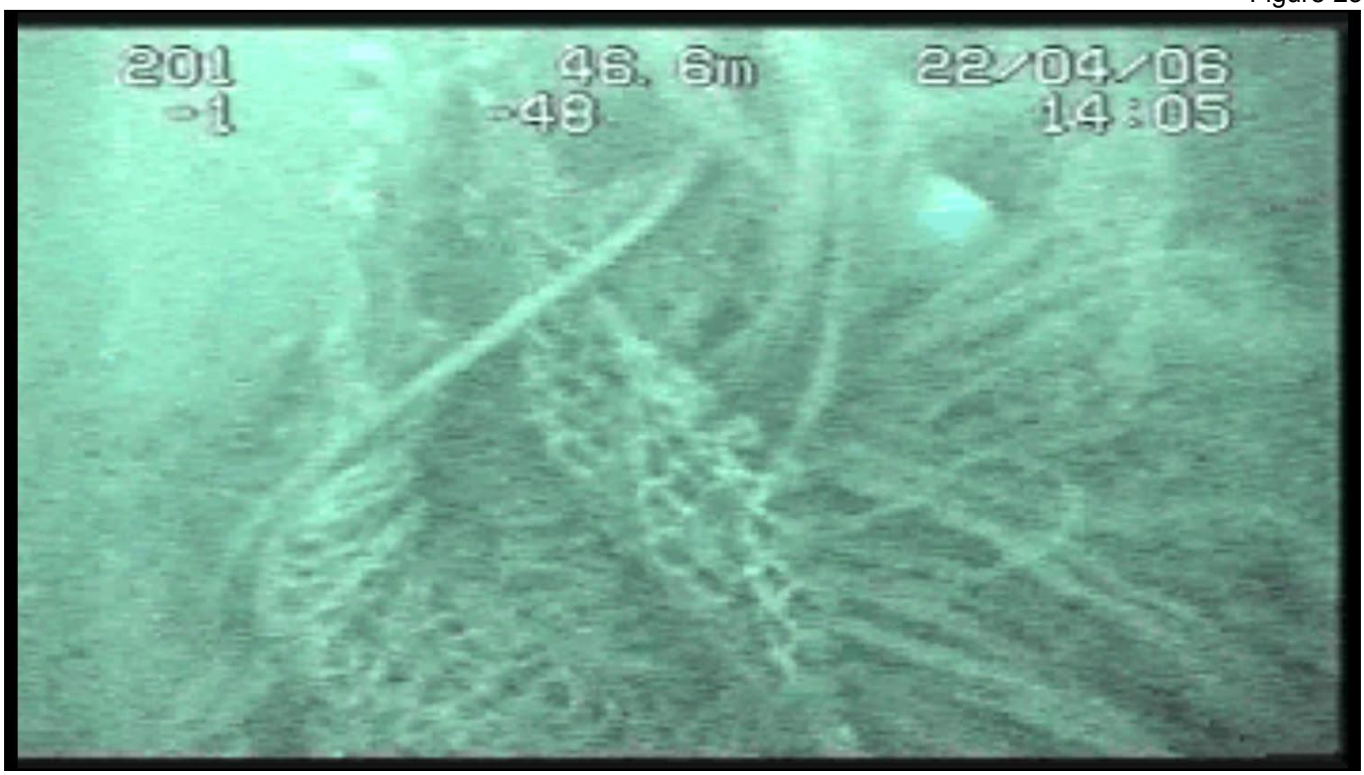
Port derrick head and warp with 50m mark

