

Report of the Chief Inspector of Marine Accidents
into the collision between the Fishing Vessel

ANTARES

and

HMS TRENCHANT

with the loss of four lives
on 22 November 1990

LONDON: HMSO

Marine Accident Investigation Branch
5/7 Brunswick Place
SOUTHAMPTON
Hants SO1 2AN

© Crown copyright 1992

Applications for reproduction should be made to HMSO
First published 1992

ISBN 0 11 551128 8

**Marine Accident Investigation Branch
Department of Transport
5/7 Brunswick Place
Southampton
Hants SO1 2AN**

15 April 1992

*The Right Honourable John MacGregor OBE MP
Secretary of State for Transport*

Sir

In pursuance of Regulation 9 of the Merchant Shipping (Accident Investigation) Regulations 1989, I submit my Report following the Inspector's Inquiry into the collision between the fishing vessel ANTARES and the submarine HMS TRENCHANT, with the loss of four lives on 22 November 1990.

I wish to place on record appreciation for the co-operation which was extended to the Inspectors who carried out the Inquiry, by the parties concerned.

I am, Sir,
Your obedient servant

Captain P B Marriott
Chief Inspector of Marine Accidents

CONTENTS

		Page
Section 1	Summary	1
PART I	FACTUAL ACCOUNT	
Section 2	Particulars of FV ANTARES and Crew	2
Section 3	Particulars of HMS TRENCHANT and Crew	6
Section 4	Narrative	9
PART II	EMERGENCY ACTION AND SALVAGE	
Section 5	Search Operation	15
Section 6	Salvage Operation	17
Section 7	Comments on Search Operation	21
PART III	CONSIDERATION OF POSSIBLE FACTORS	
Section 8	General	22
Section 9	Reconstruction of Events	24
PART IV	FURTHER COMMENT AND DISCUSSION	
Section 10	Events after the Accident	27
Section 11	Previous Incidents	29
Section 12	Responsibility	30
PART V	CONCLUSION	
Section 13	Findings	32
Section 14	Recommendations	35
Figure 1	FV ANTARES	
Figure 2	Typical Pelagic Net	
Figure 3	A Trafalgar Class Submarine	
Figure 4	MAIB Reconstruction of Accident	

1. SUMMARY

The pelagic trawler, ANTARES left her home port of Carradale on 19 November 1990 to fish in Bute Sound, northeast of the Isle of Arran, with a crew of four. At the same time the Trafalgar-class submarine, HMS TRENCHANT, was operating in the Clyde exercise area. She was acting as a training vessel for officers on the submarine command course and the complement included the Commanding Officer of the course and four student officers. The submarine was taking part in a series of exercises for the final sea phase of the course. The procedure for each exercise series was that conduct of TRENCHANT was passed by her Captain to the Course Commander who in turn gave charge of the submarine to the student to be assessed. The student, designated Duty Captain, then carried out all the functions of command while being observed by the Course Commander.

On 22 November shortly after 0200 hrs TRENCHANT was in Bute Sound, submerged at a depth of 60 metres and steering a course of northwest at about six knots. An exercise series had just been completed and the Duty Captain was preparing to hand over to the next student, who was with him in the control room. The Captain and Course Commander were in the wardroom, discussing the Duty Captain's performance. TRENCHANT was detecting surface vessels by means of her passive sonar.

At 0217 hrs TRENCHANT had a close sonar contact to starboard and turned to port to avoid it. Banging noises were then heard in the submarine and it was assumed by those in the control room that a fishing trawl had been snagged. On regaining periscope depth, two fishing vessels were seen, apparently engaged in normal fishing. TRENCHANT surfaced at about 0300 hrs and a trawl wire was discovered fouled on the submarine casing. Attempts by the submarine to contact the two fishing vessels by radio were unsuccessful. Since everything on the surface appeared normal, TRENCHANT reported the incident to Faslane base and continued with her exercises.

Later in the morning it was reported that ANTARES was missing and a full scale search operation, coordinated by Clyde Coastguard, was mounted. The wreck of ANTARES was located on the sea bed in the early afternoon, the position was where the collision with the trawl had occurred. The wreck was salvaged on 10 December. It was found that the starboard trawl warp had parted and the broken end matched the section of wire found on TRENCHANT's casing.

The bodies of the four crew of ANTARES have been recovered.

The main findings of the investigation are that the accident was caused by a partial breakdown in both the structure and the standards of watchkeeping on board TRENCHANT, following the completion of a command course exercise. Also the stowage position and securing arrangements of the inflatable liferaft on ANTARES were deficient, such that it failed to float free and inflate when the vessel sank.

Further, the delay of over eight hours prior to the mounting of a search operation was due to an incorrect report from TRENCHANT, which stated that although a trawl had been snagged, the fishing vessel involved was safe.

PART 1 FACTUAL ACCOUNT

2. PARTICULARS OF FV ANTARES AND CREW

2.1	Port of Registry	:	Campbeltown
	Fishing Number	:	CN123
	Registered Length	:	16.07 metres (52.75 feet)
	Overall Length	:	17.37 metres (57.00 feet)
	Moulded Length	:	5.64 metres (18.50 feet)
	Moulded Breadth	:	2.76 metres (9.00 feet)
	Built	:	1965 by Messrs Forbes, Sandhaven
	Engine	:	Caterpillar, type 3306, 250 bhp at 2000 rpm
	Speed	:	8 knots

2.2 Navigation, Communications and Fishing Equipment

Searby Magnetic Compass

Kelvin Hughes Navstar Navigator

Dolphin Track Plotter

Furuno Radar Type 8030D

Navigation lights appropriate for a vessel of her type and length

Uniden VHF Scanner

Furuno Radio Type FM2510

Sailor VHF Radio Type RT144D

Sailor MF Radio Type T126/R105

Simrad RW 2182 Watchkeeper

Cellnet Telephone

Net Recorder Type CN-8

Furuno Echosounder Type FCV201 and

Furuno Sonar Type CH-14

2.3 Lifesaving Appliances

Beaufort 6 man inflatable liferaft - last serviced April 1990.

Locat Emergency Position Indicating Radio Beacon (EPIRB) packed into liferaft.

5 Duncan DTp approved lifejackets.

2 Lifebuoys, one fitted with man overboard light and smoke marker - manufactured November 1987.

Schermuly line throwing apparatus - rockets manufactured November 1987 and cartridges October 1987.

12 Pains Wessex parachute distress rockets - manufactured November 1987.

2.4 Certification

Fishing Vessel Certificate - issued 6 September 1989. Results of roll period tests gave a GM of 0.76 metres as compared to a required GM of 0.68 metres.

2.5 Crew

ANTARES was manned by a crew of four. The Skipper, aged 36, who was also the sole owner of the vessel, entered the fishing industry after leaving school, but after a period of shore employment returned to the fishing industry in 1977. He obtained a Certificate of Competency as Second Hand (Special) in 1978, bought his first boat in 1980, obtained a Restricted Certificate of Competency in Radio Telephony in 1983 and purchased ANTARES in 1987.

None of the other three crew members were certificated but all had attended a Basic Sea Survival Course. One, aged 24 years, had served on ANTARES since the time she had been purchased by the Skipper. One, aged 20 years, had been in the fishing industry since leaving school and served on ANTARES since July 1990, whilst the third member, aged 29 years, had served on ANTARES since April 1990.

2.6 Construction

The vessel is constructed substantially of wood and the hull is divided into four separate compartments, a fore peak store right forward, a large fish hold abaft this and abaft this again the engine room and the crew cabin. The deckhouse is sited towards the after end partially above the engine room and the cabin.

Access to the fore peak store is provided by a small hatch on deck made watertight with a hinged mild steel cover secured by two toggles. This hatch is afforded partial protection by the whaleback. Access to the fish hold is through a centrally fitted hatch on deck made watertight with an aluminium cover secured by four toggles. This access hatch is exposed to the weather.

Access to the engine room and crew cabin is also through a small hatch on deck, sited on the port side within the confines of the deckhouse. This hatch is closed with a mild steel cover which when dogged down can be opened from above or below. Additionally the cabin is provided with a skylight escape hatch giving direct access to the outside deck aft.

Entry to the deckhouse is gained through a wooden hinged door at the after end starboard side. The wheelhouse is a separate compartment at the forward end of the deckhouse accessed through another wooden hinged door sited within the confines of the deckhouse itself. Escape from the wheelhouse is provided by two opening windows port and starboard.

All the ventilators and air pipes from below deck spaces extend to a level above the top of the deckhouse.

A photograph of ANTARES is shown at Figure 1.

2.7 Fishing Gear

ANTARES was used for various methods of trawling; she had recently been equipped for pelagic trawling and had commenced this mode of fishing early in November 1990. The details and approximate dimensions of a pelagic net are shown in Figure 2. The warps of a pelagic net are depth marked every 25 fathoms; 1 mark indicating 25 fathoms from the trawl doors, 2 at 50 fathoms, 3 at 75 fathoms and 4 at 100 fathoms. The sequence is then repeated up to 200 fathoms and repeated again up to about 250 fathoms, this being the maximum length of the warps. The third 1 mark would indicate a length of wire to the trawl doors of 225 fathoms. This system of marking allows the Skipper to put out a pre-determined length of warp and adjust it accordingly depending upon depth.

The warps pass through the top block of the gallows port and starboard and then down through the gallows bottom blocks and thence through lead blocks on each side of the vessel to a hydraulic winch. The winch has a split drum and the warps are rove on in such a manner that they can be heaved or slacked simultaneously.

Additionally, ANTARES had a facility for towing her nets using a central towing point sited on a bracket projecting horizontally from the after end of the cabin top. This central towing point had the effect of removing any of the strain from the winch itself. It is particularly useful in bad weather, however it was the practice of the Skipper to use this towing point at all times. With this arrangement the gear is deployed in the usual way with the full weight of the tow being taken by the winch. Chains are attached round the warps and linked to a wire passing through a block shackled to the central towing point. The winch is then slackened back and the central towing point takes the strain of the gear.

