Report on the investigation of the loss of

Vertrauen (BF 450)

about 75 miles north-east of Peterhead

19 July 2001

Marine Accident Investigation Branch
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Carlton House
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United Kingdom
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Report No 29/2002
August 2002

Extract from

The Merchant Shipping

(Accident Reporting and Investigation)

Regulations 1999

The fundamental purpose of investigating an accident under these Regulations is to determine its circumstances and the cause with the aim of improving the safety of life at sea and the avoidance of accidents in the future. It is not the purpose to apportion liability, nor, except so far as is necessary to achieve the fundamental purpose, to apportion blame.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

EPIRB	-	Emergency position indicating radio beacon
FRC	-	Fast rescue craft
GPS	-	Global Positioning System
kHz	-	kilohertz
kW	-	kilowatt
L	-	Length
LOA	-	Length overall
MCA	-	Maritime and Coastguard Agency
MF	-	Medium frequency
m	-	metres
mm	-	millimetres
ROV	-	Remotely operated vehicle
RSW	-	Refrigerated sea water
SAR	-	Search and rescue
UTC	-	Universal Co-ordinated Time
VHF	-	Very high frequency

SYNOPSIS

On 19 July 2001, the 23m-long wooden fishing vessel, *Vertrauen*, sank 75 miles north-east of Peterhead, after flooding. Her crew of four was rescued. The MAIB was informed about the accident at 1803 that day, and began its investigation four days later.

Vertrauen, built in 1982, was trawling about 75 miles north-east of Peterhead in moderate to good visibility, and wind from the north-north-east, force 5. At about midday, the port net became snagged on a seabed obstruction, so the crew spent the next few hours trying to haul it. Sometime during this period the vessel started to flood. Damage caused by a contact between the port trawl door and the hull is considered to be the most likely source of the ingress, although flooding via the pipework cannot be ruled out.

The flooding could not be contained, so the decision was taken to abandon the vessel. The flooding had affected the batteries for the fixed VHF radio, so the skipper called for assistance using the portable VHF radio. A fast rescue craft, launched off a guard ship from the Scott oilfield, rescued all the crew just seconds before *Vertrauen* sank by the stern. The bilge alarm did not alert the crew to the flooding because the audible signal was not working at the time of the accident. By the time the crew discovered the floodwater, it was too deep for them to be able to locate the source. Had the bilge alarm worked, the flooding might have been identified and dealt with promptly.

The two main bilge pumps were electrically-driven, and were disabled when the floodwater reached the transformer box. The MAIB considers that these two pumps were not independently driven, as required by the regulations and, therefore, recommends the MCA not to accept two electrically-driven bilge pumps as being powered by separate means unless the electricity supply for each is completely self-contained.

Figures 1 & 2 - *Vertrauen*

Photographs courtesy of Elite Photographs

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *VERTRAUEN* AND ACCIDENT

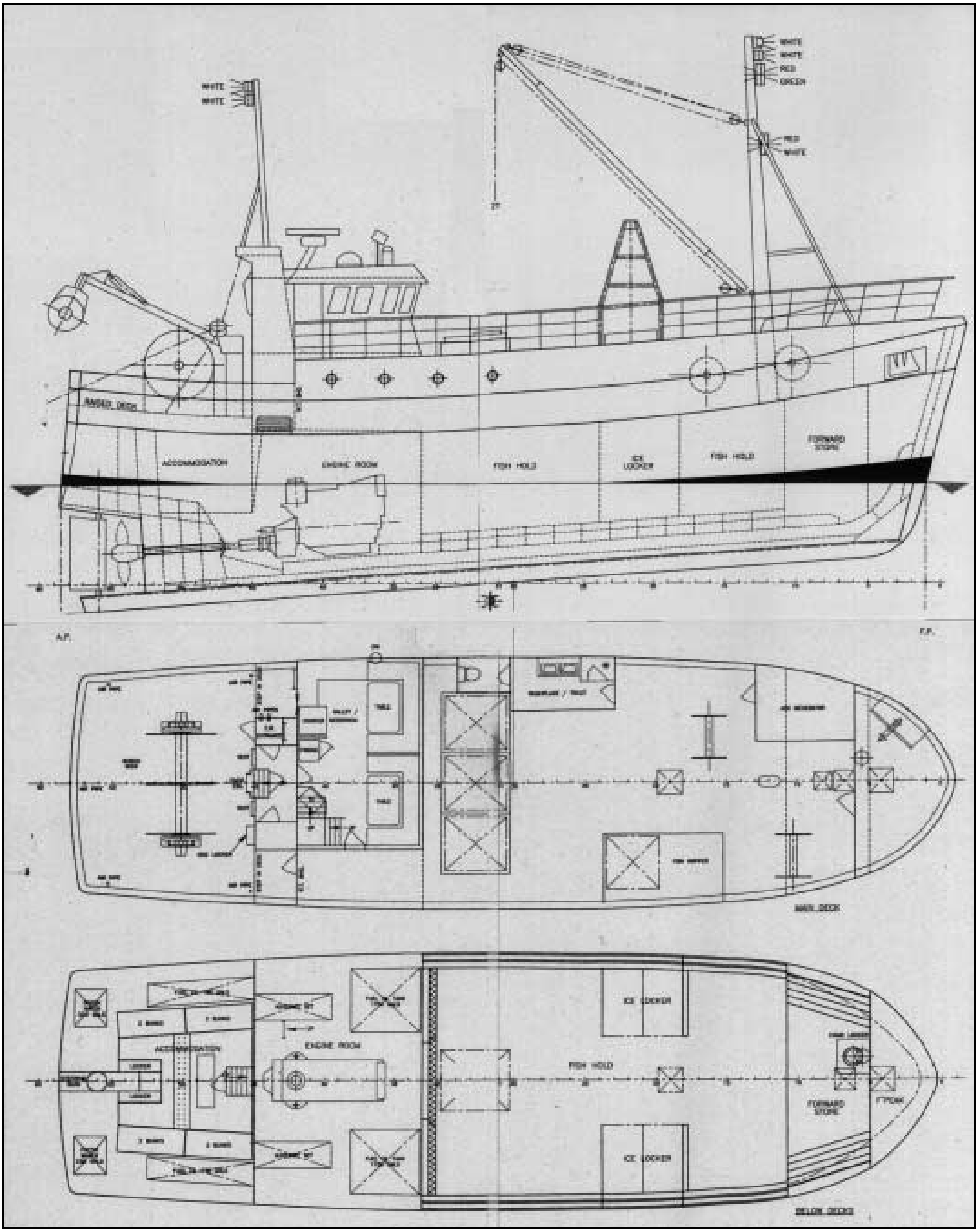
Vessel details

Owner	:	MB Vertrauen BF 450 Ltd 141 Shore Street, Fraserburgh
Skipper	:	Stephen West 4 Kennedy Road, Fraserburgh
Port and number	:	Banff - BF450
Flag	:	UK
Type	:	Fishing vessel – twin trawl
Built	:	1982 - Carrigalde, County Cork, Ireland
Classification society	:	None
Construction material	:	Wooden hull, aluminium shelter
Registered length	:	23.99m
Gross tonnage	:	211
Engine type and power	:	Caterpillar - 642kW

Accident details

Date and time	:	19 July 2001 at 1609
Location of incident	:	58° 11.23'N 000° 09.56'E Approximately 75 miles north-east of Peterhead
Persons on board	:	Four
Injuries/fatalities	:	None
Damage	:	Vessel lost

General views of *Vertrauen* are shown in **(Figures 1 & 2)**. A general arrangement drawing can be seen in **(Figure 3)**



General arrangement of *Vertrauen*

1.2 NARRATIVE

All times are UTC.

