Report on the investigation of

the collision between

Diamant/Northern Merchant

3 miles SE of Dover

on

6 January 2002

Marine Accident Investigation Branch
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Carlton House
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United Kingdom
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Extract from

The Merchant Shipping

(Accident Reporting and Investigation)

Regulations 1999

The fundamental purpose of investigating an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 1999 is to determine its circumstances and the causes 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.

This report is not written with liability in mind and is not intended to be used in court for the purpose of litigation. It endeavours to identify and analyse the relevant safety issues pertaining to the specific accident, and to make recommendations aimed at preventing similar accidents in the future.

CONTENTS

GLOSSARY OF ABBREVIATIONS, TERMS AND ACRONYMS

AB	-	Able Seaman
AIS	-	Automatic Identification System
ARPA	-	Automatic Radar Plotting Aid
CNIS	-	Channel Navigation Information Service
CPA	-	Closest Point of Approach
(D)GPS	-	(Differential) Global Positioning System
ETA	-	Estimated Time of Arrival
Fott	-	Fixed origin true trails
Green - Green	-	Starboard to Starboard
HSC	-	High-Speed Craft
ICS	-	International Chamber of Shipping
IMO	-	International Maritime Organization
ISM	-	International Safety Management (Code)
kW	-	kilowatt
m	-	metre
MCA	-	Maritime and Coastguard Agency
MF	-	Medium Frequency
MGN	-	Marine Guidance Note
MRCC	-	Maritime Rescue Co-ordination Centre
Red - Red	-	Port to Port
TSS	-	Traffic Separation Scheme
UK	-	United Kingdom
UTC	-	Universal Co-ordinated Time
VDR	-	Voyage Data Recorder
VHF	-	Very High Frequency
VTS	-	Vessel Traffic Service
WO	-	The vector derived from own ship's speed and course in radar plotting

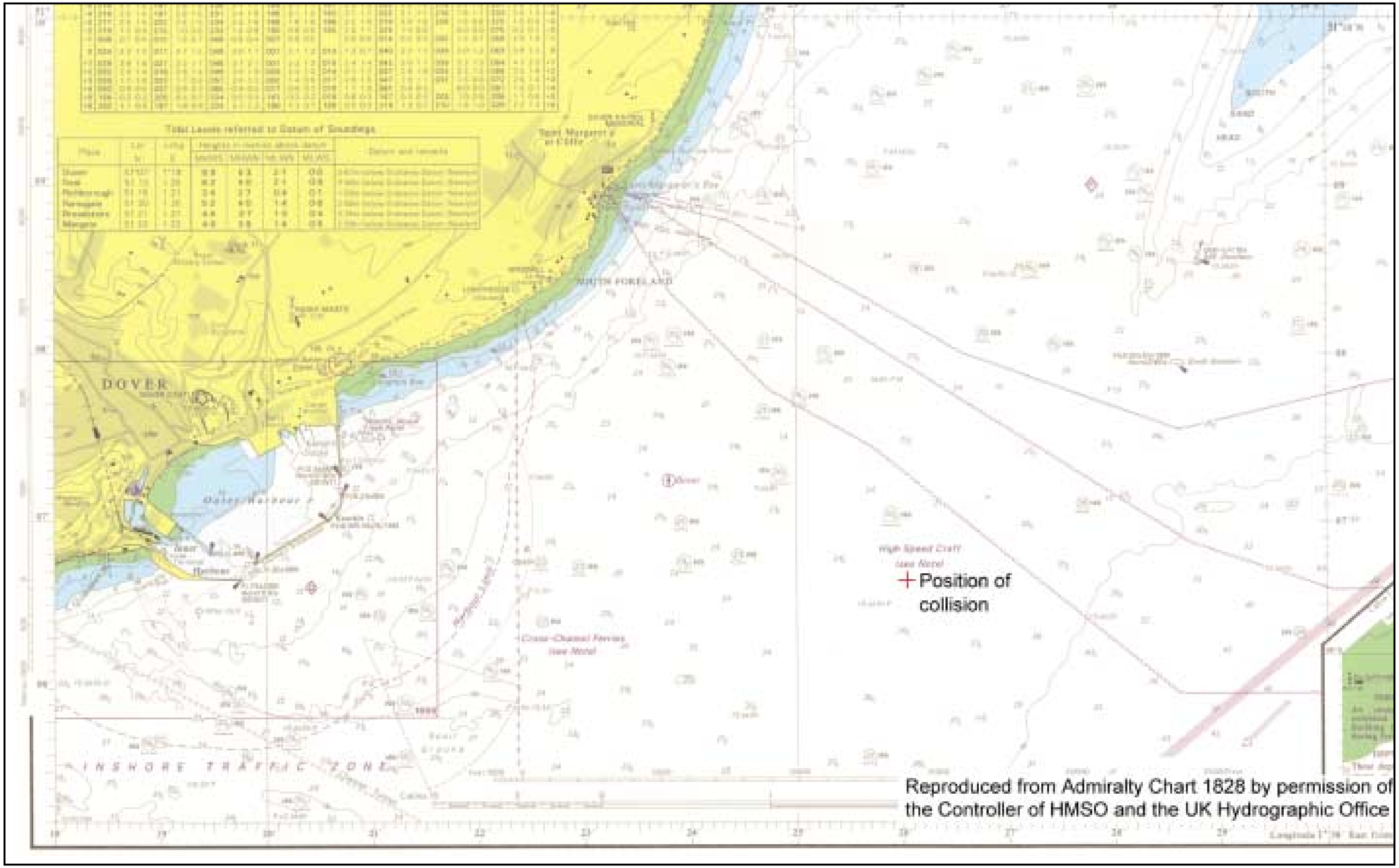


Chart extract showing position of collision

SYNOPSIS

The Marine Accident Investigation Branch (MAIB) was notified of the accident on 6 January 2002 and an investigation began that day.

The high-speed craft *Diamant* and the ro-ro passenger ferry *Northern Merchant* collided in the Dover Strait in poor visibility.