A hydraulic crane was fitted at the stern of the vessel in 1988. This crane was used to transfer the full net through the water from abaft the gallows to a position abreast of the forward derrick from where it could be lifted by the derrick from the water and inboard to a position over the fish hold hatchway. The power for this crane, together with the forward winch, are supplied by an engine driven hydraulic pump. The power take off for this pump is sited in the wheelhouse. The winch controls are also sited in the wheelhouse while the crane controls are sited locally at the crane itself.

3. PARTICULARS OF HMS TRENCHANT AND CREW

3.1	Type	:	Trafalgar Class attack submarine
	Commissioned	:	1988
	Length	:	82 metres (270 feet)
	Breadth, including the planes	:	9 metres (30 feet)
	Depth, from the top of the fin (conning tower) to keel	:	15 metres (50 feet)
	Propulsion	:	Nuclear steam turbines, single nozzle impeller
	Steering	:	Twin tiered single plate rudders

3.2 Navigation, Communications and Equipment

A CP inertial navigation system. This is a computerised system which provides an on-going position of the submarine underwater depending upon the information regarding course, speed, currents etc which is fed into the computer. The on-going position is therefore estimated only; the position requires to be updated at periodic intervals using a surface fix.

Communications system includes UHF, VHF, HF and MF radio-equipment. A single retractable radio mast is provided, so only one frequency can be worked at a time and only when the submarine is at or above periscope depth. The radar equipment has a maximum range of about eight miles when at periscope depth but the range is considerably increased when the submarine is on the surface.

3.3 Sonar Equipment

Sonar is the primary means of detection of other vessels, above or below the surface, by a submerged submarine. It has two modes, active and passive. In the active mode, sound pulses are transmitted from the submarine, reflected from an object within the beam and returned to the submarine to be detected and analyzed by the sonar receiver. In the passive mode, which is always used, noise transmissions emitted by other vessels or objects are received by the submarine. The bearing of a noise source can be measured and trained sonar operators can estimate from the frequency the type of vessel, and the loudness will give an indication of the proximity.

The primary noise emissions from a surface vessel come from the propeller. Low propeller speeds from large vessels and high propeller speeds from small vessels can easily be recognised. A vessel stopped in the water may still be detected if machinery on board, particularly below the waterline, is running. A vessel or object making no noise emissions will not be detected by passive sonar.

TRENCHANT is equipped with 2020 long range passive sonar on the bow. The arc of coverage does not include an area astern of the submarine. The 2020 sonar is augmented by the 2008 sonar, or underwater telephone, which has three transducers, covering the bow, and the port and starboard sides. These are fixed and cover a fairly wide beam. Integrated with them are two transducers in the fin which can be rotated. The transducer at the back of the fin is integrated with the 2020 bow sonar to give coverage astern. These are normally left in the "omni" position, giving 360° cover but if it is necessary to investigate something they can be trained in a particular direction. This requires them to be manned by a sonar operator.

The submarine also has 2007 intercept sonar on either side, which is long range passive and can intercept other transmissions from ships or submarines.

The submarine is also equipped with 2019 sonar, which receives active sonar transmitted by other warships.

A photograph of a Trafalgar class submarine, of which TRENCHANT is typical is shown at Figure 3.

3.4 Crew

The usual complement of TRENCHANT comprised 120 officers and ratings. She was however being used as an exercise ship for a command course and in addition to her usual complement there were five additional officers on board - the Commanding Officer of the command course and four students.

The following personnel are referred to in later sections of this Report.

The Captain of TRENCHANT, aged 37 years, had joined the Royal Navy in 1970. He passed his submarine command course in 1985 and was appointed to his first submarine command in 1987. He was appointed Commanding Officer of TRENCHANT in June 1990.

The Commanding Officer of the submarine command course (referred to as 'Teacher') aged 41 years, had served in submarines for about 18 years. He passed his submarine command course in 1980 after which he had about five years in command of submarines. He joined TRENCHANT with the students on 14 November 1990 to conduct the final sea phase of the command course.

The Duty Captain, one of the students, aged 32 years, had joined the Royal Navy in 1974 as a rating. He was promoted to Officer rank in 1981 and joined the submarine service in 1983. He was promoted to Lieutenant in 1984. Prior to the

command course he was serving on board the nuclear powered submarine HMS CONQUEROR where he was senior watch leader and Sonar Officer. He started the command course in August 1990.

The Officer of the Watch, also known as the 'Watch Leader', aged 34 years, had joined the Royal Navy as a rating in 1973 transferring to the submarine service the following year. He was appointed to TRENCHANT in January 1990 and his duties included overall charge of the Sonar Department.

The Navigating Officer, aged 31 years, had joined the Merchant Navy in 1976. He obtained a Certificate of Competency as Second Mate (Foreign Going) in 1983. He joined the Royal Navy in 1984 transferring to the submarine service in 1986, and had served as the Navigating Officer on board TRENCHANT since May 1989.

The Operations Officer in the Control Room, a Chief Petty Officer (CPO), aged 33 years, had been in the Royal Navy for 15 years. He had nine years experience as an Operations Officer and was promoted to CPO in 1985. He was appointed to TRENCHANT in March 1990.

The Sonar Controller in the forward Sonar Room, an Acting Petty Officer, aged 28 years, had worked with sonar throughout his 12 years service with the Royal Navy. His last nine years have been spent in the submarine service. He was appointed to TRENCHANT in September 1990 as Petty Officer (Sonar).

The Sonar Operator at the 2020 sonar visual display unit, a Leading Seaman (Sonar), aged 26 years, had been a sonar specialist throughout his service in the Royal Navy the last seven of which have been spent in the submarine service. He joined TRENCHANT in May 1990.

The Sonar Operator at the 2008 underwater telephone, an Able Seaman, aged 21 years, had been in the Royal Navy for three years. He joined TRENCHANT in 1988.

4. NARRATIVE

All times are in GMT.

- 4.1 The crew of ANTARES joined the vessel from their homes around 2300 hrs on Sunday, 18 November 1990, and subsequently sailed from Carradale to trawl the deep trench situated in Bute Sound to the NE of the Isle of Arran. These fishing trips usually lasted from Monday to Thursday with the vessel returning to her base at the weekends. A Scottish Office directive prohibits commercial fishing in the Lower Clyde from 1800 hrs on Friday to 2400 hrs the following Sunday.

There were three other boats in the same general area on 19 November 1990: HEROINE out of Troon, HERCULES III out of Ayr and another called BRIGHTER MORN. BRIGHTER MORN left the area either on the evening of 19 November or the morning of 20 November, while the other three boats remained. There was sporadic VHF communications on Channel 72 between all three vessels throughout that week. HEROINE and HERCULES III remained trawling in the area the whole time but ANTARES may have occasionally visited other areas to look for better fishing and additionally landed her catch in Largs on the evening of 20 November and again on the evening of 21 November.

- 4.2 On 21 November ANTARES left Largs at 1730 hrs and returned to Bute Sound about one hour later. She entered the deep trench towards the southerly end and shot her gear to the south and east of HEROINE and commenced towing NW'ly astern of HEROINE. Once the tow had commenced there was a VHF radio conversation between the Skippers of ANTARES and HEROINE. During this conversation the Skipper of ANTARES stated that it was his intention to tow north and when he turned at the northerly end of the tow he was going below and one of the crew would be taking over. The three fishing vessels continued to fish without further communication.

Just before 2230 hrs the crew member who had taken over the watch from the Skipper made his usual telephone call home to his wife and confirmed to her that they were fishing at what he described as "the back of Arran". He also mentioned that he would be calling the Skipper at 0230 hrs. This is the last known communication with ANTARES.

- 4.3 The three fishing vessels continued to fish normally for the rest of the evening of 21 November and into the early hours of 22 November until some time shortly after 0200 hrs HEROINE, towing NW'ly, passed ANTARES, towing SE'ly, about 2 cables port to port in approximate position 55°40'.3N 5°03'.7W. The time is not certain; it was recalled by the Skipper of HEROINE as "approximately" 0140 hrs. At a time recalled as some 10 minutes after passing ANTARES the watchkeeper in HEROINE looked astern and noted ANTARES turning to starboard to come back on a NW'ly tow. This is the last known sighting of ANTARES. The watchkeeper did not look astern again as he was concentrating on HERCULES III who was ahead of him and towing SE'ly towards him.

A further 10 minutes after this last sighting of ANTARES there was a VHF conversation between the watchkeeper on HEROINE and the Skipper of HERCULES III when the fact that ANTARES could no longer be seen either on radar or visually was discussed. The time of this call was given as 0200 hrs. As there is firm evidence that the accident occurred very close to 0219 hrs, it is considered the times given by the fishermen may be in error, (see Section 8.1). It was assumed by those on board HEROINE and HERCULES III that ANTARES had proceeded south out of the area and no further thought was given to the absence of ANTARES at that time. HEROINE and HERCULES III continued to fish normally.

- 4.4 The weather was excellent with light variable winds and a calm sea: it was a clear night with visibility of about 8 miles. The sea temperature was about 11°C and the air temperature over the water was 6°C. There was no significant tidal stream in the area.
- 4.5 TRENCHANT sailed from the Clyde Submarine Base at Faslane on 12 November to act as a training vessel for Officer students on a command course. This course is referred to as a Perisher course where the students are assessed on their suitability for command. Six such students, together with their Commanding Officer, joined TRENCHANT by boat transfer in Loch Ewe on 14 November. TRENCHANT then proceeded on exercise to a zone between Scotland and the Faeroe Islands.