Figure 22



Port gear on seabed

Figure 23

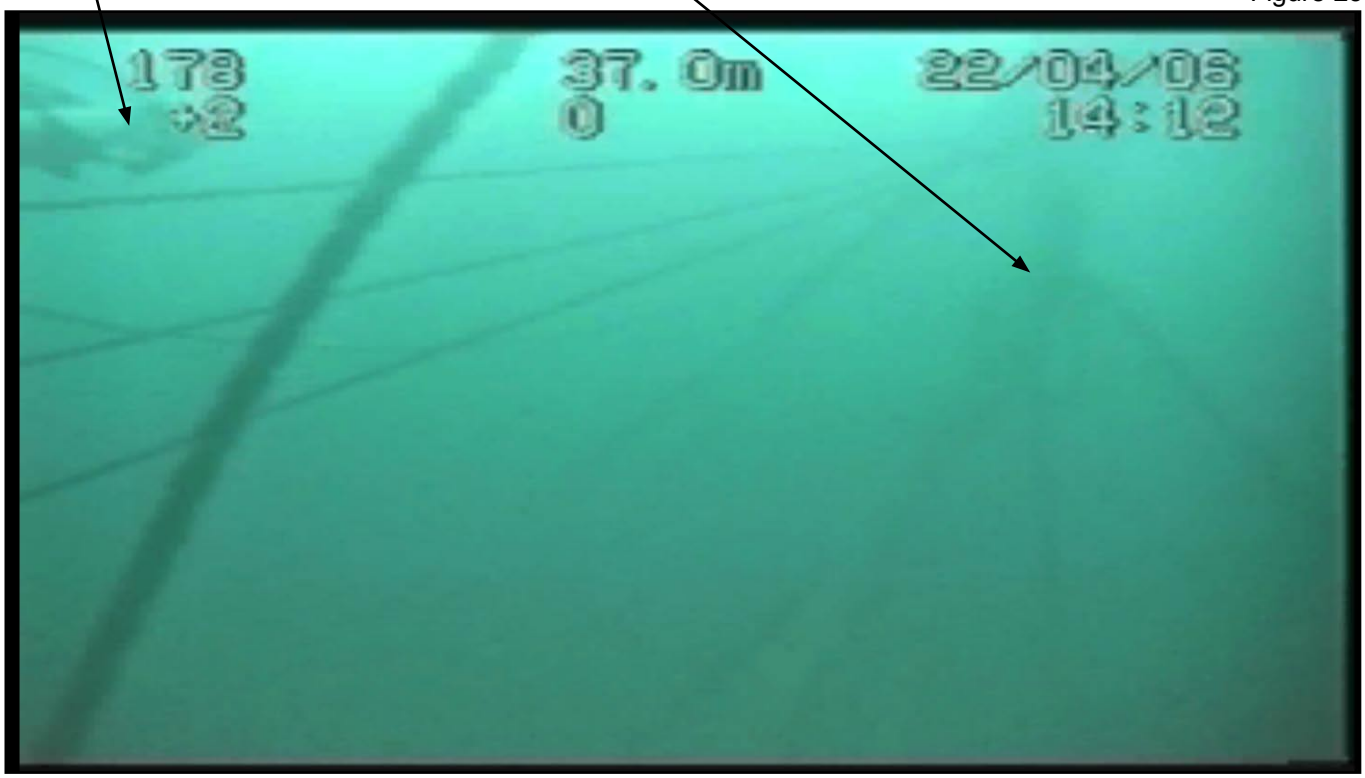


Port net

Figure 24

Forward gantry looking aft at lightmast bent to starboard

Figure 25



Relative positions of light mast and starboard derrick

Figure 26

Liferaft cradle on port aft funnel deck

Vent pipes on funnel

Aft net drum

Figure 27

Lifebuoy - port aft funnel deck

Figure 28

2.3.4 Diver inspection of wheelhouse

On 9 June 2006, a qualified commercial diver carried out a video survey of the inside of the wheelhouse.

The diver accessed the wheelhouse through the starboard door, which was open. The wheelhouse deck, bulkheads and controls had developed a considerable coating of silt and marine growth since sinking.

The central wooden wheel was intact, in front of which were two radars or track plotters; one monitor had imploded.

On the port side, a stool had become wedged against the port side below a window. Also on the port side, between two windows, was a clock, below another similarly sized instrument, possibly a barometer. The clock appeared to be the standard ship's battery-powered clock. When the clock glass was cleaned, it revealed a time of 1735 **(Figure 16)**.

After leaving the wheelhouse, the diver swam up to the funnel deck. Looking forward, the starboard derrick and gear could be seen at about 60º to the vessel horizontal. Looking aft, the port lifebuoy was still in its cradle on the aft quarter of the funnel deck and the liferaft cradle was empty.

2.4 THE CONDITION OF THE VESSEL AT THE TIME OF THE CAPSIZE

2.4.1 Vessel damage

No damage to *Noordster*'s hull was recorded during the ROV or diver surveys. Some damage to the mast on top of the forward gantry was noted, and some fittings were noted to be hanging off (a light fitting and the radar scanner). It is concluded that this damage occurred when the vessel sank.

Other damage noted during the ROV survey included a bent cleat on the starboard side of the winch room. In their drawing, *Multrasalvor'*s divers noted that the 'lazy deckie' line had been attached to the cleat at that time. The damage to the cleat also probably occurred as the vessel sank. The movement of the starboard derrick could easily have caused excessive tension on the 'lazy deckie' which, in turn, could have caused the cleat to bend and the line to be released.

There is no evidence to suggest that any of the recorded damage occurred prior to the capsize.