Diamant was en-route from Oostende to Dover with 148 passengers and crew on board. *Northern Merchant* had just departed Dover for Dunkerque with 102 passengers and crew on board.

As both vessels approached each other with a CPA of 3 cables, 3 miles south-east of Dover, *Diamant's* speed was 29 knots, *Northern Merchant's* was 21 knots. The bridge team on *Diamant* then assumed, incorrectly, a green - green situation and maintained course and speed.

On board *Northern Merchant,* the bridge team fully expected *Diamant* to keep clear, because of a perceived unwritten rule that high-speed craft will keep clear of all other vessels in all scenarios. However, as the distance between the vessels decreased to 6 to 7 cables, they realised this might not be the case and then altered course to starboard by 7° to 10° and then applied 20° of helm. At the same time, *Northern Merchant's* echo began to arc on *Diamant's* radar. The master of *Diamant*, assuming the danger to be on his starboard side, altered course to port. The result was that the vessels collided.

As a result of the collision, *Diamant* suffered substantial prow and starboard side wave piercer damage. *Northern Merchant* suffered slight damage to her port side shell plating. There were no injuries.

This accident has raised three important safety issues relating, firstly, to the perceived unwritten rule, secondly, how operators should determine a safe speed and close quarter situation in restricted visibility and, thirdly, the extent to which reliance can be placed on radar for detection in restricted visibility.

As a result of the issues, appropriate recommendations have been made to the Maritime and Coastguard Agency and the operator of each vessel.

Photograph courtesy of FotoFlite

Diamant

Figure 1

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *DIAMANT/NORTHERN MERCHANT* AND ACCIDENT

Vessel details

Name	:	*Diamant* **(Figure 1)**
Registered owner	:	Hoverspeed Ltd, Dover, Kent
Operator	:	Sea Containers Ltd
Port of registry	:	Luxembourg
Flag	:	Luxembourg
Type	:	Passenger/ro-ro cargo ferry, twin hull
Built	:	1996 Incat Australia Pty Ltd, Hobart, Tasmania
Classification society	:	Det Norske Veritas
Construction	:	Aluminium alloy
Length overall	:	81.15m
Gross tonnage	:	4,305
Engine power and type	:	22000kW 4x Ruston Paxman Diesels
Service speed	:	40 knots
Other relevant info	:	4 x water jet propulsion units

Accident details

Persons on board	:	148
Injuries	:	None
Damage	:	Substantial prow and starboard side wave piercer damage
Location of accident	:	51° 06.3’ N 001° 26.1’ E
Date and Time	:	0951 (UTC+1) on 6 January 2002

Photograph courtesy of FotoFlite

Northern Merchant

Figure 2

Vessel details

Name	:	*Northern Merchant* **(Figure 2)**
Registered owner	:	Genargo Ltd, Puttenham, UK
Manager	:	V Ships Ltd Glasgow
Port of registry	:	Dover
Flag	:	UK
Type	:	Passenger/ro-ro cargo ferry
Built	:	2000 Astilleros Espanoles S.A., Spain
Classification society	:	Lloyd's Register of Shipping
Construction	:	Steel
Length overall	:	179.93m
Gross tonnage	:	22,152
Engine power and type	:	23,760 kW 4x Wartsila diesels
Service speed	:	23 knots
Other relevant info	:	Quadruple screw

Accident details

Persons on board	:	103
Injuries	:	None
Damage	:	Slight port side shell plate damage
Location of accident	:	51° 06.3' N 001° 26.1' E
Date and Time	:	0951 (UTC+1) on 6 January 2002

1.2 DESCRIPTION OF VESSELS

1.2.1 *Diamant*

Diamant, built of aluminium by International Catamarans of Australia, in 1996, was an 81 metre Sea-Cat design, high-speed wave-piercing catamaran arranged to operate as a passenger and vehicle-carrying ferry on short domestic and short international voyages. She had a normal carrying capacity of 650 passengers plus crew, and up to 180 medium-sized vehicles. Her design speed was 40 knots with a normal operating speed of 32 knots.

The vessel was similar in design to a conventional catamaran, except that the hulls had minimum freeboard and reserve buoyancy and tended to penetrate the waves in rough conditions, rather than ride over each wave. A feature of the wave-piercing catamaran is the distinctive centre bow, which houses the anchoring winch and equipment, and protrudes beyond the wave-piercing hulls to provide reserve buoyancy in heavy seas.

The twin-hull design of the vessel incorporated three decks above the waterline. The lower one was a designated lorry and car deck. Both decks above, just forward of amidships, were dedicated car decks. These decks were separated by bulkheads, with passenger accommodation and facilities on the second deck, and a passenger lounge on the upper deck **(Figure 3)**. The main passenger deck (second deck) was fitted with a marine evacuation system on both the starboard and port sides.

An engine room in each of the hulls was located beneath the lorry and car deck aft. Forward of both engine rooms were four void spaces and a forepeak.

The bridge was situated amidships and ran the full width of the vessel. The helm position, main engine controls and navigational equipment were situated centrally in an operating console at the forward end of the bridge **(Figure 4)**. Seating on the bridge was available for the master, mate and chief engineer. The chief engineer’s position was on the port side of the console, while the master’s and mate’s positions were central, each with a radar screen directly ahead. Both positions afforded easy access to all operating controls without the need to leave the seat. It was normal practice for the master to be seated to the port of the mate.

Diamant was fitted with navigational equipment which included, one GPS and one DGPS navigator, gyro and magnetic compass, auto-pilot, echo sounder, MF and VHF radios, speed and distance log, electronic chart (not used for navigation) and two Bridgemaster ARPA radars: one 3cm (X-band) and one 10cm (S-band). Her radar scanners operated at the normal speed for a conventional vessel.