Prior to each series of exercises, 'conduct' of the submarine was passed by her Captain, to the Course Commander, who is known as 'Teacher', who in turn gave charge of the submarine to the student to be assessed for the duration of his exercise. These exercises required the student to carry out all the functions of command while being observed by 'Teacher'. This is normal procedure for the final sea phase of the command course.

- 4.6 The first phase of exercises was completed on 16 November and TRENCHANT entered the Clyde Exercise Area at 1000 hrs on 17 November to continue with the inshore phase at which time the students onboard TRENCHANT had been reduced to four. This phase of the exercises continued normally until at 1800 hrs on 21 November one of the Perisher students took over as Duty Captain.

He was required to carry out a dummy mine laying exercise during which opposition was to be provided by the surface naval vessel CHARYBDIS. This exercise which was carried out in the Hunterston Channel commenced at 2330 hrs and he was in the control room continuously from that time onwards. This exercise was completed successfully and TRENCHANT proceeded south out of the Hunterston Channel to allow detection by CHARYBDIS so that evasive manoeuvres could be practised.

This phase of the exercise, which involved frequent alterations of course and speed by TRENCHANT continued and at 0100 hrs on 22 November a change of watch took place, but the same student continued as Duty Captain.

- 4.7 The exercise, involving evasive manoeuvres to avoid detection by and to attack CHARYBDIS, continued. At 0131 hrs the submarine went to periscope depth in order to observe CHARYBDIS, prior to launching a simulated attack on that vessel. The Duty Captain took an all round look through the periscope and later remembered noticing only the frigate on the surface before the submarine returned to her submerged depth. At 0158 hrs there was a close sonar contact estimated to be at a range of 384 yards. At this time the submarine was completing a 180° turn to port.

The exercise was declared complete by 'Teacher' just before 0200 hrs. By this time TRENCHANT was steadied on a course of 150°T at about 6 knots at a submerged depth of 60 metres (the keel of TRENCHANT was 60 metres below the surface). Her approximate position at 0200 hrs was 55°39'.5N 5°02'.4W.

- 4.8 When the exercise was declared complete CHARYBDIS steamed in a NW'ly direction out of the area towards the Cock of Arran to engage another submarine, HMS OTTER, which was engaged in a similar exercise to the north. 'Teacher' instructed the Duty Captain to hold in the general area, hand over to his relief and let his relief start things up again from here. 'Teacher' left the control room at this time to discuss the performance of the Duty Captain with the Captain of TRENCHANT in the ward room. The next student to be Duty Captain was then sent to the control room. At 0204 hrs the Duty Captain altered course to starboard and at 0209 hrs TRENCHANT was steadied on a course of 315°T. Speed was still about 6 knots and depth still 60 metres. When TRENCHANT steadied on 315°T there were four apparent contacts on the 2020 Sonar trace - contact MO1 which was the surface naval vessel CHARYBDIS presently steaming away from the area, contact 03 which was classified as a fishing vessel, contact 05 also classified as a fishing vessel and contact 45 which was classified as a coaster but could also have been a fishing vessel.

The contact relevant to the sequence of events which occurred was contact 05 and it was fine on the port bow bearing 304°T. The source of this contact must in fact have been not one but two vessels, namely ANTARES and HEROINE who had just passed each other. It must be remembered that the passive sonar in use gave no firm indication of range, and both craft will have been on similar bearings. The Sonar Controller in the forward sonar room reported contact 05 as being a noisy contact and bearing rate steady. (These sonar reports may be broadcast through loudspeakers in the control room and communications between the sonar room and the control room in this mode are referred to as being 'on the net'. There is conflicting evidence as to whether or not the 'net' was switched on). At 0213 hrs the Sonar Controller reported contact 05 as bearing rate steady but with increased intensity. At 0216 hrs contact 05 was reported as bearing 306°T, moving slowly right and marking 35dB on the noise meter. Between 0216 hrs and 0217 hrs the bearing of contact 05 altered from 306°T to 322°T when it was then reported as getting louder but still marking 35dB on the noise meter and shortly afterwards reported as starting to move fast right. During this period the Duty Captain was in discussion with the student who would be the next Duty Captain. In response to this series of reports and the close contact to starboard the Duty Captain ordered 15° port rudder and later increased this to 30° port rudder. At 0218 hrs TRENCHANT's head was passing

300°T and contact 05 was bearing 355°T. The closest point of approach (CPA) of contact 05 which had already passed was reported by the Operations Officer as 200 yards. At this time, 0218 hrs, the rudder was eased to port 10° and the order to steer 260°T given by the Duty Captain. About 45 seconds later, just before 0219 hrs when contact 05 was bearing 028°T, banging noises on the outside hull of TRENCHANT were heard in the control room. These noises appeared to come from starboard forward.

- 4.9 The Sonar Controller reported almost immediately that a trawl had possibly been snagged and the order to stop engines was given from various sources. The fact that a trawl had been snagged was confirmed shortly afterwards by the noise of the trawl wires dragging down the outside of the submarine. This report was also given by the Sonar Controller. On hearing the first noises the Navigating Officer put the position of TRENCHANT on the chart using the CP inertial navigation system. This position which was considered accurate to 1½ cables was 55°39'.5N 5°03'.3W. The course being steered by TRENCHANT when the collision occurred was estimated as 285/290°T.
- 4.10 The Officer of the Watch then gave the order to stand-by to return to periscope depth and the drill for this was put into operation. This drill included the manning of the 2008 underwater telephone by an Able Seaman. Prior to this the equipment had been unmanned. 'Teacher' and the Captain of TRENCHANT then entered the control room in response to the noises which they had heard themselves and a verbal report from the Navigating Officer. The time was now 45 seconds after collision.
- 4.11 After a brief check 'Teacher' took charge of TRENCHANT from the Duty Captain and proceeded to go slow ahead (5 knots) with 30° of port rudder steadying TRENCHANT on a course of 090°T at 0222 hrs. Her approximate position at this time was 55°39'.5N 5°04'.0W. During this manoeuvre the depth was decreased to 37 metres. 'Teacher' did not want to bring TRENCHANT to periscope depth until he was certain the position of the surface craft made it safe to do so. Checks were then made on the surface contacts and attempts made to regain the previous contact 05 without success. The Able Seaman at his post on the underwater telephone heard a noise which he described as like 'a disturbance of the sea and amidst that noise a sound like a propeller winding up'. This secondary noise lasted only 5 or 6 seconds. There is some suggestion that the command team were standing behind the Able Seaman at this time listening to the same noise. The best possible estimate of time for this event is between 0221 hrs just before TRENCHANT steadied on 090°T and 0226 hrs when she passed over what is now known to be the wreck position.
- 4.12 'Teacher', after taking further evasive action to distance TRENCHANT from any close surface contact, eventually brought the submarine to periscope depth at 0239 hrs. After viewing the surface situation through the periscope he reported two fishing vessels in close proximity to each other but no close contacts to the submarine itself. He ordered Sonar Standard (this means they could relax somewhat since the surface situation was held on visual) and handed conduct of the submarine to the Captain of TRENCHANT to complete the surfacing operation.

Whilst at periscope depth the radio mast was raised and contact made with CHARYBDIS to ask if anything unusual had been heard from fishing boats. The reply was negative.

- 4.13 The Captain brought TRENCHANT to the surface at 0252 hrs in position 55°39'.5N 5°01'.0W. An inspection at this time revealed a wire with a length of chain attached fouled around the 'Paris' dome of the submarine. (This is a small dome forward of the fin which houses an active Sonar). This wire started on the starboard side of the dome where the attached chain was embedded in the glass reinforced plastic, ran around the forward end of the dome and down into the water on the port side leading aft with considerable weight on it. This wire was finally removed by a casing party when the weight came off it, but to achieve this the way had to be taken completely off TRENCHANT using astern power before the wire could be cut with bolt cutters when it fell to the sea bed. The short length of wire and the attached chain remaining was retained as evidence.

Once on the surface 'Teacher' again made radio contact with CHARYBDIS to ascertain if they had seen or heard anything unusual and the response was negative. He then called, on VHF radio, the two fishing vessels he had seen earlier through the periscope. Channel 16 and several other channels were used for these calls, which were made without formal prefixes. No response was received from the two fishing vessels which were HEROINE and HERCULES III. At about 0315 hrs 'Teacher' contacted the Operations Room at the Faslane submarine base and reported the incident.

TRENCHANT remained on the surface while the overall situation was assessed by the Captain. While on the surface one of the two fishing vessels passed close by without any contact being made. The Captain finally decided to advise Faslane that TRENCHANT should continue with the exercise. He based this decision on the apparent normality of the surface situation, the fact that no alarm had been raised and everything seemed normal with the two fishing boats in the area and the minimal damage only to his own submarine. This advice was passed to Operations at Faslane and TRENCHANT submerged at 0500 hrs to continue with the exercise.

- 4.14 At 0900 hrs CHARYBDIS completed her exercise with OTTER and steamed south down the Firth of Clyde out of the area. TRENCHANT completed the final phase of the exercise programme and returned to the Faslane base arriving there at approximately 1200 hrs. It was only at this stage and less than one hour before berthing that the command on board TRENCHANT started receiving indications that there might be a fishing vessel missing.
- 4.15 Whilst at Faslane TRENCHANT was put in dry-dock and in addition to the damage to the 'Paris' dome where the wire had embedded itself the following damage was also noted:

- a) The starboard log probe was sheared off.
- b) The pinger and its protective cowling sited centrally on the keel plate towards the forward end of the submarine were damaged with the holding down bolts at the forward end ripped away and the base plate badly bent.
- c) The leading and trailing edges of the starboard forward fin were damaged.
- d) Minor damage to the starboard side in way of the starboard forward fin.
- e) There were rubber panels missing from the starboard side of the hull not thought to be connected with the incident.