2.4.2 Starboard derrick and fishing gear

It is concluded that, at the time of the capsize, the starboard derrick was raised to about 65º. The trawl gear was hanging from the derrick head, with the towing bridle raised as far as possible. The cod end was empty and the catch had probably been landed on deck in the pound. The 'lazy deckie' was tied off on the cleat by the starboard warping drum.

It was noted that the foot rope had been shortened. This would have been to enable the gear to operate successfully over rough ground. Having a short foot rope reduces the opportunity for the trawl gear to "dig in" to the sea bottom. However, it also increases the likelihood of the trawl gear swinging inboard if the vessel heels over to the opposite side while the gear is in a raised position. (With longer foot ropes, more of the net is likely to be immersed in the sea at this point.)

2.4.3 Port derrick and fishing gear

At the time of the capsize, the port derrick was out in the normal horizontal towing position. The 50m mark on the warp was near the derrick head, indicating that the warp had been hauled to bring the vessel directly over the obstruction. The results of the ROV survey were inconclusive with respect to the contents of the net. However, by the time of the survey, the net had been dragged along the seabed for several miles over a few days, and it is possible that any material that had been in the net would have been released along the way.

2.5 STABILITY

The stability rules require that the stability criteria are met for four standard conditions **(see Section 1.11.1)**. However, calculations are not made for all operational conditions, some of which are far more dangerous and, if handling the vessel and its equipment wrongly, could lead to a situation in which the vessel is vulnerable to capsize.

Although *Noordster* met all the stability requirements for various conditions of service, she, like all beam trawlers, was still vulnerable to capsize in certain circumstances. One of these conditions arises when the derricks are operated in an unbalanced way.

As part of the investigation to determine the cause of the capsize, stability calculations were performed by the Belgian Administration.

Based on the information gained from the survivor, the ROV survey, the vessel condition at the time of capsize (with the starboard derrick topped and the port derrick horizontal), and an increasing winch force, it was possible to produce the applicable stability curves.

Additionally, the stability was analysed for the condition produced by the starboard trawl gear swinging inboard as the vessel heeled to port.

The stability calculations carried out show the vessel to be vulnerable to capsize.

The assumed condition at the time of capsize was:

- Fuel oil tanks both holding 5,365 litres (assumed full at the time of departure with a fuel consumption of 1700 litres a day after 4 to 5 days);
- Five tons of fish and 10 tons of ice (based on information from interviews with the survivor).

From the ROV survey, it can be seen that the port derrick was horizontal and that the starboard derrick was at a 60º-70º position (60º is taken for the calculations) with the fishing gear hanging free at the top of the derrick.

The effect of winch force at the port side, and the swinging of the starboard derrick, were calculated.

Figure 29 shows the righting arm curve of the vessel in the condition as described above, together with the destabilising arm curves for different winch forces.

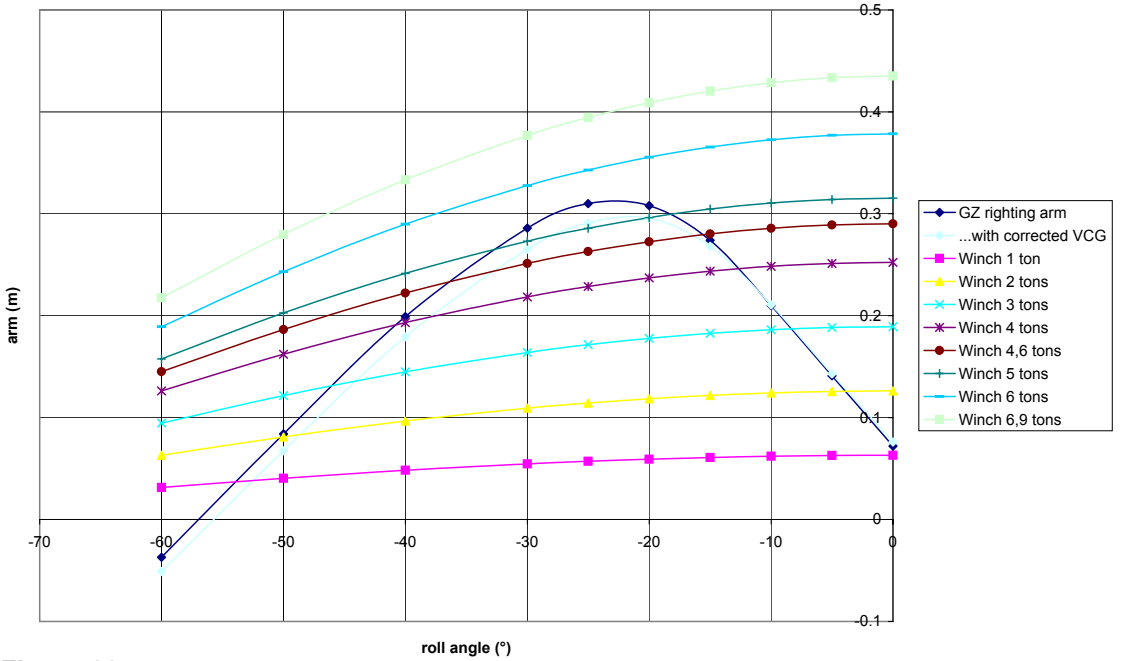


Figure 29
Stability curve of the fishing vessel with destabilising curves of winch force