On Tuesday 17 July 2001 at 1300, *Vertrauen* left Fraserburgh with a crew of four on board. Her regular engineer was not present. She headed east for about 40 miles and fishing began. After the trawl was shot, the gear was towed south, then south-westerly, and hauled at about midnight. The trawl was shot, hauled twice more, and *Vertrauen* then steamed 10 miles further east where her gear was shot and hauled a further three times.

The last fishing operation before the accident, began at about 0520 on Thursday 19 July. The trawl was towed until about 1000, when the gear came fast. The deckhand on watch called the rest of the crew. They attempted to free the gear by hauling back the trawl[1]. The starboard warp, including the trawl door and the clump weight, came up, but the port warp stopped coming in when there was about 90m out to the door. There was about 130m of sweep. The water depth was about 135m. The skipper thought they were fast on the port warp, but when he checked the GPS he noticed that they were making ½ - 1 knot, which indicated they were dragging a heavy weight. For about 1½ hours he tried to release the weight by heaving and slackening the port warp.

Initially, while trying to get free of the fastener, the main engine was clutched on to the propeller and set at low power, but the vessel's track was influenced mainly by the wind and tide, which was setting *Vertrauen* south at that time. When the skipper made a routine visit to the engine room at about 1130 he noticed no flooding. The starboard net was taken aboard, and the catch from this side was released into the hopper. The skipper then tried hauling the port wire again, but without success.

After having a cup of tea in the galley, the deckhands went forward at about 1300 to start gutting the fish from the starboard net. The skipper remained on the bridge, and continued operating the winch controls. At about 1415, he noticed the port wire was starting to come in slowly, so he asked the deckhands to stop gutting and to come aft. He kept hauling the port warp until there was only about 9m left. Eventually the door came up. The wire was winding in slowly, and as the port door broke the surface, one of the deckhands, who was standing aft on the open deck, heard a thump. When the port door was clear of the water, the port backstrap (a chain connecting the clump to the port net) was wrapped around it. This caused the trawl door to be hauled in at an unusual angle, which brought the door close in to the vessel. The skipper believes the door struck the hull. Because of the difficulty in hauling the gear, the skipper could not get enough headway to steer into the wind; the normal position for hauling. The wind was on the starboard beam, tending to blow the vessel over the port trawl door. This might have contributed to the port door striking the hull.

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[1]This is standard practice; often when a vessel is hauled directly over the fastener, the gear comes free.

After about 15 minutes, the crew were able to release the backstrap from the trawl door, and then haul in the sweeps on the port net. There was some sign of rubbing/scuffing on the port sweep of the port net, but it was undamaged. The crew started to haul the trawl on to the net drum. The cod end came up flipped over the headline, as happens sometimes when towing more slowly than the tide.

The crew had just started to use the hydraulic power block to help bring the cod end aboard, when it stopped. The hydraulics for this were driven by an electric motor, powered by the auxiliary engine. When the power block stopped, the skipper opened the shelter door before going to the engine room, and noticed the lights were out.

He entered the engine room at about 1445, and heard the auxiliary engine running. As he climbed down the ladder he encountered floodwater, which was about half a metre above the floor plates. He climbed back up and as he passed the accommodation, noticed water in there too, so informed the deckhands.

The skipper fetched a torch from the bridge, where he noticed the main engine was still running, but there was no control. The engine would have clutched out from the propeller once the compressed air reserve ran out after about 15 minutes. An electric pump supplied the compressed air.

The skipper went down into the engine room, taking the torch with him, but could not see the source of the flooding. He was looking for bubbles rising to the surface, or water spurting. The floodwater was moving from side to side as the vessel rolled.

The skipper then went to the bridge and, using the fixed VHF radio, informed the stand-by vessel *Scott Guardian* about the flooding. *Scott Guardian* was standing by the offshore platforms of the Scott oilfield, only a couple of miles from *Vertrauen*. Using the VHF radio (since this was easier and quicker than the long-range MF radio), the skipper asked *Scott Guardian*'s mate to inform the coastguard. He then returned again to the engine room. *Scott Guardian* advised the coastguard of *Vertrauen*'s problem at 1505 on MF 2182kHz.

When the skipper reached the engine room, he could still not identify the source of the flooding. He estimated the floodwater was rising about 0.3m every 10 or 15 minutes. The depth of the floodwater also prevented him from closing the seacocks. The bilge pumps were all electrically-driven, and were disabled. The engine room bilge alarm operated a light in the wheelhouse, but the skipper did not notice if it was on when he was in there. There was also an audible signal, but this had been working only intermittently before the accident. The pump which supplied the deckhose was electrically-driven. The transformer box was low down in the engine room, so once the floodwater reached it, the electricity supplying the above items was disabled. The skipper went forward with the idea of starting the harbour generator but, when he got there, he realised that starting it would not help, as the transformer box was underwater.

He came back aft again, and told the deckhands to go to the wheelhouse top and prepare the liferafts for launching. When they were ready, the skipper told the deckhands to launch the starboard one as he thought *Vertrauen* was likely to sink. He talked to *Scott Guardian* again, and was told that the SAR helicopter, which was carrying portable salvage pumps, would not be on scene for about another 55 minutes.

1.3 ABANDONING

The skipper returned once more to check the flooding, and discovered that the engine room was about three-quarters full. At 1556, he went back to the bridge and asked *Scott Guardian* to send an FRC to pick up *Vertrauen*'s oldest crew member. At this stage the skipper noticed the aft open deck was very low, and water was washing in through the freeing ports, so he called *Scott Guardian* again and said that all four crew would be abandoning the vessel. He used the hand-held VHF radio to make this call, because problems were being experienced with the fixed VHF radio, probably because the batteries which powered it were in the engine room, and were affected by the floodwater.

One of the crew managed to retrieve the lifejackets from the flooded accommodation, but, while doing so, was told that the FRC was on its way. As the deckhand moved the jackets, he found that the toggles were getting caught, so did not try to get them up on to the open deck.

At first, the crew waited for the FRC on the aft deck, but when waves started to break over the bulwarks they went up on to the shelter **(Figure 4)**. The FRC came to the port side **(Figure 5)**, and the crew were able to step across, because by that time *Vertrauen* was listing to port. The abandonment was accomplished seconds before the stern sank. Before and during the evacuation, the crew were able to keep predominantly dry. The bow stayed above the surface for about another 5 to 10 minutes **(Figures 6 & 7)** before she disappeared completely at 1609. The weather was worsening at the time, so this probably hastened her loss. The FRC returned to *Scott Guardian.*

The SAR helicopter retrieved the EPIRB from the water, and then the crew were lifted from *Scott Guardian* at 1622 and taken ashore to Fraserburgh. The helicopter arrived back at RAF Lossiemouth at 1804.