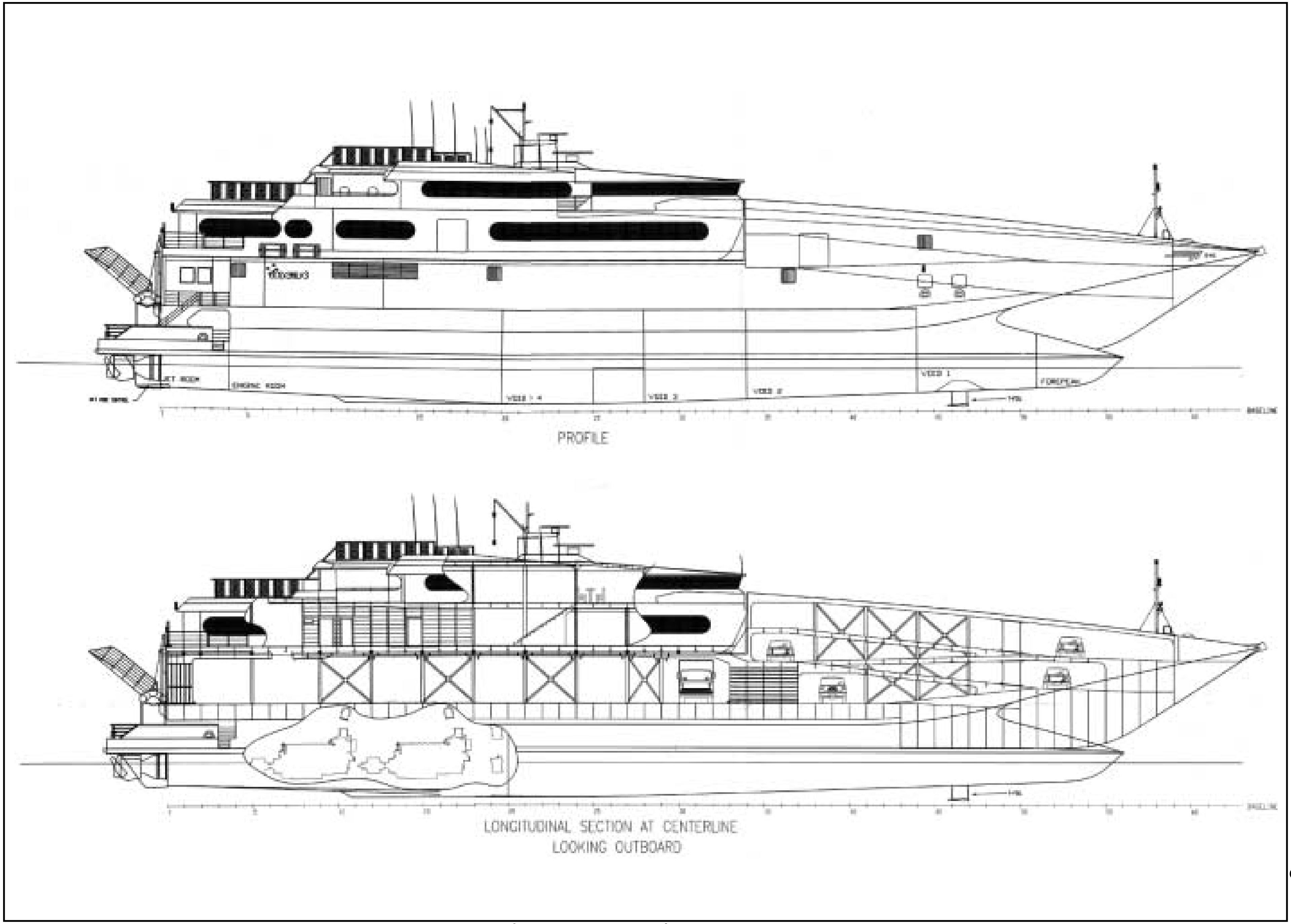


Figure 3

Diamant's general arrangement

Figure 4

Diamant's bridge

1.2.2 *Northern Merchant*

Northern Merchant, built of steel by Astilleros Espanoles S.A. of Seville in 2000, was a conventional ro-ro/passenger ferry capable of carrying a total of 400 passengers and crew, and 146 lorries. Her operating speed was 22.5 knots. The design of the vessel incorporated a total of six decks above the waterline, two main decks and four superstructure decks. The lower three were dedicated lorry and car decks and the upper three, passenger accommodation decks. Loading and discharging of the vessel was via aft loading/discharging doors; she was not fitted with conventional bow doors. The vessel was fitted with two Becker rudders. The bridge was situated forward and ran the full width of the vessel.

The helm position, main engine controls and navigational equipment were situated centrally in an operating console at the forward end of the bridge **(Figure 5)**. Seating was available for the officers of the watch.

Northern Merchant was fitted with the following navigational equipment: two Bridgemaster ARPA radars, one 3cm (X -band) and one 10cm (S-band)-normal speed scanners, DGPS, magnetic and gyro compasses, auto-pilot, echo sounder, and MF and VHF radios.

Figure 5 - *Northern Merchant*'s bridge

1.3 BACKGROUND

1.3.1 Vessels

Diamant was purchased by her current owner, Hoverspeed Ltd, a subsidiary company of Sea Containers Ltd, on 6 March 1998. Before this date, the builder Incat, delivered the vessel (Incat 041) to Denmark to operate between the ports of Arhuss and Calanberg.

Shortly after, on 1 March 1997, she was purchased by Sally Hollyman Ltd and named *Hollyman Diamant* for operation on the Ramsgate - Oostende route. During this time, Condor Marine Services was responsible for marine and technical services. This role was taken over by Sea Containers Ltd following her sale to Hoverspeed.

In addition to *Diamant,* Sea Containers Ltd operate five 74m and one other 81m Incat Sea-Cats, on routes between the UK, Eire, France and Denmark. In addition, it also operates three Superseacats and two conventional ro-ro passenger class II vessels.

At the time of the accident, *Diamant* was engaged on a regular cross-Channel route between Dover and Oostende, a crossing which normally took approximately 2¼ hours. During a normal day she was scheduled to cross the English Channel four times, leaving Oostende on the first sailing of the day at 0845 and departing Dover at 1845 on the last sailing.