From **Figure 29** it can be seen that:

- as the winch force increases, the angle of heel that the vessel takes is as follows:
    i. 4º (2 tons);
    ii. 8.4º (3 tons);
    iii. 12.7º (4 tons);
    iv. 15.6º (4.6 tons);
    v. 18.2º (5 tons);
- when the increase of VCG due to the winch force, is taken into account, the angle of heel is even greater:
    vi. 16,4º (4.6 tons);
    vii. > 20º (5 tons)

It can be concluded that:

- When the winch was operating at its maximum force (4.6 tons for 50m of warp out), the angle of heel of the vessel would be 16.4º with very little dynamic reserve left, making her position extremely vulnerable;
- With the winch operating at its stall force (6.9 tons), the vessel would capsize.

Furthermore, if the winch was operating at its maximum force of 4.6 tons, causing the vessel to heel 16.4º to port, the starboard derrick (in its position of 60º - 70º plus 16.4º) would swing around through any external dynamic force (wave, sudden tug on the fastener), and the vessel would capsize.

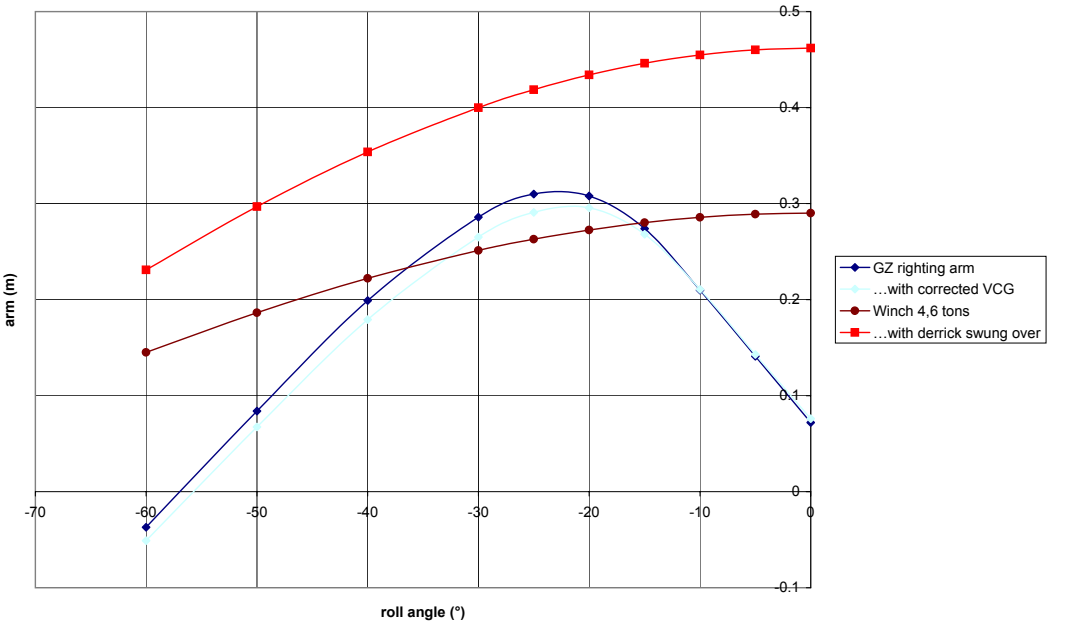


Figure 30
Stability curve of the fishing vessel with destabilising curves of winch force and the starboard derrick swinging over from the 60º position to the 120º position

Noordster had 9m long derricks, which were necessary when 8m prawn beams were used. However, when using trawl gear with shorter, heavier, beams the derricks had to be raised higher in order for the 'lazy deckie' to be brought nearer the side of the vessel so that it could be reached. When the derrick is raised higher, as the skipper had done with the starboard side (about 65º), the metacentric height of the vessel reduces further, giving a consequent significant reduction in stability.

It is a common misunderstanding among beam trawler men, that changing the type of trawl gear used does not significantly alter the vessel's stability characteristics. This is clearly incorrect. If, for instance, the derrick needs to be topped higher to bring the end of a shorter, heavier, beam to the ship's side to facilitate access to the 'lazy deckie', the vessel's stability will be reduced.