The stand-by vessel *Scott Protector* recovered the inflated liferafts after *Vertrauen* had sunk, and took photographs **(see Figures 4 - 7)**.

On 20 July 2001, the oil company Amerada Hess carried out an underwater survey of the wreck, using a remotely operated vehicle (ROV). The main purpose of this was to check that *Vertrauen* was not near any pipelines. The video taken during the survey showed that the vessel was lying to port, so had there been any damage to the planking on that side, it would not have been visible.

Figure 4

Figure 5

Figure 6

Figure 7

1.4 WEATHER

The wind was from the north-north-east, force 5, the swell was about 4m, and visibility was 8 to10 miles.

1.5 CREW

The 28-year-old skipper, Stephen West, had been fishing since he left school, and had always worked out of Fraserburgh. He started with purse seining, but for about the previous 4 years he had been trawling as skipper on *Vertrauen*. He had worked on the vessels *Julie Ann* and *Daystar.* He held a Deck Officer certificate of competency (Fishing Vessel) Class 1, and Engineer Officer certificate of competency (Fishing Vessel) Class 2. He was the skipper and also served as engineer. He worked a trip about with the other skipper, William Edwards.

The deckhands were:

James Noble, aged 59. He started fishing when 14 years old, from Great Yarmouth. Later, he fished from west coast ports and northern ports. He had worked aboard *Vertrauen* for just over a year. As well as being a deckhand, he also worked as cook.

Jonathon Runcie, aged 19. He began fishing at the age of 16 years, and had always fished out of Fraserburgh. He had been a member of *Vertrauen*'s crew for about 3 or 4 months.

Andrew White, aged 30. He had been fishing for about 4 years, working from Fraserburgh. He had worked mainly on *Vertrauen* during that time, but had undertaken occasional trips on other fishing vessels.

Normally, *Vertrauen* was taken to sea with a crew of five, but on this occasion her regular engineer, James Noble (junior), was on leave.

1.6 FISHING OPERATION

Vertrauen used a twin trawl deployed from the stern **(Figure 8)**. A bottom trawl was used, and prawns were the main catch on her final fishing trip. The trawls were stowed on net drums located on the aft deck. When the net was on board, it was handled mainly using a crane, on the end of which was a rotating drum, referred to as the power block. The net was deployed over the side using the power block. Once the net was streamed aft, it was controlled by the winch, to which were attached the two trawl warps. The trawl was usually towed for about five or six hours. When the tow was finished, the gear was hauled using the winch. When the gear was on the surface, the power block was used to move the starboard trawl from aft to the starboard beam. The gilson was then attached to the cod end, and the catch was lifted by hauling the gilson through a block, suspended by a framework over the fish hatch. When the cod end was opened, the fish were allowed to spill into the hopper. The process was repeated for the port trawl, and then the gear was shot again. While the next trawl was underway, the fish were taken from the hopper, gutted, cleaned and boxed. The boxes were then passed down from the working deck to the fish hold, where ice was shovelled on top of the fish to keep them fresh before the boxes were stowed. Trips normally lasted 7 to 9 days, depending on the fishing. They could be cut short if the weather deteriorated.

Figure 8

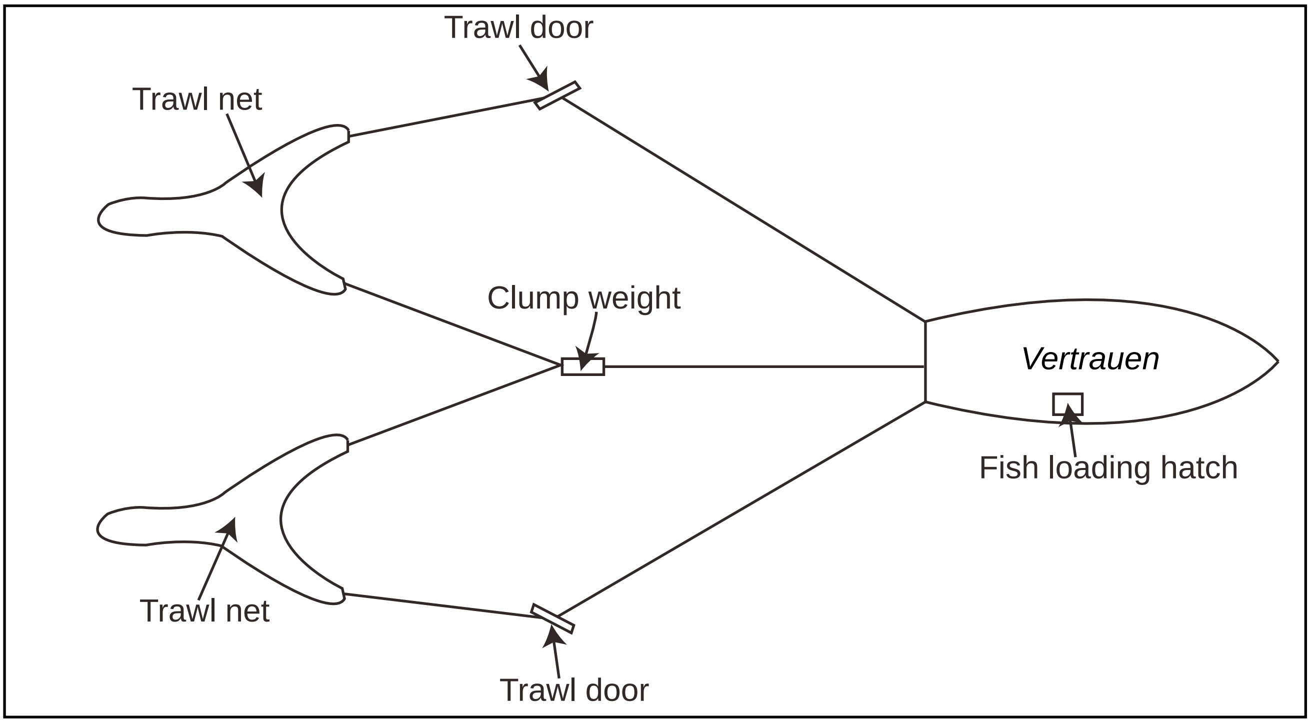

Diagram of twin trawl arrangement

The port sweep of the port net **(Figure 9)** had scuff marks on it, indicating that it had been caught on the fastener. The scuff marks covered most of the sweep where no rubber discs were fitted. Because *Vertrauen* was making some way when the gear became snagged, the fastener was probably a heavy weight which was being dragged along the seabed.

When *Vertrauen* operated in Ireland, she was fitted with three refrigerated sea water (RSW) tanks in her fish hold. These tanks were taken out after the vessel was moved to Scotland about 4 years before the accident. The RSW pipework was also removed, and the relevant hull openings were blanked off. The tanks were removed except for the aft boundary, which was integral with the engine room bulkhead. The three hatches in the tank tops, which were level with the shelter deck, also remained **(Figures 1& 3)**. The forward engine room bulkhead was probably watertight, because this division used to be part of a tank. There was, however, no effective subdivision aft of this. As she was a wooden vessel, *Vertrauen* was not required to have watertight bulkheads.