Northern Merchant, managed by V Ships, which was responsible for marine and technical services, was, and had been since being built, on a time charter to Norfolk Line which engaged her in a regular cross-Channel service between Dover and Dunkerque. The service was complemented by her sister vessel *Midnight Merchant.* Each vessel was scheduled to cross the English Channel six times a day with each crossing taking approximately 2 hours.

V Ships also operated another six ro-ro/passenger ferries. Two, *Brave Merchant* and *Dawn Merchant,* sister vessels to *Northern Merchant* and *Midnight Merchant,* on the Liverpool to Dublin route; *Lagan Viking* and *Mersey Viking*, on the Liverpool to Belfast route; and *Scirocco* and *Mistral* in the Mediterranean on the Almeria to Nador route.

1.3.2 Dover Strait

The Dover Strait and its approaches is one of the busiest waterways in the world, and poses particular safety concerns because of the density of traffic and the proximity of navigational hazards. In 1977, the traffic separation scheme (TSS) in the Dover Strait and adjacent waters, became compulsory.

The area experiences reduced visibility throughout the year, although it is rare in July and August. During January and February fog is experienced on about 4 days each month.

The ferries crossing the TSS and the vessels using the TSS, in either direction, are found to reduce speed rarely during restricted visibility. There is also evidence that vessels in this area are prepared to accept what might otherwise normally be considered small Closest Points of Approach (CPAs).

1.4 THE CREWS

1.4.1 *Diamant*

Diamant had a complement of 18 crew members, which included ten marine crew and eight cabin staff.

The marine crew comprised the master, first officer, bosun and four seamen, chief, second, and assistant engineer. Both the marine and cabin crews were Belgian. The master was the holder of a Belgian unrestricted master's certificate of competency, and had been employed on merchant vessels since 1969, having served as master for the previous 6 years. He had been employed as master on *Diamant,* since March 1997, and held an appropriate type rating certificate.

The chief officer was the holder of a Belgian chief mate's certificate of competency and had been employed on merchant vessels for 12 years. He joined Hoverspeed Ltd in March 2001 and held an appropriate type rating certificate. His previous experience at sea included a period of time spent aboard other high-speed craft.

The crew normally worked a rota system of 4-days on and 2-days off, with the 4-day on period split into morning and afternoon shifts. The vessel did not operate through the night and it was normal practice for the crew to return home then.

1.4.2 *Northern Merchant*

Northern Merchant had a complement of 44 crew members, which included 27 marine crew and 17 cabin crew. Both marine crew and cabin crew were British.

Two crews were split into two working shifts of 12 hours on and 12 hours off. Each shift spent 2 weeks on board followed by 2 weeks on leave. At the time of the accident the "day shift" navigation and engineering crew were on duty.

The on-duty master was the holder of a UK class 1 certificate of competency and had been employed on merchant vessels for 37 years, of which 13 had been spent as master on ferries. He joined V Ships 2 years before the accident, serving continually as master on board *Northern Merchant.*

The on-duty chief officer was the holder of an Australian master mariner's certificate of competency and a UK certificate of competency, and had been employed on merchant vessels for 25 years. He had been employed with V Ships for 4 months. During this time he had served continually as chief officer on board *Northern Merchant.*

1.5 ENVIRONMENTAL CONDITIONS

At the time of the accident the weather conditions were a north-westerly wind, force 2, with slight seas. The visibility was poor to very poor in areas of dense fog. The tide was ebbing in a direction of 219° at a rate of 1.4 knots, and the times of high and low water at Dover were 0400 and 1125 respectively.

1.6 NARRATIVE OF EVENTS (ALL TIMES ARE UTC +1) (ALL COURSES ARE TRUE)

At 0743, after boarding passengers and loading vehicles, *Diamant* left the port of Oostende en-route for Dover. The visibility was approximately 300 to 500 metres.

The master, mate, chief engineer and a lookout were on the bridge. They had all joined the vessel that morning, after spending the night at home. As soon as *Diamant* passed the piers, at 0747, the automatic fog signal was started and another lookout was called. A lookout was then posted on either side of the bridge.

The master, who had the conduct of the navigation, was sitting in the left-hand seat, with his radar (3cm) offset on the 6-mile range. The chief officer was sitting in the right-hand seat, the navigator's seat, with his radar (10cm) also offset on the 6-mile range. Both radars were displaying water-based information. It was normal practice to operate the radars in Fott, changing to relative motion for collision avoidance. During the crossing of the TSS, the range of both radars was increased to 12 miles, all targets acquired, then reduced to the 6-mile range once clear of the TSS.

There was very little traffic as *Diamant* began crossing the Channel.

Shortly after leaving Oostende, all four engines were increased to 930 rpm giving a speed of 32 knots. However, at 0755, the port inner engine tripped because an oil mist detector alarmed. With only three engines in operation, the speed was reduced to 24 knots.

At 0825, the problem with the port inner engine was rectified and 25 minutes later a speed of 32 knots was once again attained. The ETA at Dover was revised from 0945 to 1000.

At 0830 in Dover harbour, *Northern Merchant* began loading freight and boarding passengers. The operation was completed by 0920. After loading, the chief officer, who was supervising on deck, made his way to the bridge where the master, who had been there for some time, was making preparations for departure. The visibility in Dover at that time was approximately 150 to 200 metres.

At 0930 *Northern Merchant* let go. On doing so, her automatic fog signal was activated. The master, chief officer, and also an AB/helmsman, who had made his way there after helping let go forward, were on the bridge. The master had the conduct of the navigation while the chief officer monitored the starboard radar, which was set to the 0.25 mile range. The port radar was set to the 6-mile range.

At the same time, *Diamant,* still at 32 knots, having crossed the TSS, was passing CS4 Buoy on a course of 250° for the approach to Dover's western entrance. Both the master and the chief officer had heard *Northern Merchant* request permission, on VHF radio channel 74, from Dover harbour to depart.

After letting go, *Northern Merchant* maintained her position in harbour to allow *Cezanne,* another outgoing ferry, to depart. *Northern Merchant* then followed *Cezanne* through the breakwater at a distance of approximately 3 cables.