PART II EMERGENCY ACTION AND SALVAGE

5. SEARCH OPERATION

- 5.1 The first report of the incident to the shore was made by 'Teacher' around 0315 hrs to the Officer in the Operations Room at Faslane. This report indicated that although TRENCHANT had collided with a trawl and could not contact the fishing vessel involved, the fishing vessel was in fact safe.

At 0410 hrs this report was relayed from the Operations Room at Faslane to Clyde Marine Rescue Coordination Centre (MRCC), who asked to be kept advised. On receipt of this report Clyde MRCC attempted to obtain further information and put out a call on Channel 16 VHF to all fishing vessels south of the Cumbraes. There was no response to this call.

At 0415 hrs the Operations Officer at Faslane telephoned the Secretary of the Clyde Fishermen's Association and made him aware of the incident.

Clyde MRCC telephoned the Operations Room at Faslane at 0504 hrs in an attempt to get further information. There was nothing further to add to the original report except that they were given the position of the incident.

Later that morning the Secretary of the Clyde Fishermen's Association, who was concerned about the situation, telephoned fish salesmen in the ports in the area to try to identify the fishing vessel which had been involved. They could not provide any information and at 0847 hrs he telephoned Clyde MRCC expressing his concern about the need to identify the fishing vessel and to establish that it was in fact safe.

After this call, Clyde MRCC started to check with the fishing vessels in the area but it was not until 0943 hrs, after they had spoken to the Skipper of HEROINE, that they realised ANTARES might have been the fishing vessel involved. Attempts were then made to contact ANTARES on the cellnet telephone without success and a search of all harbours was then commenced to see if the vessel was in port. This search failed to locate ANTARES and with concern mounting a helicopter was scrambled from the Royal Naval Air Station, Prestwick to search the area south of Garroch Head.

- 5.2 At 1057 hrs the helicopter crew reported fish boxes and oil in position 55°40'.0N 5°05'.1W and a full scale search operation was mounted using a second helicopter, Lamlash and Troon lifeboats and fishing vessels in the area. A shoreline search was also mounted.

At this time the fishing vessels HERCULES III and HEROINE who had been continuing to fish, hauled their nets and joined the search. The search continued over a wide area with the number of search units increasing as time passed.

At about 1200 hrs CHARYBDIS, which was steaming south out of the area, was recalled by the Navy arriving back in the area about 1320 hrs to act as on-scene co-ordinator. Strathclyde Police were also advised of the situation.

The fishing vessel BRITANNIA which was coming to join the search reported an oil slick and HERCULES III and HEROINE proceeded to the position to carry out a sonar search hoping to pick up a signal from the net of ANTARES. They were diverted at one stage around 1310 hrs to look for a body in the water which had been reported by one of the helicopters. This report turned out to be a false alarm and the two fishing vessels returned to the area of the oil slick to continue their search. At about 1400 hrs they located a new wreck on the sea bed in position 55°39'.5N 5°03'.5W. CHARYBDIS was given this information and laid a dan buoy at 1433 hrs to mark the position.

- 5.3 Meanwhile the surface search for survivors both at sea and along the shoreline continued. At one stage there were 40 search units in the area, 33 of which were fishing vessels. The search was not confined to the area around the datum point alone but was extended both south and north in case the crew had managed to abandon into a liferaft and had drifted well away from the scene.

At 1630 hrs the search was called off for the day with only wreckage and fish boxes found.

- 5.4 At 0318 hrs on 23 November the new wreck was positively identified by RMAS TOREADOR as that of ANTARES. The wreck was lying in approximately 150 metres, heading in a north easterly direction and lying over on the starboard side to an angle approximately 70° to the vertical, that is it was almost over on its starboard beam.

The surface sea and shoreline search was resumed at 0800 hrs and it was finally called off in deteriorating weather conditions at 1200 hrs that day with nothing found. Shoreline searches along the west coast of the Isle of Bute continued on 24 and 25 November without success.

6. SALVAGE OPERATION

6.1 The Ministry of Defence decided on 24 November that they would arrange to have the wreck of ANTARES raised. After initial attempts using RMAS SALMOOR and a delay of several days it was realised that SALMOOR was unsuitable for the task and a team of saturation divers would be required. During this initial work the body of one of the crew members was found on the sea bed. This body was weighed down and its position marked with a transponder. The presence of another body in the wheelhouse was also confirmed at this time. The DSV (Diving Support Vessel) WILCHIEF was then chartered by the MoD to salvage ANTARES. WILCHIEF arrived in the area on 7 December; amongst those on board were the MoD Salvage Officer and his assistant, two members of the Strathclyde Police Investigation team and an MAIB Inspector.

6.2 On arriving at the wreck position, WILCHIEF positioned near the transponder marking the position of the body on the sea bed. The divers quickly located the body and it was recovered on deck; it was later identified as one of the crew members who had been off-watch.

WILCHIEF then moved to position her moon pool just to starboard of the wreck. The immediate task was to recover any bodies which might be in the wreck itself. The divers found it necessary to break two of the forward wheelhouse windows and a further one on the starboard side to allow the divers safe access to the wheelhouse. Two bodies were recovered from this area. One was later identified as the Skipper and the second as the other crew member who had been off-duty.

The wreck then had to be made safe to allow the divers to search inside for the body of the remaining crew man. This involved cutting away nets and cordage. When the search had been completed as far as possible, consistent with the safety of the divers, the remaining body had not been found. The only area which had not been fully searched was the engine room.

6.3 A survey of the wreck was then done with a view to raising it. At 0600 hrs on 8 December the port warp was located on the sea bed lying underneath the wreck of ANTARES and emerging under the port bow and leading off in a NNE'ly direction. This warp was cut and a transponder fitted on the cut end for later recovery. The operation to sling ANTARES then commenced and continued until 0840 hrs when diving operations were suspended to allow the saturation divers a proper rest period. When the divers resumed in the afternoon they again searched the wreck for the remaining body since the visibility below was improved. This further search also proved negative. Subsequently the divers carried out a complete video survey of the wreck as a precaution against later mishap. During this survey two tapes from the Dolphin video plotter and a briefcase full of paper were recovered and preserved in salt water for later analysis. This later analysis provided no useful information.

The operation to sling ANTARES was delayed due to inclement weather and this operation was not completed and ANTARES raised to a depth of 30 metres until the morning of 9 December. At this depth the wreck was further secured to WILCHIEF using a bow rope and WILCHIEF then proceeded toward the shallow waters of Kilchatton Bay at about 1 knot. The wreck was eventually lowered on to the sea bed in Kilchatton Bay at 2221 hrs on 9 December 1990.

- 6.4 SALMOOR then took over for the final phase of the operation while WILCHIEF returned to the original wreck position to recover the remains of the port warp which had been earlier marked with a transponder. 168 metres of this port warp were recovered and subsequently landed at Fairlie. The warp had only extended some 24 metres away from the wreck in a general NNE'ly direction and had been lying on the sea bed in big coils. When inspected on 11 December this warp was found to be depth marked. Meantime, the wreck was finally raised and pumped out around 1700 hrs on 10 December.

- 6.5 When surveyed afloat ANTARES was found to be virtually undamaged and making very little water. The electronic equipment in the wheelhouse had been severely damaged by the effects of sea water and water pressure making it difficult to ascertain the complete status of the equipment at the time of the sinking, however the following was noted:

The engine controls were set at normal full ahead.

The hydraulic steering was hard to starboard.

The Furuno radar was switched on.

The Furuno Sonar CH-14 was switched on.

The CN8 Net recorder - not possible to determine whether the power was on or off.

The Simrad RW 2182 Watchkeeper was switched off.

The Sailor MF Radio was switched off.

The Sailor VHF Radio, which was detached from its brackets, was switched on to Channel 72 only; the dual watch switch was not activated.

The overhead Searby compass lay on the deck on the starboard side where it had fallen from its mountings in the deckhead.

A claw hammer lay on a small ledge under the windows on the starboard side.

6.6 On top of the wheelhouse the Beaufort 6 man liferaft, which had failed to float free, was sited in a cradle directly underneath the mast structure with the painter attached to a nearby strong point; there was no hydrostatic release unit. The liferaft container was not compatible with the cradle since the rolling rims fell directly in line with the cradle supports. Another liferaft cradle was found fitted on top of the starboard shelter with part of a liferaft lashing still attached.

6.7 On the main deck under the whaleback, all the moveable equipment was found deposited on the starboard side. Alongside the wheelhouse on the port side the same condition existed where the moveable equipment was lying towards the wheelhouse and away from the port bulwarks. This equipment included the boat's permanent fendering. The port wheelhouse window was found shattered with the jagged edges removed. Broken glass from it was found on the outside deck under the window.

A lead block to the forward winch sited underneath the starboard deck shelter was found free of wire. The wire which should have led through this block was lying forward of it. It had either passed through the block due to recoil when it parted or it had been pulled through during the initial phase of the salvage operation.

At the after end the ring bolt on the central towing bar was bent from starboard to port. Again at the after end the starboard gallows was fouled by one of the spare nets and there was no warp rove through the gallows blocks.

6.8 In the sleeping cabin all the moveable equipment and personal effects were deposited on the starboard side. The lifejackets stowed in the spare bunk had moved towards the starboard side before becoming jammed.

6.9 In the engine room all the moveable equipment, eg batteries, had been moved to the starboard side. A portable water/gas fire extinguisher was found lodged in the engine room deckhead held there by pipework.

This inspection and search of the engine room did not reveal the body of the missing crew member.

6.10 The wreck of ANTARES was then towed to Great Harbour, Greenock by SALMOOR arriving there at 1230 hrs on 11 December. Subsequent inspections when the vessel was alongside confirmed the findings of the earlier inspection carried out in the darkness on the evening of 10 December and in addition the following facts were noted:

The tops of the masts were slightly bent from port to starboard.