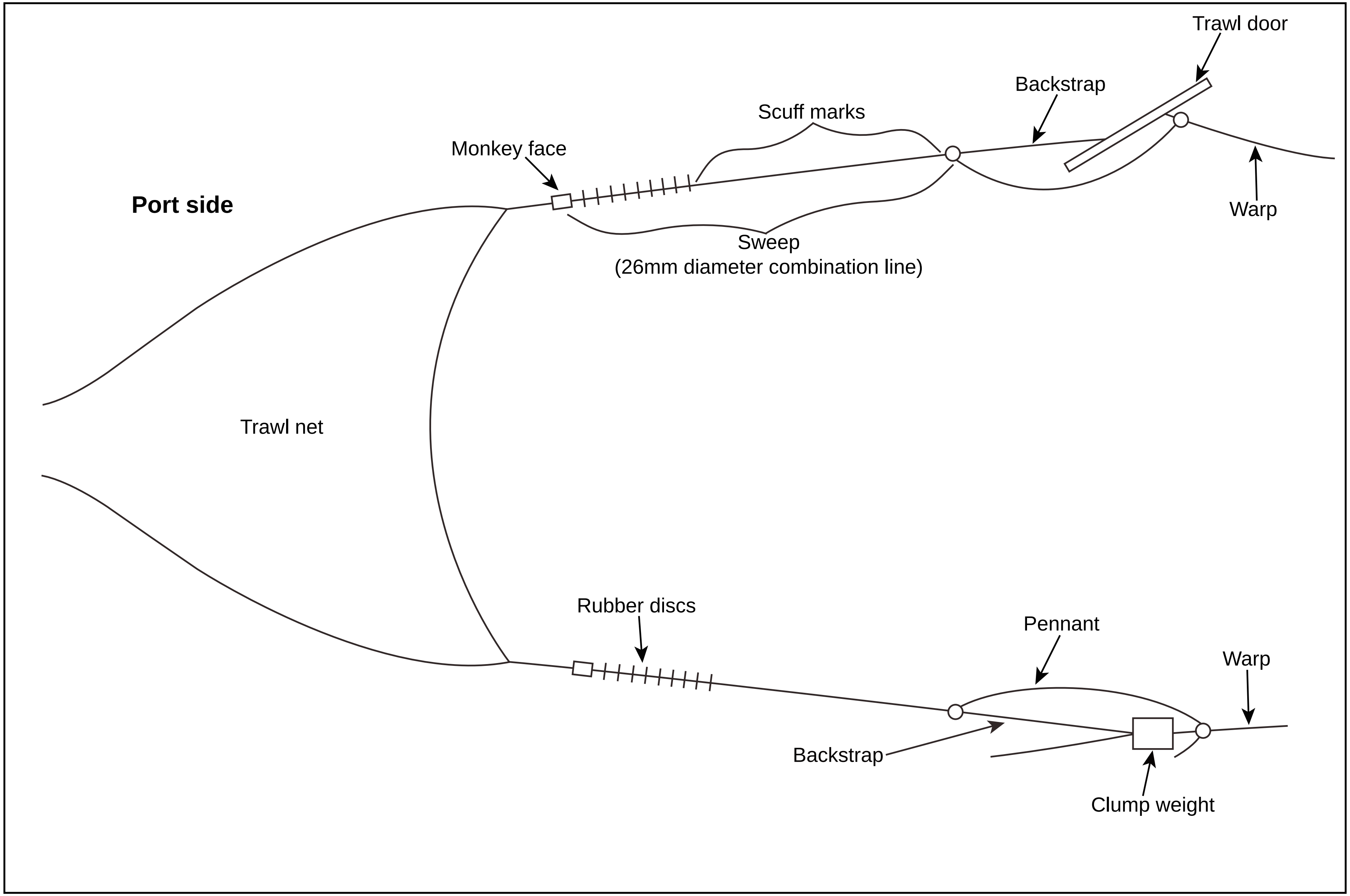

Figure 9

Diagram of the port half of the fishing gear

1.7 BILGE ALARMS

The requirement to fit an engine room bilge alarm is stated in regulation 12(2) of *The Fishing Vessels (Safety Provisions) Rules 1975*. The second sentence of this regulation states: "*In unmanned machinery spaces suitable warning devices shall be installed to indicate leakage of water into the space or leakage from any other system"*.

The bilge alarm in the engine room was fitted with an audible signal, but this had worked only intermittently for some time, and was not working when the accident occurred. It served simply as an indicator light on the final trip, and was located in a bridge console, which the watchkeeper could see when looking forward. When the skipper was trying to release the fastener, he was in the wheelhouse facing aft, operating the winch controls. If the engine room bilge alarm had lit up, he would not necessarily have seen it.

A bilge alarm, which activated a light and audible signal in the wheelhouse, was also fitted in the fish hold. The alarm went off at about 1125 on the day of the accident, but this is not considered to be relevant to *Vertrauen*'s loss. The unit was set quite low in the fish hold and melting ice often triggered it.

1.8 PIPING AND PUMPING SYSTEMS

Vertrauen had two electrically-driven centrifugal bilge pumps, which were manufactured by Desmi. The suction pipe from each pump led to a valve chest. Pipes from this valve chest led to bilge wells in the engine room, fish hold, shelter and starboard alleyway on the main deck. When one, or both bilge pumps were running, suction from each space could be achieved by opening the appropriate valve on the chest. Outlet pipes from the pumps discharged bilge water overboard. There were no bilge pumps driven directly by either the main or auxiliary engine.

The vessel's shelter was fitted with a flapped freeing port on each side. These devices are designed to let water out, but not in, and are usually referred to as tonnage valves. Sea water, used for washing the catch, discharged from the shelter either through the tonnage valves, or could be pumped out using the bilge system.

The seacocks in the engine cooling and bilge systems were below the engine room floor plates. To close these valves, first the floor plates had to be lifted. When the flooding was initially discovered, the floodwater was about 0.5m above the floor plates, so the seacocks were inaccessible.

An emergency fire pump was fitted in the accommodation, but this could not be rigged as a bilge pump to help pump out the floodwater, because the suction was a fixed pipe routed to an inlet below the waterline.

Vertrauen was fitted with a Cummins auxiliary engine. Both this, and the main engine, were cooled by sea water. The Cummins engine drove the two electrical generators (transmotors) which, in turn, powered the electrically-driven Desmi pumps. A harbour generator, which could also supply electricity to the Desmi pumps, was fitted forward.

The transformer box was fitted just above the floor plates on the centreline of the forward engine room bulkhead. When the flooding was first discovered, the Cummins engine was still running, but the transformer box was being splashed with the floodwater, which was washing from side to side as the vessel rolled. The skipper knew from previous experience that when the transformer box became wet, the electrical system stopped functioning.

The owners had an ongoing process of replacing galvanised mild steel pipe with stainless steel. The pipes which looked to be in the poorest condition were replaced first. The main engine cooling water pipes were stainless steel.

There were two small automatic electrically-driven bilge pumps, as well as the two main bilge pumps. One was fitted in the engine room, and the other in the forward store. They were designed to pump out only small quantities of bilge water, such as seepage through the hull planks. No hand-operated bilge pumps were fitted.