Noordster was operating with long derricks and short heavy beams, which necessitated the derricks to be raised to 65º, allowing them to swing readily inboard should the vessel adopt a large angle of heel. *Noordster* would not have capsized so easily had this not been the case.

Since 1995, new Belgian beam trawlers have been required to have increased levels of reserve buoyancy through the stipulation of a higher minimum freeboard. *Noordster* was not required to meet the same minimum freeboard standard required of new vessels of her size, and she did not do so. However, in her condition at the time of capsize, the increased margin of freeboard would have made little difference to her ability to resist capsize.

2.6 CAUSE OF THE CAPSIZE

Evidence provided by the survivor in separate interviews was, in itself, contradictory about the cause and precise circumstances of the capsize. Furthermore, in some respects, the witness evidence was not in accord with hard evidence gained from the CNIS recordings and underwater surveys. On a number of occasions, the MAIB has found that witness evidence can become unreliable after a traumatic experience.

Considering all the available evidence, experience gained from previous beam trawler accidents, and advice from beam trawler experts, the following are considered to be the most probable circumstances which led to the capsize.

When *Noordster* came fast at about 1630, it is considered possible that the survivor had charge of the watch and the skipper and crew were in the accommodation, resting. As the vessel slowed and swung rapidly to port, the skipper and crew were woken abruptly from their sleep, either by being called by the survivor, or due to the sudden movement of the vessel. They had all been at sea for 4 days and, given their probable work pattern, would have been tired **(see Section 2.9)**. That the skipper had recently indicated to the skipper of *Alles Wisselt* Z431 that he was going for a rest, and that his body was subsequently noted to be dressed only in underclothes, support this possibility, as he normally wore thermal underwear while inside the vessel.

It appears likely that *Noordster* had come fast on a natural feature described in the 1987 hydrographic survey as 'a small gravely ridge' which, although still marked on some charts, had reduced in size and importance sufficiently to be deleted from nautical charts by the UKHO. It is unclear whether Admiralty charts were used on

Noordster, but the skipper would almost certainly have planned the fishing based on his own detailed knowledge of the area. Other fishermen who were experienced in the area were not aware of any fasteners in the vicinity of the capsize, and it is assumed, therefore, that *Noordster*'s skipper would not have known of it.

The skipper took over in the wheelhouse, and the three crewmen mustered on deck, having rapidly donned their oilskins as the skipper heaved the trawl gear on both sides to bring the vessel over the fastener. The starboard beam and net were then brought up to the surface. The starboard derrick was raised, the cod end lifted, and the 'lazy deckie' tied off on a cleat on the starboard side of the winch housing. In the circumstances, the skipper's decision to heave up the starboard gear was understandable as it negated any possibility of it becoming entangled with the port gear or in the propeller. However, on completion, the starboard derrick was left in the raised position with the heavy gear suspended. This is contrary to recognised good practice, which would have been to lower the derrick to the horizontal, with the gear suspended at the surface to act as a counterbalance when force was applied to the port gear. As it was, the weight of the gear acting at the head of the raised derrick substantially reduced the vessel's stability.

The subsequent attempt to free the port side gear from the fastener caused the vessel to list to about 16º to port. As the charted water depth at the capsize position was about 58m, and the 50m mark on the port warp was close to the derrick head, the port trawl warp would have been at a near vertical angle at that time.

It would have been possible to pull *Noordster* over with the force of the winch alone, but it is more likely that the starboard derrick, with the beam, nets and stone mats still suspended, swung inboard, causing the vessel to list further and to capsize. The swinging gear could have easily hit one or two of the crew who were on deck, and knocked them over the side.

The engine stopped as the heel increased, probably due to the activation of the oil level switch which is designed to prevent damage as a result of insufficient oil pressure, if the heel is sufficient for the oil pump to lose suction.

With the vessel capsized, downflooding through the open engine room port door (at deck level), the fish hatch and fish chute, would have occurred as the list increased further, and the vessel eventually inverted.

As *Noordster*'s port side became submerged, the EPIRB HRU released, but the EPIRB became trapped and did not float free to transmit.

For a while, the vessel remained anchored to the seabed by the port gear. The gear was eventually released from the fastener, probably as the vessel swung due to the effect of the tides. *Noordster* then drifted across the shipping lane, dragging her gear behind her until she eventually sank in the traffic separation zone.