At 0940, once clear of the breakwater, on a course of 120°, the chief officer increased the range of his radar to 6 miles and the master then ordered a course of 105° and began to increase speed. However, as he was doing so he became aware that *Calais,* another ferry, was inward bound. He then ordered an alteration of course to 115° to pass to the north of *Cezanne*, and reduced speed to 12 knots. At the same time, the bridge team on *Diamant* were made aware that *Hoverspeed Great Britain*, another HSC, was going to be late in departing the berth; consequently, they reduced speed to 29 knots to allow more time. The time was 0943.

As soon as *Cezanne* and *Northern Merchant* were clear of Dover harbour, both the master and chief officer on board *Diamant* began plotting them on the vessel's ARPAs, from which they interpreted the following information relating to the target they considered to be *Northern Merchant*: course 085°, CPA 3.0 cables. The other target was passing clear to the south on a course of 120°. Course and speed were maintained.

At 0945, as *Diamant* passed South Goodwin light vessel, the visibility began to deteriorate. Both radars' ranges were then reduced from 6-miles to 3-miles with the closing target being monitored constantly.

At approximately the same time, after passing clear to the north of *Cezanne*, the master on board *Northern Merchant* ordered a resumption of course to 105° and increased speed to 20 knots. He then engaged the autopilot. He also heard on VHF radio, *Diamant,* requesting permission to enter Dover harbour. The master was monitoring the starboard radar and the chief officer the port radar. Both radars were set to the 6-mile range and the information displayed was ground-based, relative vectors. Shortly after settling on the resumed course, the master informed the chief officer that "a situation" was developing with respect to a target near the South Goodwin light vessel. From the ARPA radars monitored by the master and chief officer, they interpreted the following information: course approximately 230°, range 2 miles, speed 32 knots, CPA 2.0 cables. The master then instructed the helmsman to return to the wheel. Course was then altered 7° to 10° to starboard.

At 0949, after requesting permission for entry to Dover harbour, the bridge team on board *Diamant* interpreted, again from the vessel's ARPAs, the following information on the closing target, which they considered to be a green-green situation: range 6 to 7 cables, bearing 023° relative, CPA 2.0 cables. They instructed the two lookouts to keep a sharp visual and listening watch. The chief officer then started giving the master constant range readouts of the target. Shortly after this the CPA increased to 3 cables.

On board *Northern Merchant*, at approximately 0951, with no improvement in the situation, the master, in an attempt to avoid a collision, ordered 20° starboard helm and began rapidly sounding the fog signal. The chief officer and the second officer then went to the port side of the bridge and joined a fitter who was working there. They all heard the engines of an approaching vessel getting louder.

Back on *Diamant,* when the range reduced to 4 to 5 cables, the echo of the target began to arc through about 180° from slightly to port of *Diamant*'s heading marker around her starboard side to abaft the beam on the radar screen. The master began to alter course to port, initially by applying 5° helm, and then hard over when *Northern Merchant*'s port side became visible out of the fog, at a distance of approximately 50 to 150 metres. He then reversed the port engines in an attempt to increase the rate of turn. Realising a collision was unavoidable, the chief officer warned the passengers of an imminent collision and instructed them to sit down. Shortly after, at approximately 0952, *Diamant* collided with the port side of *Northern Merchant* at a point slightly aft of amidships, her prow making contact first, followed by her starboard wave piercer. Fortunately, as both vessels were turning away from each other, the collision was more a glancing blow than "square-on" contact.

Immediately after the collision, the chief officer called *Northern Merchant* on VHF radio channel 74 to enquire as to her status and to offer any assistance. The chief officer on *Northern Merchant* replied that there appeared to be some minor damage.

After reporting the situation to Dover coastguard, the chief officer on *Northern Merchant* instructed the crew to check for any further damage. Meanwhile, on board *Diamant*, the crew and engineers also checked for damage and sounded round. The cabin crew were instructed to report any passenger injuries. There were none.

After soundings and checks were made, it was reported that there was substantial damage to No.1 void space in the starboard hull **(Figure 6)** with ingress of water, but the bilge pumps were coping. Damage to some cars was also reported. Ten minutes after the collision, the master made a further announcement to the passengers to inform them the vessel would be continuing to Dover at slow speed.

Northern Merchant then contacted *Diamant* to inform the master she had sustained only minor damage, and if no assistance was required, she would continue her passage to Dunkerque.

At 1005, *Diamant* obtained permission to enter Dover harbour, after which the master informed the passengers that the vessel was fully manoeuvrable and they would shortly be arriving in port.

At 1026, *Diamant* was securely moored alongside in Dover. Soon after, the passengers were disembarked.

1.7 HIGH-SPEED CRAFT

1.7.1 Manoeuvring

Unlike conventional ships, high-speed craft have inherently different manoeuvring characteristics. The catamaran has a significantly larger deck area when compared with a mono-hull of the same displacement (usually in the order of 50% greater). They also exhibit high transverse stability and high speed capability where the hulls are designed in a semi-planing form. Low draught and lightness of construction are also advantages of the catamaran.

Propulsion is normally provided by diesel engines (two in each engine room) coupled to water jets giving in excess of approximately 35 tonnes thrust each at maximum acceleration. Thrust vectoring and steering is provided on all jets.

On average, at operating speeds of between 30 and 40 knots, a rate of turn of 130° - 145° per minute can be achieved, with the completion of a full circle in less than 500 metres laterally and transversely. In addition, crash stopping distances are usually in the order of no more than 4 to 5 times the length of the vessel. *Diamant*'s crash stopping distance was 463 metres, carried out during sea trials before delivery.

Another feature of this type of vessel is the capability of “momenting”; a manoeuvre carried out with both sets of water jets directed inwards towards the centre line of the vessel or outwards away from it. When employed, the vessel can be turned through 360° in the vessel’s own length. However, this is only practical at low speeds due to the danger of substantial damage to the manoeuvring buckets at high speeds.