1.9 HARBOUR COLLISION

Vertrauen was involved in a collision with the fishing vessel *Forever Grateful*, in Fraserburgh harbour, in March 2001. *Forever Grateful* was winding a wire on to the main fishing winch under about 15 tonnes of tension, when the headlines parted **(Figure 10)**. The tension in the wire propelled her stern into *Vertrauen*'s bow. *Vertrauen* subsequently hit her stern on the harbour wall.

Initially, the damage did not seem too bad. A survey of the external hull above the waterline, and an internal survey, did not identify any significant problems, although the steel sheathing on the bow was slightly disturbed. When *Vertrauen* was taken to sea, she leaked every time her bow dipped into the swell. The ingress was so serious that the trip was cut short. The vessel was raised out of the water by shiplift on 14 March 2001. The steel sheathing was removed and the bottom plank, or wash strake, of the bulwark on both sides was renewed, from the bow aft for about 6m. Also, some plank ends forward were refastened with 150mm galvanised steel boat nails. She was put back in the water on 22 March 2001. *Vertrauen* was constructed with oroko planks on oak frames.

When she put to sea again, she was found to be leaking at the stern. This second source was not too bad, so it was not considered necessary to return early. *Vertrauen* was put on the shiplift again. She had been leaking around the rudder, so foam was injected between the rudder tube and the outrigger, the wooden structural member supporting the rudder. The steel sheathing, over the joint between the hull and the transom, was removed. The plank seams were recaulked from the transom forward for about 0.5m. Part of the outrigger was renewed with an oak graving piece.

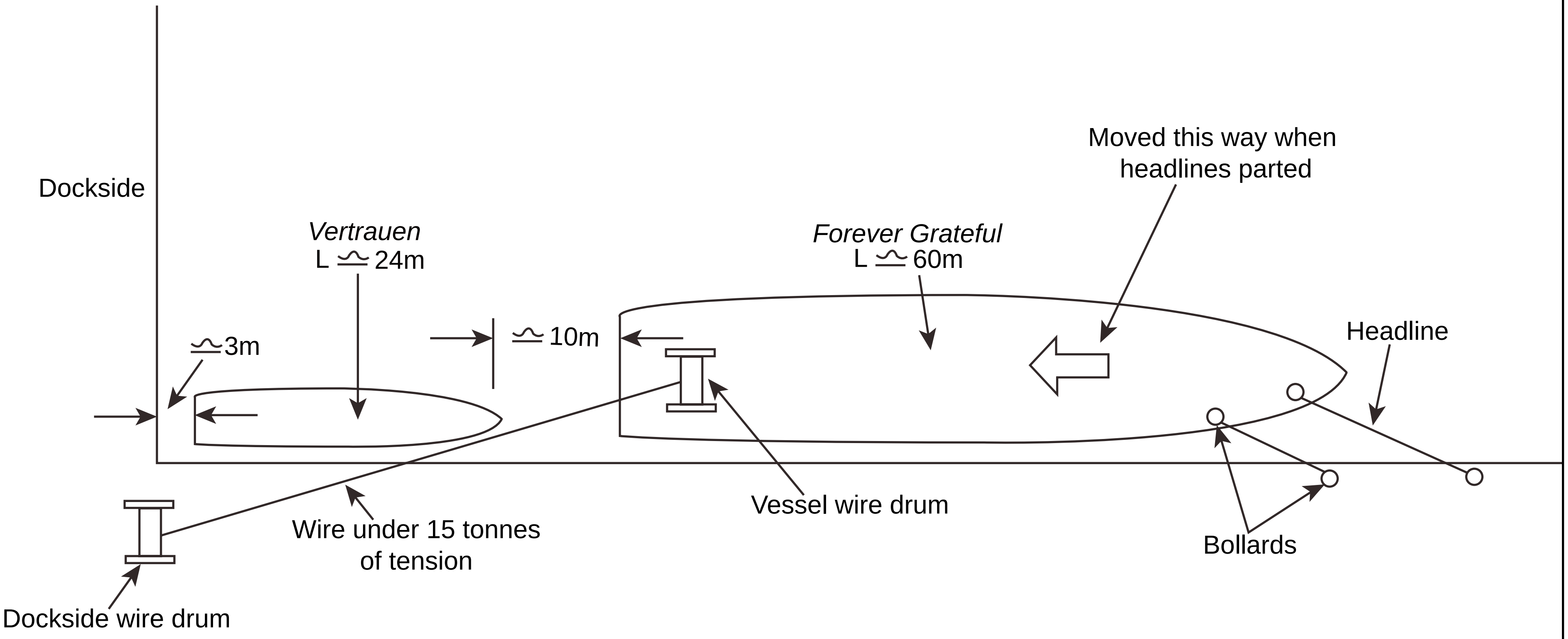
Dockside
Vertrauen
L ≃ 24m
Forever Grateful
L ≃ 60m
Moved this way when headlines parted
≃3m
≃ 10m
Headline
Vessel wire drum
Wire under 15 tonnes of tension
Bollards
Dockside wire drum
Dockside

Figure 10

The shipwright considered the foam injection to be only a temporary repair, nonetheless, it was what the owner requested. The full repair would have been to rebore the outrigger, and then fit a rudder tube with a slightly larger diameter. The rudder tube would have been inserted into the outrigger using a hydraulic jack.

The collision resulted in some play in the rudder. The skipper believes the collision weakened *Vertrauen*'s structure. The maximum wind speed encountered since this “crunching” incident was force 7.

The shipwright who undertook the repairs had 46 years of experience, working mainly on wooden vessels. He inspected all the plank seams and plank ends before *Vertrauen* was returned to the water. He is fairly sure that none of the plank ends would have sprung during the accident. Before the repairs were carried out, the putty over the seams was inspected. In the limited areas where it had been disturbed, the seams were recaulked.

The shipwright knew of only one case where a trawl door had damaged a wooden vessel. The incident occurred when a trawl door broke an oroko plank between two frames, as it was being hauled.

1.10 PREVIOUS FLOODING INCIDENTS

The MAIB was informed of the following previous flooding incidents:

On 4 June 1998, *Vertrauen* suffered engine room flooding. A variation on the rev counter alerted the crew to the problem. When the flooding was first discovered, it was found to be above the floor plates. A portable pump was on board at the time. The fixed bilge pumps, plus the portable pump, were able to contain the flooding until another salvage pump was delivered by SAR helicopter. The operation of all these pumps kept the vessel afloat while another fishing vessel towed her to Lerwick. The source of the flooding was found to be where the hose supplying cooling water to the stern gland had become disconnected. The engine room bilge alarm gave no warning of the flooding. The flexible cooling pipes, which caused the problem, were subsequently renewed with solid pipes, and the bilge alarm was repaired.

On 8 November 1998, an auxiliary engine failed, causing *Vertrauen* to lose all power. She was being towed when her crew noticed she was flooding through defective caulking. The flooding was up to the engine room floor plates. The bilge alarm did not activate, and the bilge pumps could not be used because there was no electrical power. The portable pump, which was carried during the first incident, was not on board at the time. An SAR helicopter attended the vessel, and lowered a portable salvage pump, which blocked during use. Another one was lowered, and this coped with the floodwater until *Vertrauen* reached Fraserburgh.