The starboard warp was rove back through the lead blocks and it was confirmed that it had broken at the top gallows block. The broken piece of this starboard warp was recovered for forensic examination which showed that it matched the broken piece of wire which had been recovered from the 'Paris' dome of TRENCHANT.

The port warp was still in position where it had been cut by the salvage team and run through the top gallows block to the bottom one and thence forward to the winch.

The central towing wire was lying on the afterdeck attached by a chain to the cut portion of the port warp which had been pulled in a bight through the central towing block from port to starboard.

The winch brakes were off and the brake clutches of the winch were in.

The power pack in the wheelhouse which provided power to the winch was engaged and the two winch controls in the wheelhouse were in the off position.

The Jabsco fire pump in the engine room was disengaged.

The hydraulic pump attached to the main engine was engaged.

The searchlight sited on top of the wheelhouse was switched on and the starboard wheelhouse window was open.

- 6.11 The Carradale fishermen stated their intention to try to locate and recover the net in case the missing body was fouled in it. They were advised to grapple using position 55°39'.5N 5°01'.0W as a datum point, this being the position where TRENCHANT had surfaced and cut the wire fouled on the 'Paris' dome. There was some delay awaiting suitable weather conditions, however the net was eventually located at or very near this position and brought back to Carradale where it was lowered to the sea bed just off the harbour entrance. The missing body was not found in the net.
- 6.12 Further attempts to find the missing body were made by the men of Carradale by saturation trawling of the area this time using the wreck position as a datum point. They had hoped to trawl the body up but their attempts were unsuccessful; however a fishing boat trawling in the area in the course of his normal business brought a body up in his net on 15 April 1991, and this was later identified as that of the remaining crew member who had been the watchkeeper.

7. THE SEARCH OPERATION

- 7.1 The collision occurred at 0219 hrs on 22 November but a full-scale search and rescue operation was not put into effect until 1100 hrs that day. This lengthy delay was due entirely to the reports emanating from TRENCHANT which indicated that although a trawl had been snagged, the fishing boat involved was safe. Neither Clyde MRCC nor the Secretary of the Clyde Fishermen's Association accepted this at face value and they attempted to carry out their own checks. These were necessarily delayed until the start of the business day in the area but it was through their efforts that it was finally realised that ANTARES was missing and the search and rescue operation mounted.

When the search was finally mounted it was thorough and well co-ordinated and the number of search units was such that if anyone had survived on the surface they should certainly have been found. The only crew member who is likely to have reached the surface was the watchkeeper since his body alone was not in the immediate vicinity of the wreck; but the failure of the liferaft to float free would have meant that the only means of support available would have been through clinging on to fish boxes or other floating debris. Life expectancy in those circumstances, with the sea and air temperatures as they were, would probably have been short. It is possible that if a search and rescue operation had been put into operation immediately he might have been saved, but this is only speculation and of course it is not known whether he did make it to the surface.

- 7.2 The finding of the wreck so soon after the search operation started was skilfully carried out by the Skippers of HEROINE and HERCULES III who made sonar sweeps in tandem in the vicinity of the reported oil slick. Their quick success was due in part to the high standard of sophisticated equipment which is fitted on board these boats and their understanding of the equipment. Their efforts are to be commended. The search continued into the following day (23 November) in very inclement weather conditions and was only called off when all reasonable hope of finding anyone alive had vanished. All those involved in this operation are also to be commended for their efforts.

PART III CONSIDERATION OF POSSIBLE FACTORS

8. GENERAL

8.1 Time Differences

The narrative of events regarding ANTARES is based on the evidence of the fishermen on board HEROINE and HERCULES III. This evidence is considered to be reliable as regards the approximate positions given but the times stated appear to be in error. According to the Skipper of HEROINE, his vessel passed ANTARES close port to port at 0140 hrs on 22 November. He then went below and left one of his crew on watch. The watchkeeper looked astern about 10 minutes later, at 0150 hrs, and noted ANTARES altering course to the SW to come back on a NW'ly tow. The VHF conversation between HEROINE and HERCULES III to the effect that ANTARES could no longer be seen was remembered as taking place at 0200 hrs; yet the collision did not occur until just before 0219 hrs. Thus the time of this conversation, at least, must be some 20 minutes or more in error.

Moreover, CHARYBDIS noted two fishing vessels passing each other, and the description of their lights and the position as recalled by the frigate's watchkeepers, leaves no doubt that they were ANTARES and HEROINE; but the time was about 0210 hrs, 30 minutes later than that given by HEROINE.

It would seem clear that the times given by the fishermen were inaccurate but there is no obvious reason for such an error, other than that they had no reason to note the times particularly and were relying purely on memory. Their positions, however, being related to their fishing track, would be much more accurately recoverable.

8.2 Radio Watchkeeping

After the collision, it has been established through Clyde MRCC that TRENCHANT made three calls on Channel 16 VHF to the fishermen in the area with no response. There is no reason to doubt that these calls were repeated on Channel 72 and other VHF channels as claimed by 'Teacher'. Additionally Clyde MRCC also attempted to raise all fishing vessels south of the Cumbraes around 0415 hrs, again with no response. The watchkeeper on HEROINE said that he heard this transmission but did not respond as his vessel was north of the Cumbraes by that time: it is possible that HERCULES III was also north of the Cumbraes, although her watchkeeper had no recollection of hearing the calls.

8.3 Positions of Liferafts

When inspected it was apparent that ANTARES had been a very well maintained boat. However, the siting and securing of the inflatable liferaft gives cause for concern. This liferaft was sited underneath the mast structure on top of the wheelhouse with the painter secured directly to a strong point without benefit of

a hydrostatic release unit. It was quite impossible therefore for the liferaft to float free even if ANTARES had sunk on an even keel and upright. The proper stowage position for the liferaft was the cradle sited on top of the starboard shelter, which was the position approved by the Surveyor during the last survey. Even if the liferaft had been sited in the position approved by the Surveyor, it is possible that it would not have floated free initially with the vessel capsizing to starboard. However, it most probably would have done so as the vessel sank to the bottom, since she would not have remained upside down all the way from the surface to the seabed. See also Section 10.3.

8.4 Navigation Lights

Although ANTARES had the facility to exhibit the proper recognition lights of a trawler, namely all round green over white, the Skipper of ANTARES invariably showed all round red over white. It is not known why this practice was adopted, except that it made ANTARES a very distinctive boat in the area.

8.5 HMS CHARYBDIS

On board CHARYBDIS there were nine individuals separately monitoring the surface situation to one degree or another and none of them noticed anything unusual. As well as the two visual lookouts on the bridge there were two ratings tasked to maintain a surface radar plot in the Operations Room, but it was not usual practice to plot fishing vessels that were not navigationally relevant. If ANTARES was painting a radar echo then that echo must have disappeared suddenly or become intermittent for a brief period before disappearing. This was not noted on board CHARYBDIS. However, it should be borne in mind that at the time of the tragedy, CHARYBDIS had completed the phase of exercise which involved HMS TRENCHANT and was exercising with another submarine some three miles to the north and had no intention of returning to the area occupied by the fishing vessels. There were therefore no operational or navigational reasons for her to maintain a detailed surface plot of this area.

9. RECONSTRUCTION OF EVENTS

- 9.1 The normal behaviour of pelagic trawlers fishing in Bute Sound is to tow up and down the trench only turning at the northerly and southerly limits of the tow. When turning, the procedure is to first increase speed to normal full ahead to raise the net from the bottom. Once this is done, an alteration of course of 90° is made quickly using hard over rudder and then steadying on this course until the weight comes back on the trawl gear. When this occurs, a further alteration of 45° is made and then steadying on this course until once again the weight is on the trawl gear, and then complete the 180° turn with a further 45° alteration. The first part of this turn from increasing speed to steadying on a course of 90° from the original takes about 4 minutes and the complete turn from start to finish about 15 minutes. When carrying out this procedure by turning to starboard, both warps would lead out taut over the starboard quarter. The warp on the outer part of the turn, in this case the port one, takes more strain and the trawl door attached to it 'flies' higher in the water than the starboard one so that the port warp would be higher in the water than the starboard warp. Additionally, during the turn the net closes bringing both warps close together and a constant watch has to be kept on them to avoid them crossing each other. These trawlers are very vulnerable when turning and the Skipper is always on the bridge at this time.
- 9.2 From the evidence of the wreck of ANTARES, that is with the engines at normal full ahead, rudder hard to starboard, starboard wheelhouse window opened and the searchlight switched on, it is probable that she was executing a normal turn at the southerly end of her tow. The open window and searchlight would be necessary to see that the warps did not cross each other during the turn.
- 9.3 ANTARES was held on a near steady bearing by TRENCHANT from 0209 hrs until 0216 hrs when something happened on board ANTARES to make the bearing change and start to draw right. The reported increase in noise level to 35dB at this time is possibly indicative of the time that ANTARES increased to normal full speed to raise the net from the bottom. This would have caused the bearing to start to draw right.

This implies that ANTARES was in the first part of her turn when the collision occurred and this is further corroborated by the previous steady bearing of contact 05 on board TRENCHANT. The very fact that the bearing remained steady indicates that the course and speed of ANTARES during that period did not alter and this would not have been the case if ANTARES had been engaged in her turn at any time prior to 0216 hrs.

- 9.4 Consideration of the evidence indicates a course for ANTARES during the last few minutes before she began her turn of about 102°T. The natural course for a SE'ly tow down the trench would be more in the region of 130°T. It is probable that once the net of ANTARES was clear of the net of HEROINE, (after they passed in close proximity), ANTARES was angled over more to the east of the trench so that when it was time to execute the planned turn they would be lined up on the track which had previously been selected for the next

NW tow. It is probable therefore that ANTARES altered course and steadied on a course of 102°T around 0209 hrs. One effect of this will have been to tend to keep ANTARES and HEROINE on about the same relative bearing from TRENCHANT, thus helping to explain the failure to distinguish them as two separate contacts.