Figure 6 - damage to *Diamant*

Even though high-speed craft are deemed to be highly manoeuvrable, they are restricted to certain operational speeds. All high-speed craft have a range of critical speed, ie speeds which should be avoided, because of either potential damage/vibration to the vessel, or the wave wash generated, which can be dangerous to other vessels and shorelines.

Diamant's critical speed was 14.5 – 25 knots.

1.7.2 History of high-speed vessels in UK waters

Hovercraft were first used on a regular commercial service in the UK on the Solent between Southsea and Ryde in the mid-1960s. This is the last commercial hovercraft service still in operation in the UK.

In the late 1960s, commercial hovercraft began operating across the Dover Strait. In 1969, hydrofoils were used to cross the Solent between Southampton and Cowes.

From the beginning of the 1990s, high-speed catamarans and mono-hulls have been used on a variety of routes to and from UK ports. In 1996, Stena Line introduced the first of three high-speed ferries known as HSS. These ferries are the largest high-speed craft operating anywhere in the world, and can carry up to 1500 passengers and 375 cars, at service speeds in excess of 40 knots.

1.7.3 Previous accidents involving high-speed craft

Among international accidents involving high-speed vessels are:

- The *Apollo Jet* grounding in Hong Kong harbour on 15 December 1989, resulting in four dead and seven seriously injured.
- The collision off the coast of British Columbia, Canada on 6 February 1992, between the ferry *Queen of Saanich* and the passenger catamaran ferry *Royal Vancouver*, in which 23 were injured.
- The *Sleipner* grounding off the Norwegian coast on 26 November 1999, in which 15 were killed along with one missing.

In the UK, the MAIB has investigated the following accidents involving high-speed vessels:

- The grounding of the catamaran *St Malo* off Corbiere Point, Jersey on 17 April 1995 in which 55 passengers were injured.
- The hovercraft *Princess Margaret* struck a boundary wall while berthing in Dover in September 1997, causing damage but no injuries.
- An angler on the small boat *Purdy* was washed overboard and drowned in July 1999 after his vessel was swamped by a wave from the HSS *Stena Discovery*.

- The hovercraft *Princess Alice* suffered heavy wave impact damage in adverse weather in February 2000, with one passenger suffering minor injuries.

In addition, there was a collision between a hydrofoil and a yacht in the Solent in 1989 which occurred before the MAIB was formed and was investigated by the Department of Transport's Marine Directorate.

1.7.4 High-speed craft navigation

Research carried out by the MAIB into navigation involving five other high-speed craft operators throughout the UK on the majority of routes, which include 17 current serving masters, officers and marine superintendents, many with considerable experience on these types of vessels, has provided the following results:

- All those interviewed believed, because of the manoeuvrability of the vessel, that a high speed can be a safe speed in all scenarios.
- They would avoid, whenever possible, any situation where the Steering and Sailing Rules (part B of the International Regulations for Preventing Collisions at Sea) would come into force.
- 14 out of the 17 interviewed indicated that they would not normally reduce speed in restricted visibility, only doing so when radar information became suspect. They preferred to use speed, rather than reduce it to keep clear.
- In determining a safe speed, the most important factor was seen as the stopping distance of the vessel in relation to the visibility, followed by the quality of the radar, engine status and traffic density.
- Normally, they adhered to a perceived "unwritten rule" that high-speed craft keep clear of all other vessels.
- There was an assumed expectation by other vessels that high-speed craft will keep clear irrespective of the situation.
- They would not be averse to altering course for another vessel on their own port side, to prevent a crossing situation developing, and likewise would not readily expect that vessel to alter course.
- They depend, to a considerable degree, on the information provided by an electronic chart.
- They normally allow a minimum closest point of approach of 0.8 to 1 mile ahead and 0.7 to 0.8 mile astern.
- They would not welcome any change to the Collision Regulations.

1.8 RADAR

1.8.1 Scanner rotation speeds

High-speed craft are now being fitted with high-speed rotating radar scanners, which provide a much quicker update of radar information. This is an important element in improving radar accuracy and navigational safety.

However, before high-speed scanners became available, many high-speed craft operated with normal-speed scanners with which both *Diamant* and *Northern Merchant* were fitted.

1.8.2 Side lobe effects

Although a radar scanner is designed to concentrate radar energy into a single beam, it is inevitable that minor beams, or lobes, will form either side of the main beam. Targets which are close enough to the scanner to be swept by these lobes, will paint more than once on the display. Each side-echo will be at the same range as the true echo but on a different bearing. The number of side echoes will depend on the proximity of the target, the nature of its reflective properties and aspect. It is possible that an extremely close target will be continually swept by radar energy as the scanner rotates, and in this case, it will paint as an arc around the centre of the display.

Since the radar energy in the side lobes will be considerably less than that in the main beam, side echoes can usually be eliminated by use of the clutter controls and, possibly, the gain control.

1.8.3 Radar accuracy

Performance standards, in accordance with IMO IEC60954 and IEC60936 give minimum tolerances to be achieved with respect to CPA under four standard conditions with 1 and 3 minute trends as follows:

Condition	1 minute	3 minutes
End on	1.6 miles	0.5 miles
Opening	-	0.8 miles
Crossing	1.8 miles	0.7 miles
Overtaking	2.0 miles	0.7 miles

1.9 COLLISION REGULATIONS

1.9.1 Rule 2

The International Regulations for Preventing Collisions at Sea, Rule 2, Responsibility, states:

(a) *Nothing in these Rules shall exonerate any vessel, or the owner, master or crew thereof, from the consequences of any neglect to comply with these Rules or the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.*

(b) *In construing and complying with these Rules due regard shall be had to all dangers of navigation and collision and to any special circumstances, including the limitations of the vessel involved, which may make a departure from these Rules to avoid immediate danger.*

1.9.2 Rule 5

Rule 5, Look-out states:

Every vessel shall at all times maintain a proper lookout by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.

1.9.3 Rule 6

Rule 6, Safe Speed states:

Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.