1.11 FISHING VESSEL CERTIFICATE

The fishing vessel certificate for *Vertrauen* expired on 13 April 2001, although the survey in anticipation of the renewal began before this date. Initially, a number of defects were found, but they were all rectified subsequently. If an owner applies for survey before the certificate expires, and then actively addresses the defects found, it is not MCA's policy to detain the vessel after the certificate has expired, provided none of the defects are serious.

All the seacocks were stripped down and inspected towards the end of 2000. The plank seams and pipework were surveyed on 9 July 2001. Flexible pipes to the main and auxiliary engines were renewed. The bilge alarms were found be defective at survey, but they were subsequently repaired.

The updated stability book arrived at the MCA's Aberdeen Marine Office on 16 July 2001, and would have taken about a week to examine. Had it been found satisfactory, the survey would have been complete, as this was the last item which needed to be checked. The loss of *Vertrauen* on 19 July 2001 rendered the issue of a new certificate unnecessary.

Vertrauen was required to carry a certificated deck officer on board. A qualified engineer was not required, however, as her propulsive power was less than 750kW.

1.12 RISK ASSESSMENT

The *Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997*, requires that assessments be carried out to identify the risks to the health and safety of workers. *Vertrauen* carried a safety folder to comply with these regulations, which contained a variety of risk assessments and safety information. Page G006 of the safety folder lists three hazards where the possible consequence is flooding **(Annex 1)**. In all cases control measures are suggested. The reverse side of this page discusses the risk of flooding in relation to pipework, bilge alarms and sea inlet valves.

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 from occurring in the future.

2.2 FLOODING

Three possible sources of flooding have been identified. The deck hose is not included among these possibilities, because the pump which supplied it was electrically-driven. When the electricity failed, the flooding continued. This indicates that the floodwater was not coming from the deck hose at that stage.

The floodwater was deep when the crew first discovered it, so the source could not been seen. The three possibilities are, therefore, speculative:

2.2.1 Hull damage

Vertrauen was a wooden vessel. In such vessels the seams between planks are caulked to provide a seal. The caulking material is usually oakum, which consists of tarred rope fibres which swell when wet. When seams are caulked, oakum is driven into the gaps between the planks, and then putty is normally applied to the top surface of the seam to provide a smooth surface. Sometimes caulking comes out when a wooden vessel is at sea. If a wooden vessel is bumped heavily in harbour, some of the caulking can be loosened, and then, when the structure is being “worked” at sea, the caulking can drop out. This may lead to flooding. However, seepage through caulked plank seams is normal when a wooden vessel is being “worked” at sea, and does not constitute a significant flooding risk.

Vertrauen was involved in a harbour collision in March 2001. Before the flooding, which resulted in her loss, was discovered, she had probably been dragging a heavy weight along the seabed with her port net for about 4 hours. This put extra load on the hull. When the very experienced shipwright undertook the repairs, he was satisfied that her hull was sound, apart from his reservation about the repair to the rudder, which he felt was temporary. The fact that the skipper noticed floodwater in the accommodation, adds some support to the leak originating there, because the top of the rudder stock was in that space. However, the flooding might have originated in the engine room, as the bulkhead between those two spaces was not watertight.

The skipper was the last person to enter the engine room, at about 1130, about 3¼ hours before the flooding was discovered. When it was found, the skipper estimated the floodwater was rising about 0.3m every 10 or 15 minutes. This rate is not consistent with the flooding starting just after 1130. The start time is much more likely to have been about 1415, when the port trawl door hit the hull.

One of the crew heard the port trawl door thump the hull when it was being hauled. This contact could have sprung a plank. However, the shipwright who repaired *Vertrauen* thought this was unlikely. The skipper felt the hull was weakened by the harbour collision. If so, dragging the heavy weight would have exacerbated the weaknesses.

After careful consideration, the damage caused by the contact between the port trawl door, and the hull, is considered to be the most likely source of the flooding.

2.2.2 Pipework

The MAIB accident database shows that defective pipework is the main source of flooding on fishing vessels. Some examples of this sort of flooding are: bolts in pipe flanges working loose, flexible joints bursting, and pipes corroding through. Every four years the MCA surveys each fishing vessel over 12 metres in length, for certificate renewal. The seacocks should be stripped down and inspected at this time. Most of the vessel's sea water pipework is in the engine room under the floor plates, and much is very difficult to access. The MCA surveyors look at what they can, in the time they have available. Vessels nearly 20 years old, such as *Vertrauen*, can expect problems with pipework; leaks often occur from places where access is most difficult.

If pipework is the problem, closing the seacocks should stop the flooding. Seacocks should be easily accessible, and should preferably be operable from above the floor plates. In this case, the crew were unable to access the seacocks by the time the flooding was discovered. The seacocks on *Vertrauen* were positioned in the bilges under the floor plates, and were difficult to access. If flooding is detected at a late stage, usually the source is difficult to ascertain. If the source cannot be identified, the flooding cannot be stopped. All the crew can do then is operate the bilge pumps, in the hope that the pumping can keep pace with the ingress.

It is considered that this source of flooding cannot be ruled out.

2.2.3 Back flooding

This is the third possible source of flooding. Discharge outlets were situated near the waterline. A non-return valve fitted in one of these pipes might have become jammed open some time before the accident. This might not have been apparent when the vessel was floating normally, if the outlet was just above the waterline. Dragging the heavy weight meant that the aft end was lower in the water than normal, possibly deep enough to immerse a discharge, which would have led to flooding if a non-return valve was jammed open. The non-return valves, which were all integral with seacocks, were stripped down and inspected by an MCA surveyor less than a year before the accident. There were no discharges at the aft end.

This method of flooding is considered to be unlikely.

2.3 BILGE ALARMS

The current regulations are contained in *The Fishing Vessels (Safety Provisions) Rules 1975*. *The Code of Safe Practice for the Construction and Use of 15m (LOA) to 24m (L) Fishing Vessels* will partially supersede the 1975 rules. Requirements for vessels of *Vertrauen*'s size will be specified in this Code. The Code should be in force on 23 November 2002, although many requirements do not have to be met until the first periodical survey after this date. The draft code contains the following additional requirements to the current regulations:

(a) *A bilge alarm should be fitted in the fish hold(s) of the vessel.*

(b) *A bilge alarm should provide an audible and visual warning at the control position(s).*

(c) *Each engine room bilge alarm should be provided with a fail-safe warning should the circuit become faulty; alternatively a second, independent, bilge alarm should fitted.*

These enhanced requirements (a, b and c above) should help to prevent similar accidents. Had *Vertrauen* complied with these requirements, her engine room bilge alarm should have worked and the crew would have been alerted. With flooding discovered sooner, the source would probably have been identified. The vessel might then have been saved.

The bilge alarm system currently being developed by Banff and Buchan College is considered to be an excellent product for satisfying the requirement for a bilge alarm with a fail-safe warning facility.

Bilge alarms are a vital piece of safety equipment. All reasonable precautions should be taken to ensure they are working properly. A light signal in the wheelhouse is not considered to be adequate on its own, because it can easily be missed. The new code will also require an audible alarm.