2.7 EMERGENCY RELEASE SYSTEMS

Noordster, in common with most Belgian beam trawlers, was fitted with a system that was designed to quickly release the drum brakes and allow the trawl warps and topping lifts for the derricks to run free but under control by the proportional value **(see Section 1.8.3)**. It is not known whether the skipper attempted to use the emergency

release system before the capsize, but the underwater surveys indicated that beams and derricks were still suspended and in position. Other Belgian beam trawler skippers have shown a lack of knowledge of the system's operation and purpose.

The system is designed to be used in case of electrical power failure. Belgian skippers do not use it, probably due to a lack of awareness of the correct function of the system and a belief that the gear and derricks will fall to the deck in an uncontrolled fashion, risking injury to the crew and damage to the vessel. However, once the starboard gear had started to swing inboard there was little the skipper could have done to stop the inevitable capsize. No emergency release systems on board *Noordster* were useful at that time.

An appreciation of the capabilities of this type of emergency release system could benefit beam trawler skippers during similar incidents in the future.

Noordster was also fitted with a mechanical release system on each derrick **(Figure 10)** designed to release the derrick head block so that the point of suspension was quickly lowered and brought to the ship's side in the event of an impending capsize. This, or another system, is fitted to all beam trawlers and, once again, is designed to be used only in an emergency. Because it is extremely difficult to haul the block back out to the derrick head and re-secure it after the system has been used, there is a natural and understandable tendency to contemplate using the system only when all other avenues to free a net from a fastener have been exhausted. Additionally, it takes several seconds, possibly as many as 30, to release one side. This effectively makes this system redundant, as capsize usually occurs quickly and unexpectedly.

2.8 SAFE BEAM TRAWLER OPERATION

Surveys of the wreck of *Noordster,* and other evidence, indicate some serious concerns about her safe operation during the accident. These concerns include:

- Watertight doors and hatches had been left open.
- The starboard derrick was left topped with the gear hanging, while attempts were made to free the port gear.
- No precautionary measures were taken in case the operation to free the net went wrong – the crew were not wearing lifejackets, for example.

Closure of watertight openings is recommended at all times when they are not being used. This maxim should be applied under all routine operational conditions, but becomes vital when undertaking a known hazardous operation like trying to free snagged gear.

All beam trawler men should be aware of the risks associated with unbalanced loads and the important need to counterbalance the force required to free snagged gear. It is difficult to understand why an experienced beam trawler man would have left the starboard derrick topped under such circumstances, but this might have been an oversight.

Experienced fishermen will be aware of the dangers associated with snagged gear. Even if not worn routinely, donning lifejackets when hazardous operations are being undertaken is a prudent action, which, in this case, could well have saved lives.

In the UK, MGN 265 (F) **(Annex 1)** provides practical advice for British beam trawler skippers when attempting to recover their gear from a fastener. The Belgian authorities do not provide similar advice to their fleet.

Of relevance to the capsize of *Noordster,* are the following extracts from the notice:

- *Every effort should be made to avoid an excessive list by ensuring uneven loads are kept to a minimum during recovery of the gear.*
- *When hauling on snagged gear, this should ideally be carried out with the warp acting as low as is possible and not from the derrick head.*
- *Generally, when gear is stuck fast on an obstruction such as a rock or wreck, the vessel is stopped and hauled back over the obstruction. It is possible that the gear on the free side may be raised to act as a counterbalance to the snagged gear, however this is a dangerous operation and capsize may occur if the snagged gear is suddenly released. All crew members should be advised when gear recovery operations commence and when they are completed. During recovery they should be on deck with their lifejackets.*
- *For beam trawlers, the use of a "weak link" near to the cod end can increase the chances of capsizing during trawling or gear recovery operations. The problem will arise if a "weak link" parts in one of the trawls when both trawls are laden and at or near the sea surface. The condition of these weak links is therefore very important and these should be inspected whenever the nets are on board.*
- *It is important that all weathertight doors and hatches are closed and freeing ports are checked free and clear, before the recovery operation takes place. Unless this is done and if the vessel heels suddenly, it is possible that water may downflood into the hull and this, if unchecked, will invariably lead to capsize and the loss of the vessel.*
- *If snagged gear cannot be freed without hazarding the vessel, the safe course of action is to release the gear, mark it with a buoy and leave it until conditions improve or a more capable vessel can recover it.*

2.9 FATIGUE

It is possible that an oversight caused the experienced skipper to leave the starboard derrick topped while he worked on freeing the port gear. This might have been due to fatigue.

It is known that fatigue can produce the following effects that might have contributed to the accident:

- Inability to concentrate, including being less vigilant than usual;
- Poor memory, including forgetting to complete a task or part of a task;
- Slow response, including responding slowly to normal, abnormal or emergency situations;
- Attitude change, including:
    - Being too willing to take risks;
    - Displaying a "don't care" attitude;
    - Disregarding warning signs.