9.5 The following is the most probable sequence of events:

ANTARES turned at the northerly end of the trench sometime around 2230 hrs on 21 November and after this turn the watchkeeper took over from the Skipper with the intention of calling him some four hours later for the turn at the southerly end of the tow.

ANTARES then towed SE on an approximate course of 130° until at about 0205 hrs she passed HEROINE (towing NW) port to port, at a distance of 2 cables. Once clear of the nets of HEROINE, ANTARES altered course to 102°T around 0209 hrs to bring the vessel further east in the trench, prior to turning to commence her NW tow.

TRENCHANT meanwhile, having just completed an exercise with CHARYBDIS, altered course from 150°T at 0204 hrs and steadied on 315°T at 0209 hrs. At 0210 hrs the approximate position of TRENCHANT was 55°38'.9N 5°02'.4W. TRENCHANT continued on this course at a speed of about 6 knots until at 0217 hrs a close sonar contact to starboard with ANTARES occurred, when TRENCHANT altered course to port to put more distance between herself and this close contact.

At about this time ANTARES who had gone to full ahead about 0216 hrs commenced to turn to starboard as the first part of a 180° turn back into the NW.

At 0219 hrs TRENCHANT collided with the warps of the ANTARES fishing gear which, at that stage, would be leading broad on the starboard quarter so that ANTARES was almost beam on to them, and the resulting transverse pull caused ANTARES to capsize to starboard and sink in position 55°39'.5N 5°03'.3W. (See Figure 4)

- 9.6 The MoD have also carried out their own investigation into the accident. Their reconstruction of events in respect of the movement of ANTARES and other fishing vessels in the area differs appreciably from that of the MAIB Inspectors given above. The MoD reconstruction is that ANTARES had completed her turn and was on her NW'ly trawl track when the accident occurred. However, both investigations agreed that TRENCHANT altered course to port and collided with the trawl gear of ANTARES at 0219 hrs.

These two reconstructions were both considered by the Sheriff Principal during the Fatal Accident Inquiry held in September 1991 and he regretted that both teams of investigators were unable to agree a joint reconstruction. He did add however it was of very limited significance to the actual outcome of what happened at 0219 hrs, and this point is fully accepted by MAIB.

10. EVENTS AFTER THE CASUALTY

- 10.1 The inspection of ANTARES after the salvage operation established that the central towing point was being used that night and the central towing wire together with a bight of the port warp had been pulled through the block and was lying on the after deck. For this to happen, the port warp must have broken first.

The starboard warp was contacted first, but it would not have been sharply loaded at this time and it is considered that capsize occurred when the port warp became fouled on the starboard side of TRENCHANT and most probably when it jammed under the base plate of the pinger. The time interval between these two events would only be a matter of seconds.

Once capsize occurred the additional force caused by the increased drag of ANTARES in the water caused the port warp to break at its maximum point of loading where it was fouled around the pinger. It was at this time that the ringbolt on the central towing point was bent from starboard to port. Although the initial force causing capsize was from port to starboard causing a starboard capsize, the maximum strain did not come on until ANTARES was upside down in the water at which time the direction of this force would be reversed and act from starboard to port. The weight coming on to the starboard warp, caused the warp to break at the top gallows block. When this occurred the central towing wire would continue to run out being pulled completely through the towing block followed by the bight of the broken port warp. This caused the remains of the port warp to become tight and the third and last breakage occurred at the chain joining the starboard warp to the central towing wire with the remains of the chain being taken away with the warp to become embedded in the 'Paris' dome.

These breakages would have occurred in rapid succession and with the last one ANTARES would have been finally released from TRENCHANT floating upside down in the water probably with only the forefoot showing. She would continue to float like this until the ingress of water sank her. This would have occurred quickly since the starboard wheelhouse window was open.

- 10.2 It is probable that the strange noises heard on the underwater telephone were in fact the noises generated by ANTARES as she sank. A 'disturbance of the sea' seems to be a very apt description.
- 10.3 Two of the fishermen managed to escape from the wreck but the evidence of the broken port wheelhouse window appears to indicate that they did not escape until ANTARES was underwater and regaining her normal attitude. If this window had been broken when ANTARES was upsidedown in the water all the broken glass would have fallen free. It also tends to indicate that after capsize ANTARES tended to right herself in the opposite direction. She did not turn a complete circle underwater as further evidenced by the fact that all the heavy moveable gear was found to starboard when the vessel was salvaged.

One of the bodies of the fishermen who escaped from the wreck was found on the bottom in close proximity to it and the other was found much later, a little further away but still in the general position of the wreck. This also possibly indicates that they did not escape until ANTARES was actually on her way to the bottom.

- 10.4 After the collision, TRENCHANT, still fouled on the nets, executed a tight turn at slow speed and came back on a heading of 090°T. The intention was to go to periscope depth, however this was delayed until the submarine manoeuvred south and east to ensure that the surface was clear. TRENCHANT eventually surfaced in position 55°39'.5N 5°01'.0W after which the wire was cut from around the 'Paris' dome. This was where the net was grappled later by the Carradale fishermen which shows that TRENCHANT dragged the complete net to that position after the breakages occurred.

While the submarine was coming to periscope depth the command team attempted to regain contact 05 without success. This means that the engine of contact 05 had stopped, for whatever reason; so the command team should have expected to see contact 05 stopped in the water close to the submarine when she came to periscope depth. They did not do so; but the absence of contact 05 in close proximity was never questioned.

Again from what is now known, the noises heard by the seaman on the 2008 underwater telephone were probably caused by ANTARES sinking. It is not clear whether these noises were reported to the command team or whether in fact they heard them for themselves. The fact remains that they were heard on board so that these noises, allied with the absence of contact 05 when the submarine came to periscope depth, should have provided sufficient evidence that they had caused the sinking of contact 05. No proper analysis of these two pieces of information appears to have been done.

- 10.5 After TRENCHANT surfaced, radio contact was made with CHARYBDIS to establish if any alarm had been raised on the surface. This proved negative and then attempts were made to call the two remaining fishing boats in the area without response. On the basis of this, 'Teacher' felt able to report the incident to Faslane and further report that the fishing vessel involved was safe. However, it was a fact that they had carried away at least part of the trawl of a fishing boat and under these circumstances they would not have expected to find that fishing boat fishing normally when they viewed it through the periscope some 20 minutes later. It seems though that this is what the command team on board TRENCHANT accepted without serious question. No attempts were made to attract the attention of the fishing vessels using the Aldis lamp when there was no response to the radio calls.

11. PREVIOUS INCIDENTS

- 11.1 There have been a series of incidents involving submarines and trawlers over the last few years and prior to this particular incident the recorded number involving allied submarines since 1980 was 15. One of these incidents resulted in the foundering of the trawler involved, namely SHERALGA in 1982.

These incidents have led to close co-operation between the Ministry of Defence (Navy), the Surveyor General's Organisation and the Marine Accident Investigation Branch of the Department of Transport in an effort to resolve the problem. This co-operation has led to some useful initiatives.

- 11.2 One such initiative was the feasibility study by the ARE (Admiralty Research Establishment) into the possibility of submarines receiving signals from echo sounders and fish finders of surface craft to assist in the evaluation of such contacts. This resulted from a recommendation in an earlier report. The study concluded that the recommendation could not be accepted because present sonar capacity could not receive all echo sounder frequencies.
- 11.3 A further initiative resulting from the co-operation between the Departments has resulted in tests of a pinger device to assist submarines to detect the presence of trawl nets. It is understood that these tests are well advanced and the outcome of them is awaited. If these tests are successful this would be a useful device in particular for pelagic nets which do not scrape along the bottom and consequently do not make much noise.

12. RESPONSIBILITY

12.1 ANTARES was going about her legal business of commercial fishing in the area and despite the fact that it was a submarine exercise area, there is no possible way that she could have known of the presence of TRENCHANT underwater, and no blame can therefore be attached to ANTARES.

12.2 Royal Navy standing orders, in force at the time, required submarines to "remain clear of fishing vessels and never approach (them) within 2,000 yards"; additionally the standing orders set by the Captain of TRENCHANT specified, that he (or whoever had conduct of the submarine at the time) was to be called if the submarine 'found itself' within 4,000 yards of a surface contact. It was therefore the duty of the command team on board TRENCHANT to ensure that she kept clear of surface contacts and where applicable their attached nets. The fact that she failed to do this is due in part to the exercise which had just been completed. The exercise itself meant frequent alterations of course and speed making a proper evaluation of the surface situation difficult so that at 0209 hrs when TRENCHANT steadied on 315°T, the command team had no clear idea of what the surface contacts were doing.

At this time the bearing of contact 05 steadied at about 304°T fine on the port bow. It does not appear to have been appreciated by the command team that this contact was in fact two vessels, one of which was going away (HEROINE) and the other was coming towards them (ANTARES). An incorrect report at this time (0209 hrs) by the Operations Officer regarding contact 05, to the effect that the bearing was steady and the range opening may have lulled them into a false sense of security so that no serious attempt was made to analyse contact 05 from 0209 hrs until 0216 hrs when it started to move right with increased noise intensity.

12.3 With a steady bearing, no proper calculation of range can be made and in these circumstances the submarine must alter course or speed or both to make the bearing change; range can then be worked out. This is called a ranging manoeuvre and it is understood that such a manoeuvre is required by standing orders when a steady bearing is encountered. No ranging manoeuvre was carried out and it is ironic that the very act of carrying out a ranging manoeuvre in good time would in itself have averted this collision.