Bilge alarms should be kept in good repair, be tested regularly, and be checked at the start of each voyage, and then daily during the trip. Further guidance on bilge alarms, and related issues, is provided in MGN 165(F) *Fishing Vessels: The Risk of Flooding*, which the MCA provides free of charge. Bilge alarms are especially important on board wooden vessels, which are not currently required to have any watertight bulkheads. Where no watertight bulkheads are fitted, flooding can spread throughout the vessel.

Vertrauen should not have put to sea with a defective engine room bilge alarm, especially bearing in mind her two previous flooding incidents. As soon as the audible signal from the unit became intermittent, it should have been either repaired or replaced. MAIB's Safety Digest 2 of 2001, published in August of that year, highlighted some of the issues relating to flooding, and alerted its readers to the importance of bilge alarms. The text is attached at **(Annex 2)**.

2.4 BILGE PUMPS

Vertrauen was fitted with two main bilge pumps, each driven by an electric motor. For a vessel of her size, where two power pumps are fitted, the *Fishing Vessels (Safety Provisions) Rules 1975*, requires that each pump is "independently driven". Both *Vertrauen*'s bilge pumps were run by the one electricity supply system on board. If this was disabled, for instance, by the transformer box being underwater, both pumps were lost. "Independently driven" usually means being powered by two separate prime movers. Nevertheless, the MCA's opinion is that, strictly speaking, the bilge pumping system on *Vertrauen* complied with the 1975 Rules.

In the new Code (ie The Code of Safe Practice for the Construction and Use of 15m (LOA) to 24m (L) Fishing Vessels), where two power-driven bilge pumps are fitted, it is required that the second pump is "powered by separate means" to the first pump. This is another way of saying that each pump should be independently driven. This requirement needs to be applied properly, so a recommendation has been made to the MCA not to accept two electrically-driven bilge pumps as being powered by separate means, unless the electricity supply for each pump is completely self-contained.

If the drive for one of the electrically-powered bilge pumps had been changed to a direct drive from the main engine, this would have provided independence and been a much better bilge system for *Vertrauen.*

MAIB records show that a portable salvage pump was carried on board during the flooding incident on 4 June 1998, although neither skipper has any recollection of *Vertrauen* ever carrying such a pump. A portable salvage pump was not on board during the flooding incident on 8 November 1998, but the other skipper indicated that a portable diesel pump would be carried in future. These two previous flooding incidents both highlighted the value of a portable salvage pump; if one had been on board on 19 July 2001, probably *Vertrauen* would have been saved.

2.5 CREW

Vertrauen's crewing arrangement met the requirements of the regulations; a certificated skipper was present at the time of the accident. A crew of four was on board, although five were normally carried. The vessel had only been at sea for just over 2 days, so even with one fewer than her normal complement, it is unlikely the crew were tired at the time of her loss. Trips normally lasted between 7 and 9 days.

If the regular engineer had been on board, the engine room would have been visited more frequently, and the flooding would probably have been discovered earlier. If the source of the flooding could have been identified before the floodwater got so deep as to make this impossible, *Vertrauen* might have been saved. The skipper undertook his normal operational duties, in addition to those of the regular engineer who was not on this trip. This arrangement put a workload on the skipper which is considered to be too high, particularly in the event of any unforseen incidents. Before the accident, he was attending to his duties in the wheelhouse, and in particular was trying to free the vessel from the fastener. While occupied at this position, it appears he did not monitor the engine room adequately. This can be considered a contributing factor to the accident.

2.6 RISK ASSESSMENT

Annex 1 shows the Standard Risk Assessment Form. As can be seen, the severity of flooding has the highest value of 3. The risk factor is minimised because the frequency/probability is deemed to have the lowest value of 1. If the frequency/probability is to be taken as 1, the control measures for flooding must be applied rigorously; otherwise the value should be 2. If a frequency/probability of 2 is used, the risk factor increases to 6. A risk factor this high is not acceptable, and must be attended to. This brings the assessment back to applying the control measures to reduce the danger.

The concept of risk assessments has recently been introduced by the MCA. The idea is to try to move away from prescriptive requirements and, instead, to examine the dangerous activities on each individual fishing vessel, with a view to implementing safety controls for each particular situation. It is intended that assessments are undertaken primarily by those involved in the activities, as they are best placed to understand the risks. Although the concept appears to be worthy, consultants usually carry out risk assessments, with little involvement from the crew. The safety folders, which contain the risk assessments, tend to be in a standard format, with little variation between vessels. Although this meets the requirements of the regulations, it is doubtful they enhance safety significantly.

Vertrauen's safety folder was produced by a consultant, and contained little information which was specific to her. It is evident that the guidance in this document did not prevent the vessel's loss.

2.7 RESCUE

Scott Guardian's crew, particularly the officer who handled the radio at the time of the accident, performed admirably. *Vertrauen*'s skipper was apparently quite calm when he made the transmissions. He used VHF radio channel 10 as he felt there was no benefit in changing to channel 16 (the distress frequency) as the changeover might have caused problems.

The crew of the FRC are also commended, since the conditions were quite choppy. *Scott Guardian* is fitted with a heave-compensated davit for the FRC. Even with this facility, recovery in heavy weather is difficult.

The crews of both the SAR helicopter and *Scott Protector,* also played a useful part in the rescue.

- *Vertrauen*'s portable VHF radio was vital during the rescue. If communication with *Scott Guardian* had been lost, the abandonment might have been delayed, and the crew could have still been on board when the vessel sank.

- The liferafts and EPIRB also operated correctly after the vessel was lost, but were not used.

The successful abandonment of *Vertrauen*, and the rescue and survival of her crew, demonstrated that properly functioning lifesaving appliances are vital during an accident.

SECTION 3 - CONCLUSIONS

3.1 CAUSE

1. *Vertrauen* sank by the stern after flooding. The damage caused by the contact between the port trawl door and the hull is considered to be the most likely source of the ingress [2.2.1], although flooding via the pipework cannot be ruled out. [2.2.2]

3.2 CONTRIBUTING FACTORS

1. The engine room bilge alarm did not alert the crew to the flooding. [2.3]

2. The two main bilge pumps were not independently driven. When the transformer box became immersed in floodwater, electrical power was lost to both of the main bilge pumps. [2.4]

3. *Vertrauen* carried no portable salvage pump. [2.4]

4. The skipper's workload was too high as a result of not having the regular engineer on board during the accident. [2.5]

3.3 OTHER FINDINGS

1. The vessel had been involved in two previous flooding incidents, and in both cases the bilge alarm had failed to operate. [2.3]

2. The vessel had a safety folder, which identified control measures for flooding, but the existence of this document did not prevent the accident. [2.6]

3. The coastguard, SAR helicopter, and stand-by vessels undertook the rescue of the crew very effectively. [2.7]

4. *Vertrauen*'s lifesaving appliances operated satisfactorily during her abandonment. [2.7]

SECTION 4 - RECOMMENDATION

The Maritime and Coastguard Agency is recommended:

1. Not to accept two electrically-driven bilge pumps as being powered by separate means under *The Code of Safe Practice for the Construction and Use of 15m (LOA) to 24m (L) Fishing Vessels*, unless the electricity supply for each pump is completely self-contained. [2.3]