In determining a safe speed the following factors shall be among those taken into account:

(a) *By all vessels:*

- *(i)* *the state of the visibility;*
- *(ii)* *the traffic density;*
- *(iii)* *the manoeuvrability of the vessel with special reference to stopping distance and turning ability in the prevailing conditions;*
- *(iv)* *at night the presence of background light such as from shore lights or from back scatter of her own lights;*

(v) *the state of the wind, sea and current, and the proximity of navigational hazards;*

(vi) *the draught in relation to the depth of water.*

(b) *Additionally, by vessels with operational radar:*

(i) *the characteristics, efficiency and limitations of the radar equipment;*

(ii) *any constraints imposed by the radar range scale in use;*

(iii) *the effect on radar detection of the sea state, weather and other sources of interference;*

(iv) *the possibility that small vessels, ice and other floating objects may not be detected by radar at an adequate range;*

(v) *the number, location and movement of vessels detected by radar;*

(vi) *the more exact assessment of the visibility that may be possible when radar aids used to determine the range of vessels or other objects in the vicinity.*

1.9.4 Rule 7

Risk of Collision states:

(a) *Every vessel shall use all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists. If there is any doubt such risk shall be deemed to exist.*

(b) *Proper use shall be made of radar equipment if fitted and operational, including long-range scanning to obtain early warning of risk of collision and radar plotting or equivalent systematic observation of detected objects.*

(c) *Assumptions shall not be made on the basis of scanty information, especially scanty radar information.*

(d) *In determining if risk of collision exists the following considerations shall be among those taken into account:*

(i) *such risk shall be deemed to exist if the compass bearing of an approaching vessel does not appreciably change;*

(ii) *such risk may sometimes exist even when an appreciable bearing change is evident, particularly when approaching a very large vessel or a tow or when approaching a vessel at close range.*

1.9.5 Rule 8

Rule 8, Action to Avoid Collision states:

(a) *Any action taken to avoid collision shall, if the circumstances of the case admit, be positive, made in ample time and with due regard to the observance of good seamanship.*

(b) *Any alteration of course and/or speed to avoid collision shall, if the circumstances of the case admit, be large enough to be readily apparent to another vessel observing visually or by radar; a succession of small alterations of course and/or speed should be avoided.*

(c) *If there is sufficient sea room, an alteration of course alone may be the most effective action to avoid a close quarters situation provided that it is made in good time, is substantial and does not result in another close quarters situation.*

(d) *Action taken to avoid collision with another vessel shall be such as to result in passing at a safe distance. The effectiveness of the action shall be carefully checked until the other vessel is finally past and clear.*

1.9.6 Rule 19

Rule 19, Conduct of Vessels in Restricted Visibility, states:

(a) *This Rule applies to vessels not in sight of one another when navigating in or near an area of restricted visibility.*

(b) *Every vessel shall proceed at a safe speed adapted to the prevailing circumstances and conditions of restricted visibility. A power-driven vessel shall have her engines ready for immediate manoeuvre.*

(c) *Every vessel shall have due regard to the prevailing circumstances and conditions of restricted visibility when complying with the Rules of section 1 of this part.*

(d) *A vessel which detects by radar alone the presence of another vessel shall determine if a close-quarters situation is developing and/or risk of collision exists. If so, she shall take avoiding action in ample time, provided that when such action consists of an alteration of course, so far as possible the following shall be avoided:*

 (i) *an alteration of course to port for a vessel forward of the beam, other than for a vessel being overtaken;*

 (ii) *an alteration of course towards a vessel abeam or abaft the beam.*

(e) *Except where it has been determined that a risk of collision does not exist, every vessel which hears apparently forward of her beam the fog signal of another vessel, or which cannot avoid a close-quarters situation with another vessel forward of her beam, shall reduce her speed to the minimum at which she can be kept on her course. She shall if necessary take all her way off and in any event navigate with extreme caution until danger of collision is over.*

1.10 NAVIGATION IN FOG

Advice concerning navigation in fog is contained in *Marine Guidance Note MGN 202 (M&F),* published by the MCA and entitled *Navigation in Fog,* **(Annex 1)** which states, in part:

The Maritime and Coastguard Agency (MCA) is concerned that a number of casualties to ships have resulted from serious disregard for the basic principles of good seamanship and prudent navigation in bad visibility. Sensible use of radar and other aids to navigation greatly assists the conduct of ships in fog, but these aids have not reduced the need to comply fully with the Collision Regulations: to proceed at a safe speed, pay special attention to good watch-keeping, and navigate with proper caution.

It gives a brief outline of three casualties in fog, then states:

None of the casualties described led to loss of life, but clearly this was only due to good fortune. In all cases those responsible for the ship's navigation sacrificed seamen for expediency. They failed to recognise the limitations of aids to navigation; or to follow the requirements of the Collision Regulations and the advice of Marine Notices. It is worth stressing that the ships involved were all well-equipped vessels in the charge of men with sound qualifications; it was not skill or experience that was lacking, but the proper seamanlike approach to the situation.

Whatever the pressure on masters to make a quick passage or to meet the wishes of owners, operators, charters or port operators, it does not justify ships and those on board them being put unnecessarily at risk.

The document also stresses the responsibilities of owners; it is the duty of the company to take all reasonable steps to ensure that the ship is operated in a safe manner. In this regard, it states:

The company must have established and implemented an effective Safety Management System which includes procedures to ensure safe operation of ships as well as reporting accidents and non-conformities.

1.11 COMPANY PROCEDURES/RISK ASSESSMENT

Both *Northern Merchant* and *Diamant* had been issued with a safety management certificate and had in place, in compliance with ISM requirements, guidance and instructions to masters and crew in the form of operating manuals.

In the case of *Northern Merchant*, her *Ship Operating Manual (SOM)* **(Annex 2)** under *Part Four – The Ship at Sea - Special Requirements in Bad Weather and Fog* states in part:

Prevention of Collision

We would bring to the master's attention the need and requirement for deck officers to review the Rules for Preventing Collisions at Sea 1972 in their entirety but with specific reference to the following:

Rule 2 Responsibility

Rule 6 Safe Speed

Rule 19 Conduct of Vessels in Restricted Visibility

We would stress that it is the bridge watchkeeper's prime duty to ensure that these Rules are complied with at all times on the vessel and that proper application of these rules will take precedence over the commercial pressure or requirements of the vessel.