12.4 When the exercise was declared complete there was a general lowering of awareness among the watchkeepers in the control room with a certain amount of movement for cups of tea etc. Additionally, the withdrawal of CHARYBDIS could have been a subterfuge and this vessel might have returned to the attack. In these circumstances it is possible that any attention which was being paid to the surface contacts was in fact concentrated on CHARYBDIS. Between 0209 hrs and 0216 hrs there is one report from the Operations Officer on the range, course and speed of CHARYBDIS when she was still going away. There was no attempt whatsoever at serious analysis of any of the other surface contacts.

- 12.5 Just before 0200 hrs, 'Teacher' left the control room with the Captain and went to the wardroom to discuss the performance of the Duty Captain during the previous exercise. When 'Teacher', who had conduct of the submarine at this time, left the control room, the surface situation had still not been evaluated properly and he instructed the Duty Captain to hold in the general area and hand over to his relief. The next Duty Captain was waiting in the wardroom to be called and when 'Teacher' entered the wardroom he sent this officer to the control room to allow the Captain and himself some privacy. When the new Duty Captain entered the control room, he engaged in conversation with the Duty Captain he was to relieve; it is probable that the Duty Captain was not paying complete attention to what was happening around him with the result that, even though a contact was held on a steady bearing fine on the port bow no sense of urgency was transmitted from him to the watch in the control room.
- 12.6 A contributory factor to the lack of any sense of urgency regarding contact 05 was that no trawl noise was reported. This may have lulled the command team into a false sense of security since TRENCHANT was operating at a safe depth of 60 metres. A safe depth is a depth at which it is impossible for the submarine to come into contact with any surface craft, however deep drafted, so that the only possible hazard would have been a net. But the deep trench is fished regularly by the Clyde fishermen and the command team on TRENCHANT should have been aware of this, so that the possibility of encountering a net in these waters ought never to be discounted. Although no trawl noise was reported, the contact was classified as a fishing vessel and in these circumstances the assumption that the boat was fishing should have been made. This was not done, as evidenced by the lack of any alarm in the control room even after the close contact with 05 was experienced.
- 12.7 When the bearing of contact 05 started to move fast right the Duty Captain altered course to port away from it. This alteration of course was ordered without sufficient information regarding contact 05 being available, but it was correctly made in accordance with standing instructions for all submarines, which require a turn away from any close surface contact. It was blind and instinctive but without panic; but in the final analysis it actually caused the collision with the warps since, if no alteration of course had been made by TRENCHANT, it is probable that she would have passed close astern of ANTARES and underneath the warps which at this point would have been at a shallower depth.
- 12.8 There is conflicting evidence regarding the number of hours worked by the Duty Captain for the period in question. According to him he had two hours rest before he came on duty at 1800 hrs on 21 November and this short rest period had been preceded by a considerable period as Duty Captain. According to Navy records he went off duty at 0700 hrs on 21 November and did not take over as Duty Captain until 1930 hrs that day implying that he had a considerable rest period of some 12½ hours. In the circumstances it is difficult to form an opinion as to whether the Duty Captain may or may not have been fatigued; the possibility that he was should not be discounted, but he did not at the time feel impaired from discharging his responsibilities.

PART V CONCLUSIONS

13. FINDINGS

The Inquiry carried out by the Inspectors has covered great detail. It is inevitable in an accident such as this when there are no survivors from the fishing vessel, no direct eye-witnesses on the surface to the accident and the submarine was submerged at the time, that a certain amount of supposition must be taken into account.

During their Inquiry, the Inspectors received the full co-operation of the Ministry of Defence and the Royal Navy, who carried out their own inquiry into the accident. Even so both inquiries came to different conclusions as to the exact circumstances of the collision and the difference in the two reconstructions of the course ANTARES was steering at the time and how TRENCHANT came into contact with the trawl gear is fundamental. At the same time however it was of very limited significance to the cause of events.

However, the suppositions made by the Inspectors to reach their reconstruction are based on logical reasoning and I support their conclusions.

Furthermore, I support the findings of the Inspectors who carried out the Inspectors' Inquiry and these follow:

- 13.1 On 22 November MFV ANTARES was engaged in trawling in the deep trench situated in Bute Sound, to the northeast of the Isle of Arran. Just before 0219 hrs ANTARES was turning to starboard at the end of her southeasterly tow when HMS TRENCHANT collided with the warps of her trawl gear. ANTARES was lying beam on to her gear at this time and the resulting transverse pull caused her to capsize to starboard and subsequently founder, with the loss of all hands, in position 55°39'.5N 5°3'.3W.
- 13.2 The sole cause of the collision was a partial breakdown in the watchkeeping structure and standards on board TRENCHANT.
- 13.3 ANTARES was a seaworthy vessel and her stability was more than adequate for a vessel of her class. However, her life-saving appliances were deficient in that the stowage position and securing arrangements of the inflatable liferaft prevented it from floating free and inflating as the vessel sank. This could have been a contributory cause to the loss of life.
- 13.4 The partial breakdown of watchkeeping procedures on board TRENCHANT was caused mainly by the successful completion of a Perisher exercise. There was some movement among watchkeepers and the general level of alertness was lowered. The command team on board TRENCHANT had no clear appreciation of the surface contacts held on sonar during the period between the completion of the exercise and the collision.

- 13.5 The command team on board TRENCHANT did not fully appreciate that there were two vessels within the sonar contact relevant to this collision going in opposite directions.
- 13.6 No ranging manoeuvre was carried out with respect to the sonar contact on a steady bearing line on the port bow. This would have established the range of that contact.
- 13.7 The execution of a ranging manoeuvre in adequate time would in itself have averted collision.
- 13.8 More attention was paid by the command team on board TRENCHANT to the sonar contact emanating from the surface naval vessel CHARYBDIS than from the other surface contacts.
- 13.9 The concentration of the Duty Captain with respect to the overall situation was impaired due to his conversation with the next Duty Captain in the minutes before collision.
- 13.10 The Duty Captain may have been fatigued but this in itself did not contribute to the casualty.
- 13.11 The absence of any report regarding trawl noise from the ANTARES sonar contact lulled the command team on board TRENCHANT into a false sense of security and the incorrect assumption that ANTARES was not engaged in trawling.
- 13.12 The alteration of course to port by TRENCHANT in response to a close sonar contact to starboard was made on the basis of insufficient information, but it was the correct action to take in accordance with standing procedures for submarines.
- 13.13 No proper assessment of what might have occurred on the surface was carried out by the TRENCHANT command subsequent to the collision.
- 13.14 The attempts which were made to establish contact with the fishing vessels in the area after TRENCHANT surfaced were not adequate. Standing orders for submarines required communications to be established (by whatever means) after a snagging incident.
- 13.15 The report to the Faslane Operations Room regarding the incident, which indicated that the fishing vessel involved was safe, was made on the basis of insufficient information.
- 13.16 The initial incorrect reports from TRENCHANT led to an approximate 8½ hour delay in a search and rescue operation being mounted. This may have contributed to the loss of life.

- 13.17 TRENCHANT left the scene of the collision and resumed exercise and this decision was based on insufficient information and a lack of appreciation of the reality of the situation.
- 13.18 Clyde MRCC bear no responsibility for the delay in mounting a search and rescue operation which, when finally mounted, was thorough and well co-ordinated.
- 13.19 A listening watch was not being kept on board HEROINE and HERCULES III on Channel 16 VHF. There is no mandatory requirement for such a listening watch, but it is recommended by Admiralty Notices to Mariners. The failure to follow this recommendation may have contributed to the loss of life.

14. RECOMMENDATIONS

Based on the Inquiry into the accident and the findings of the Inspectors, a number of recommendations are made which, if implemented, will prevent recurrence of such an accident.

The Sheriff Principal, before whom the Fatal Accident Inquiry was heard in September 1991, also made in his Determination a number of recommendations. Some of the recommendations which follow are in a similar vein to those made by the Sheriff Principal and may be considered as a possible duplication of effort. However it is only right that all recommendations forthcoming from the Inspectors' Inquiry should be included in this Report and should be considered as complementary to those made by the Sheriff Principal.

One recommendation made by the Sheriff Principal was that immediate action should be taken to establish a separation zone of at least 3,000 yds between dived submarines and vessels engaged in fishing. This particular recommendation was accepted and the Royal Navy has increased from 2,000 yds to 3,000 yds the distance by which dived submarines should be separated from vessels which are fishing, navigation and shipping constraints permitting.

During the early stages of the Inspectors' Inquiry an interim recommendation was made that early research should be initiated by the Ministry of Defence into the feasibility of equipping submarines with positive means of detecting echo sounder and fish finder transmissions from fishing vessels in submarine exercise areas. The Marine Directorate, Department of Transport, could perhaps then reconsider an earlier recommendation, made following a previous incident, that all fishing vessels should be advised to run such equipment continuously when in submarine exercise areas.

This recommendation was put to the Ministry of Defence by Marine Directorate and examined by their technical experts. They responded in May 1991. There are technical difficulties in providing equipment capable of covering the wide range of frequencies used by echo sounders and fish finders. In the meantime this was overtaken by later events; the bringing forward by the Ministry of Defence of trials of 'pingers' to be fitted to fishing nets and the undertaking given that all resources necessary would be provided to ensure that these devices are made available as soon as possible. It is felt that this action answers the full spirit of that recommendation.

This accident also highlights concern about liferaft stowage. This has previously been addressed in the recommendations associated with another fishing vessel accident, the loss of MAJESTIC. This recommendation is currently under consideration by the Marine Directorate, Department of Transport; for completeness it is repeated below.

"Merchant Shipping Notice number M.1400 gives advice and guidance on the stowage, launching and fitting of float-free arrangements for inflatable liferafts. The Department of Transport booklet "Fishermen and Safety" also gives some advice and a copy of the booklet is forwarded to a fishing vessel's owner when the vessel's United Kingdom Fishing Vessel Certificate is first issued or renewed.