Marine Accident Investigation Branch
August 2002

ANNEX 1

Standard Risk Assessment Form

Vessel Name: VERTRAUEN	Vessel Registration: BF450	Reference No : G006

Standard Risk Assessment Form			ENGINE ROOM			
Activity or area	**Possible hazards**	**Possible consequences**	**F/P**	**S**	**F/P x S**	**Control measures necessary with respect to your vessel**
Engine Room (Cont.)	Batteries	Explosion, fire	1	3	3	Ensure that the battery compartment is well ventilated, maintain the batteries in good order and ensure that no spare gear or tools are allowed to accumulate on top of them. Smoking or naked flames must be prohibited near batteries.
	Electricity	Electric shock, burns, fire	1	3	3	Ensure that electrical fittings are in good order and that fuses or circuit breakers are correctly rated. Only competent people should be allowed to work on electrical systems.
	Compressed air	Explosion	1	3	3	Alert crewmembers to the possible hazards of using compressed air. Instruct crewmembers never to misuse air lines or compressed air equipment. All crewmembers to use correct PPE.
	Hydraulics	Equipment failure	2	2	4	Ensure that hydraulic systems are well maintained. Cleanliness is essential. If working on equipment with rams, make sure that it cannot fall when fittings are released. All crewmembers to use correct PPE.
	Corroded pipes, loose fittings, worn seals	Flooding - vessel loss, possible deaths	1	3	3	Regularly check and maintain all sea water systems (e.g. pipework, fittings, valves and seals).
	Bilge level alarms not fitted or not working	Flooding not detected	1	3	3	Ensure bilge level alarms are fitted and tested regularly to ensure that they are working.
	Seal inlet valves seized or cannot reach item	Flooding cannot be stopped	1	3	3	Ensure that seacocks are well maintained and consider fitting extension handles so that they can be operated even if they are under water.
	Inexperience lack of training	Vessel breakdown, vessel and crew at risk	1	3	3	Ensure that the person in charge of the operation and maintenance of the engine and other equipment on the vessel has sufficient experience/training to be able to ensure the safe working of all essential items.
Other						

Assessor Name:..

Assessor Signature: ....

Date Assessed:.....................

Frequency/Probability (F/P) (How likely that harm may occur)		Severity (S) (How harmful)	
1	Very unlikely	1	Slightly harmful
2	Unlikely	2	Harmful
3	Likely	3	Very harmful

Risk Factors (F/P x S)

1 -	No action is needed
2 -	Can be tolerated, but make sure that it does not become worse
3/4 -	Take action but subject to it being reasonable and sensibly possible
6 -	Must be attended to, you must reduce the risk
9 -	Cannot be accepted and work/activity must not continue

Engine Room

Batteries

Batteries have the potential to explode if the hydrogen and oxygen gas given off is not properly vented away. Smoking, or any naked flame/spark could ignite an explosion. Check that the battery compartment is well ventilated, maintain the batteries in good order and ensure that no spare gear or tools are allowed to accumulate on top of them. Smoking or naked flames must be prohibited near batteries.

Electricity

Various electrical systems may now be used on fishing vessels ranging from 24 V DC to 240 V AC and 3 phase systems. Such high power systems are potentially dangerous and proper precautions must be taken. The consequences of poor maintenance, incompetent repairs or alterations could be extremely harmful. Even 24 V DC systems are potentially dangerous, as short circuits can cause fires and give a fatal shock in wet conditions. Ensure that electrical fittings are in good order and that fuses or circuit breakers are correctly rated. Only competent people should be allowed to work on electrical systems.

Compressed air

Compressed air has lots of potential energy which may result in an explosion if receivers or storage bottles are damaged. A blast of compressed air from a pipe can cause injury and crewmembers must be instructed never to misuse air lines or compressed air equipment.

Hydraulics

Aside from the fire risk from hydraulic oil, the hazards which hydraulic systems pose are generally of system failure which results in the vessel being incapacitated i.e. the failure of the winch or net drum etc. Ensure that hydraulic systems are well maintained. Cleanliness is essential. If working on equipment with rams, make sure that it cannot fall when fittings are released.

Corroded pipes, loose fittings, worn seals

Flooding is the cause of a high proportion of vessel losses and many more vessels are only saved by pumps being air lifted to them. Corroded pipework, fittings coming loose, valves and seals failing all can result in the vessel rapidly filling with water. Regularly check and maintain all sea water systems.

Bilge level alarms not fitted or working

Early detection of any flooding situation is essential in order to have any chance of stopping it. Bilge level alarms should be fitted and tested regularly to ensure that they are working.

Sea inlet valves seized or cannot reach them

In many instances, it would have been possible to stop the flooding by simply closing the seacocks, but this was not possible because they were seized or the flooding was too deep to allow anyone to reach them.
Ensure that seacocks are well maintained and consider fitting extension handles so that they can be operated even if they are under water.

Inexperience/lack of training

The person in charge of the operation and maintenance of the engine and other equipment on the vessel must have sufficient experience/training to be able to ensure the safe working of all essential items. Lack of experience and knowledge could result in very serious consequences.

ANNEX 2

Extract from MAIB’s Safety Digest 2/2001

Part 2 – Fishing Vessels

There was a very high number of fishing vessel founderings during the year 2000. The saving grace was that very few people lost their lives as a result.

Whenever a trend develops, the MAIB tries to identify why. One can, of course, draw almost any conclusion from statistics to meet a particular viewpoint, but two features stand out. The first is the continuing failure of bilge alarms to provide adequate warning that flooding is taking place, and the second is the number of times that those on board find themselves in a situation they are unable to cope with.

We have referred to bilge alarms before. We make no apologies for returning to the same point again and again. One of the most basic checks to be made before going to sea is to ensure it is functioning correctly. If it has been landed for repair and you are sailing without it, or it has been disconnected for some reason, or there is a defect and you haven't done anything about it, the chances of receiving adequate notice of flooding are reduced significantly. It matters.

If the vessel then sinks you may well be saying farewell to your livelihood. Some people may start asking awkward questions, the paperwork becomes a nightmare and, worst of all, somebody may get killed. Don't let any of these possibilities happen. Your aim is to make sure flooding doesn't occur in the first place and, if it does, be sure you know what to do about it. The more notice you have of flooding, the greater the prospect of a satisfactory outcome. **Make sure the bilge alarm is working correctly before sailing. Test it regularly once at sea.**

If flooding is detected – hopefully very soon after it starts – the first priority is to stop or contain it. Bilge pumps can help keep the vessel afloat until either she reaches port, or assistance arrives, but they don't stop the water coming in. Flooding is bad news. It gets in through the hull, broken or corroded pipework, or via a broken or faulty valve. Your aim is to stop that flooding and save the vessel and all on board her.

Knowing your craft is the first step, understanding the nature of flooding is the second. You should have a very good knowledge of all sea openings, where they are and how far below the waterline they are positioned. And remember, the deeper the source of flooding and the bigger the hole, the faster the rate at which the water enters.

The second priority must be to contain the area of flooding. Watertight bulkheads go a long way to achieving this, but the question any crew might reasonably ask is "how watertight are the bulkheads?"

No two vessels are the same, but every crew should have given very careful thought to how they might deal with a flooding incident, should it arise. Asking the coastguard to provide another pump might help, but the important thing is to stop the water coming in. As quickly as possible.