- Diminished decision-making ability, including:
    - Misjudging distance, speed, time etc;
    - Overlooking information required for complex decisions;
    - Failing to anticipate danger.

With only four crew on board, and having worked continuously (shooting, towing, hauling and gutting) for 4 days and nights, the crew, especially the skipper, could be expected to have been very tired. It was normal to have only short (about 1 hour), disturbed periods of sleep during the voyage.

Although the vessel met the minimum manning requirements, one of the crew was quite inexperienced, and often carried out a watch alongside the skipper. This would have increased the workload and level of fatigue of the other three, more experienced crew.

As part of the investigation, MAIB carried out a fatigue analysis of the deceased skipper.

This analysis took into account the number of crew on board, their work pattern, any errors in the operation of the vessel, the likely quality and availability of sleep, the demanding nature of the tasks carried out, and any known personal factors.

The results of the analysis indicated that he was probably suffering moderate levels of fatigue. However, if he had only just been woken, from what could have been a deep sleep, at the time of the accident, it is likely that sleep inertia could have contributed further to his fatigued state. Taking this into account, the MAIB believes that it is likely that the skipper's level of fatigue was a significant factor in the cause of the capsize.

Measures to raise the awareness of the effects of fatigue, particularly when operating dangerous equipment on beam trawlers, should be considered.

2.10 LOCATION AND USE OF SAFETY EQUIPMENT

Noordster carried an EPIRB and a liferaft, both of which were fitted with hydrostatic releases. The sole purpose of vessels like *Noordster* carrying and maintaining this equipment is to help save lives in the event of an emergency. That neither of these vital pieces of safety equipment functioned after the vessel capsized is of serious concern.

It would appear from the evidence that in all probability the hydrostatic releases operated correctly but that, in both cases, the equipment was trapped and prevented from floating free. In both cases, the equipment was subsequently proved to have been fully operational. The EPIRP activated correctly after it was recovered by the *Multrasalvor* divers, and the liferaft inflated after it eventually freed itself just before the vessel finally sank.

The EPIRB had been located on the port side of the funnel, and had become trapped on a light fitting on the starboard side of the galley after the capsize.

The liferaft was located above the wheelhouse on a relatively clear area of deck behind the funnel. It is unclear what trapped it and prevented its deployment.

Having considered *Noordster*'s general arrangement, it is difficult to suggest more suitable locations for this equipment. Every fishing vessel is cluttered by rigging and equipment, and the location for equipment like this must take into account the need for shelter from heavy seas which might cause damage or inadvertent release. The location also needs to be accessible, so that the equipment can be easily manually retrieved and activated in the case of a less immediately catastrophic accident.

One option that should be considered, although adding to the costs for the fishing vessel owner, is to fit more than one of each type of safety device, to provide a back-up and a greater chance of successful deployment when required. It should be noted that MSN 1770F (15m to 24m fishing vessels) requires UK flagged vessels to carry at least two liferafts. When compared to the loss of life that can occur in a vessel capsize, the additional costs that would be incurred in providing the additional equipment would appear to represent money well spent.

The crew of *Noordster* apparently did not consider donning lifejackets before attempting to free the trawl gear from a fastener.

Despite the lessons of many previous accidents, including the recent loss of four lives from *Flamingo*, fishermen generally remain reluctant to wear lifejackets on deck, even when undertaking known hazardous operations. Had the crew been wearing lifejackets, their chances of survival on the night of the capsize would have been dramatically improved.

Further measures should be taken to raise awareness among fishermen that lifejackets should be worn on deck when carrying out hazardous tasks.

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES

The following safety issues have been highlighted by the investigation. They are not listed in any order of priority.

1. At 1630 on 13 December 2005, *Noordster*'s port trawl gear came fast on the seabed. It is probable that it had caught on an obstruction known to the UKHO, and which had been described as 'a small gravely ridge'. [2.2, 2.6]

2. *Noordster* suddenly capsized while trying to free her port trawl gear from a seabed obstruction. [2.6]

3. The precise time of the vessel's capsize cannot be determined, but it is considered probable that it occurred between 1635 and 1658. [2.2]

4. At the time of the capsize, the port derrick was horizontal and perpendicular to the ship's side, and the starboard one was topped to an angle of about 65º. The starboard gear was hauled close to the derrick head and secured. It was contrary to good practice to have left the starboard derrick topped while exerting force to free the port gear. [2.4;2.6]

5. *Noordster* complied with all the required minimum stability and freeboard requirements for a vessel of her size and type. However, in common with all beam trawlers, she was still vulnerable to capsize under certain conditions. [2.5]