Consideration should be given to increasing the advice given in the booklet including some illustrations indicating how liferafts need to be positioned and fitted to increase the probability of their floating free when necessary".

The recommendations made are as follows:

- 1) The Scheme implemented in the Firth of Clyde where fishermen are notified of the areas and times of planned submarine activity should be extended to all submarine exercise areas.
- 2) Any area where submarine exercises are taking place and where fishing activity can be expected should be policed by surface naval craft so that accurate information regarding an occurrence on the surface will always be available and any vessel which has not heard and/or heeded the warning broadcasts can be alerted.
- 3) Submarines not on exercise but traversing an area of known fishing boat activity should, as a matter of routine, proceed on the surface.
- 4) Any contact identified as a fishing vessel should be given as wide a berth as possible consistent with the safety of navigation of the submarine. Consideration should be given to extending the existing Royal Navy minimum to 4,000 yds, to allow for the extent of towed fishing gear.
- 5) When incidents are reported, these reports should contain facts only and premature inferences should not be drawn.
- 6) The MoD should carry out a thorough review of the contents of "Fishing Vessel Avoidance - Flotilla Guidance" and any other of their instructions on this subject to ensure that all lessons learnt from this accident are disseminated to all submariners.
- 7) The need for all the existing submarine exercise areas, presently shown on Admiralty Charts, should be re-assessed with the aim of reducing the number and extent to a minimum consistent with training requirements.
- 8) Every effort should be made to ensure that fishermen are aware of the consequences of not maintaining a continuous watch on VHF Channel 16 as recommended in Admiralty Notices to Mariners.

NOTE:

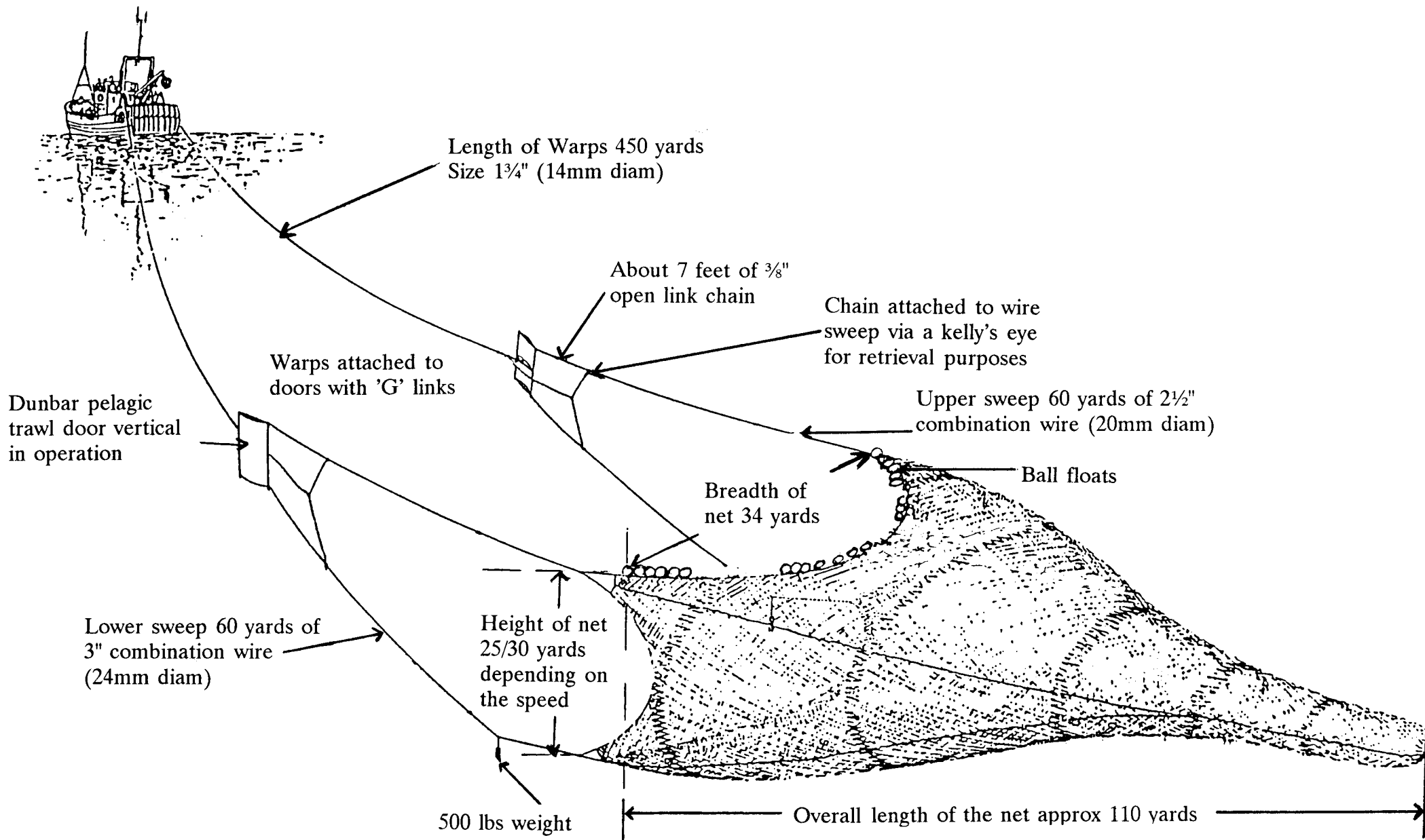
It is welcomed that a review of the command and control arrangements when the Submarine Command Course is embarked has been undertaken by the Navy and no recommendations in this regard have been put forward.

Figure 1

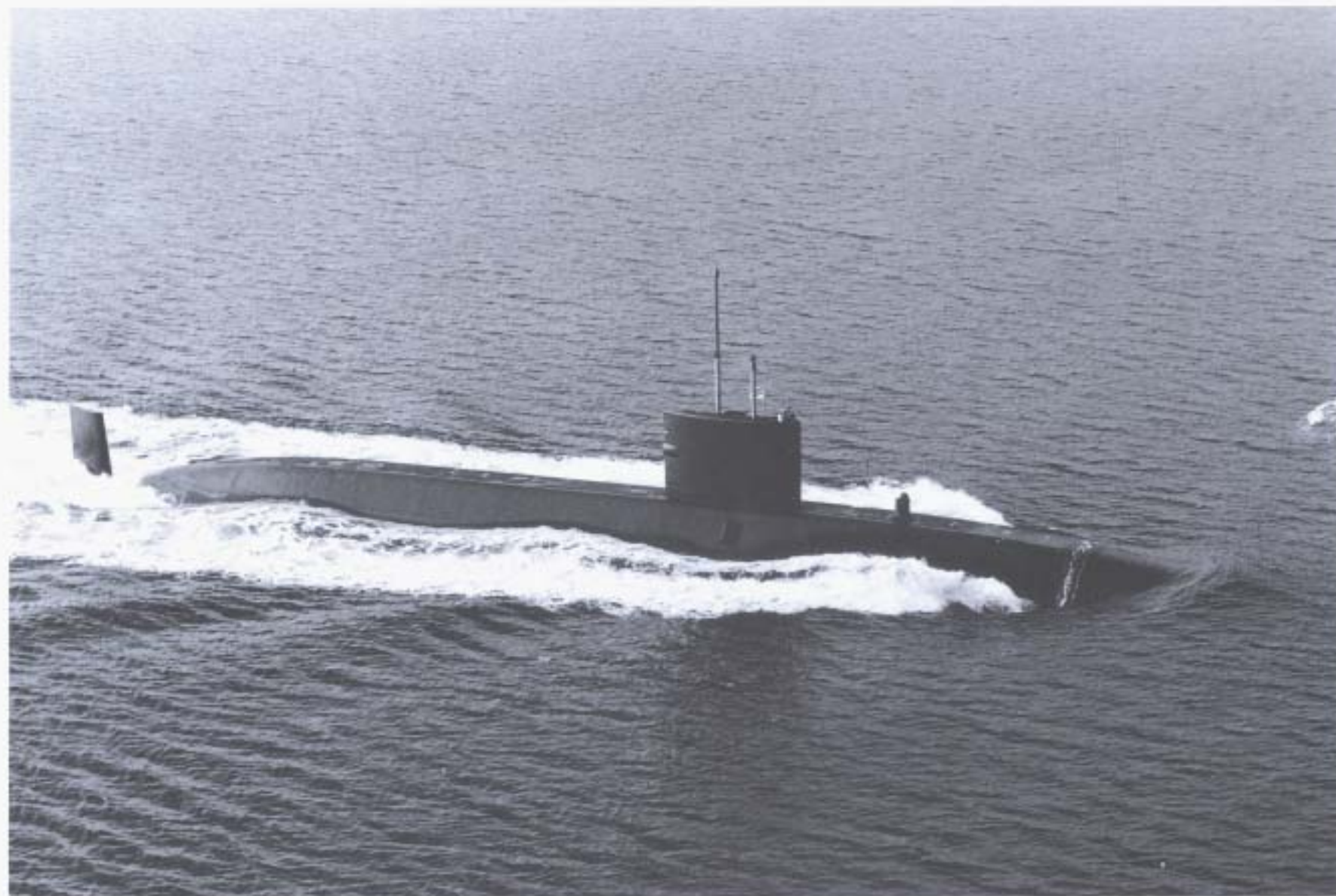


Courtesy of Mrs J Russell, wife of the Skipper

ANTARES at sea



A Typical Pelagic Net



Courtesy of Ministry of Defence

A Trafalgar Class Submarine of
which HMS TRENCHANT is typical

Reproduced from Admiralty Charts/Publications
with the permission of the Hydrographer of the Navy