6. An analysis of the vessel's stability in her condition just prior to the capsize, with the port derrick horizontal and the starboard one topped, shows that the winch operating at its stall force would have been sufficient to cause the vessel to capsize. [2.5]

7. If the winch had been operating at its maximum force of 4.6 tons, the vessel would have had a 16.4º list. The port list could have caused the starboard derrick to swing inboard, and this would have been sufficient to cause the vessel to capsize. [2.5]

8. *Noordster* was operating with long derricks and short heavy beams which necessitated the derricks to be raised to 65º in normal operation where they were vulnerable to swing inboard if the vessel adopted a large angle of heel. *Noordster* would not have capsized so easily had this not been the case. [2.5]

9. *Noordster* was not required to meet the same minimum freeboard standard required of new vessels of her size, and she did not do so. However, in her condition at the time of the capsize, it would have made little difference to her ability to resist the capsize. [2.5]

10. It is unknown whether the skipper attempted to use the winch emergency release system before the capsize, but the underwater surveys indicated that the beams and derricks were still suspended and in position. Skippers of other Belgian beam trawlers fitted with similar systems have shown a lack of understanding of its design and operation. [2.7]

11. Once the starboard gear had started to swing inboard there was little the skipper could have done to stop the inevitable capsize. No emergency release systems on board *Noordster* were useful at that time. [2.7]

12. Surveys of the wreck of the vessel, and other evidence, indicate some serious concerns about the safe operation of *Noordster* during the accident including:
    - Watertight doors and hatches had been left open.
    - The starboard derrick was left topped with the gear hanging while attempts were made to free the port gear.
    - No special measures were taken in case the operation to free the net went wrong; the crew were not wearing lifejackets, for instance. [2.8]

13. The Belgian authorities do not provide specific advice to their beam trawler fleet on stability and safe operations. [2.8]

14. It is possible that an oversight, due to fatigue, caused the experienced skipper to leave the starboard derrick topped while he worked on freeing the port gear. [2.9]

15. The MAIB believes that it is likely that the skipper's level of fatigue was a significant factor in the cause of the capsize. [2.9]

16. *Noordster* carried an EPIRB and a liferaft, both of which were fitted with hydrostatic releases. The sole purpose of vessels like *Noordster* carrying and maintaining this equipment is to help save lives in the event of an emergency. That neither of these vital pieces of safety equipment functioned after the vessel capsized is of serious concern. [2.10]

17. The evidence indicates that both the EPIRB and the liferaft released correctly but became trapped. However, it is difficult to suggest better locations for this equipment on *Noordster*. [2.10]

18. It is unfortunate that some of the lessons from previous accidents have not been learned and, in particular, that the crew of *Noordster* were not wearing lifejackets while carrying out the hazardous operation to free the port trawl gear from a seabed obstruction. [2.10]

SECTION 4 - ACTION TAKEN

The Marine Accident Investigation Branch has:

Provided the Belgium Maritime Inspectorate with copies of:

- The MCA beam trawler safety video, “Level Headed”;
- MGN 265(F) - *Fishing Vessels: The Hazards Associated with Trawling, Including Beam Trawling and Scallop Dredging, Notice to all Owners, Operators,, Skippers, Crews, Managers, Gear Fitters, Ship Builders and Designers,* and;
- Relevant sections on the stowage of survival craft and EPIRBs within MSN 1770(F) – *Code of Safe Working Practice for the Construction and use of 15m LOA to less than 24m Registered Length Fishing Vessels*.

The Belgian Maritime Inspectorate has:

- During annual surveys, begun a process of informing beam trawler skippers about the function and use of the emergency release system for the towing winch brakes.

SECTION 5 - RECOMMENDATIONS

The Federal Public Service of Mobility and Transport, Belgium is recommended to:

2006/220 Consider how best to promulgate safety advice to beam trawler skippers. Such advice should focus on vessel stability, the interrelationship between gear and stability, the dangers of fasteners, the effects of fatigue on decision-making, and the importance of personal lifesaving apparatus (LSA), particularly when the vessel is in a precarious position, such as when coming fast.

2006/221 Consider issuing a notice for display in the wheelhouses of Belgian beam trawlers, advising skippers of the recommended procedures to be adopted when freeing snagged gear, and the vital need to keep the forces involved balanced as far as possible.

2006/222 Verify the suitability of the location and number of EPIRBs and liferafts fitted to Belgian fishing vessels. In determining the number and/or location of such equipment, consideration should be given to the possibility that it may become entrapped, and fail to operate, in the event of vessel capsize.

Marine Accident Investigation Branch
November 2006