Fog and Restricted Visibility

Prior to entering fog or areas of reduced visibility the main engines must be slowed and precautions carried out as per the ICS Bridge Procedures Guide.

In the case of *Diamant*, her *Route Operating Manual* **(Annex 3)**, under section 3.6.4 *Navigation – Planning and Execution* states in part:

Commercial considerations must not take precedence over good seamanship. In poor visibility or if there is any doubt about the craft's position, or in the presence of other traffic/obstacles, speed should be reduced to that which is considered safe in the circumstances.

3.7.5 Collision Avoidance states:

The high speed of the craft makes it particularly important for collision avoidance alterations to be made early and positively, so that other vessels are aware, both visually and on radar, that effective action has been taken. Alterations should therefore be large enough to easily be detected, and made early enough to give adequate distance at the closest point of approach. In open waters the closest point of approach should be 1 mile ahead or 5 cables abeam or astern of the other vessel.

Care should be taken in the use of VHF for collision avoidance, especially at night or in poor visibility or when the identity of the other vessel cannot be guaranteed.

The International Regulations for Preventing Collisions at Sea must be strictly complied with at all times.

Radars must be monitored continuously and checked frequently one against the other by visual means. The data read from the ARPA radar should be treated with caution and not implicitly relied upon.

Neither vessel had in place any further detailed instructions or guidance regarding what actually constitutes a safe speed in restricted visibility. Additionally, in relation to the operating speed of both vessels, an assessment of the risks involved of high speed in restricted visibility had not been carried out.

1.12 CHANNEL NAVIGATION INFORMATION SERVICE (CNIS)

The IMO's resolution A.578 (14) defines Vessel Traffic Services (VTS) as:

Any service implemented by a competent authority designed to improve safety and efficiency of vessel traffic and the protection of the environment. The service shall have the capability to interact with marine traffic and to respond to traffic situations developing in the VTS area.

The following are extracts from the IMO resolution A.857 (20) Guidelines for VTS:

> *.9.1 An <u>information service</u> is a service to ensure that essential information becomes available in time for on-board navigational decision-making.*
>
> *.9.2 A <u>navigational assistance service</u> is a service to assist on-board navigational decision-making and to monitor its effects.*
>
> *.9.3 A <u>traffic organisation service</u> is a service to prevent the development of dangerous maritime traffic situations and to provide for safe and efficient movement of vessel traffic within the VTS area.*
>
> *2.1 The purpose of VTS is to improve the safety and efficiency of navigation, safety of life at sea and the protection of the marine environment and/or the adjacent shore area, worksites and offshore installations from possible adverse effects of maritime traffic.*
>
> *2.1.2 The type and level of service or services rendered could differ between both types of VTS; in a port or harbour VTS a navigational assistance service and/or a traffic organisation service is usually provided for, while in coastal VTS usually only an information service is rendered.*

2.3.4 When the VTS is authorised to issue instructions to vessels, these instructions should be result-orientated only, leaving the details of the execution, such as course to be steered or engine manoeuvres to be executed, to the master or pilot on board the vessel. Care should be taken that VTS operations do not encroach upon the master's responsibility for safe navigation or disturb the traditional relationship between master and pilot.

As suggested in 2.1.2 above, there are two types of VTS: port/harbour and coastal, which can be found throughout the world. The former is a service provided for ships entering and leaving the confines of a port, and/or transiting within harbour limits, and the latter is concerned with traffic passing through an area outside harbour limits.

When entering the area covered by the Dover Strait TSS, all ships over 300gt report to Dover Coastguard, which deals with south-west bound traffic, or to Gris Nez Traffic (in France), which handles north-east bound traffic. The reporting system is mandatory, and the short title for the system is CALDOVEREP.

The following description is from the IMO's publication *Ship's Routeing*:

The CNIS processing and display system receives inputs from the radar and VHF DF equipment, processes the information and presents it on any or all of six displays. Each display shows processed images (tracks) from any of the three radar inputs overlaid on a synthetic map of a selected area. New targets entering radar range are automatically tagged with a unique track number. The position course and speed information of up to 300 tracks is automatically updated and recorded, for each of the three radars, throughout the vessel's passage through the CNIS area, giving the CNIS a 900-track capability.

DOVER COASTGUARD maintain a continuous watch on traffic in the Dover Strait/Pas de Calais. Operators can add vessel information to the information processing and retrieval system database (such as name and cargo) and can display that supporting information on a separate screen. CNIS is capable of providing an automatic alarm to identify any track, which strays into an unauthorised area. VHF DF vectors appear when a VHF radio transmits on the frequency selected on the VHF DF equipment. Recording equipment automatically stores information from all tracks which can either be replayed on the system or specific track movements can be plotted onto an A0-size sheet of paper.

CNIS was introduced in 1972. It provides a 24-hour radio service for all shipping in the Dover Strait and is operated from the MRCC at Langdon Battery near Dover.

CNIS broadcasts on VHF radio channel 11, every 60 minutes (every 30 minutes in poor visibility), and gives warnings of navigational difficulties and unfavourable conditions likely to be encountered in the Dover Strait. These include adverse weather conditions, exceptional tides, misplaced or defective navigational aids, and hampered vessels such as oil-rigs or deep-draught tankers. The positions, course and speed of those vessels, which are in contravention of Rule 10 of the Collision Regulations (in particular those vessels travelling in a traffic lane in the opposite direction to that of the general flow), are broadcast to all stations over the radio. The vessels are also reported to their flag-states for action to be taken in accordance with IMO Resolution A432 (XI).

1.13 PASSENGER FEEDBACK

In accordance with MAIB policy, all passengers on board *Diamant* were sent a questionnaire to complete **(Annex 4)**. The purpose of this questionnaire was to obtain the passengers' description of the event, how, in their opinion, the situation was handled, whether any injuries were sustained, and to gain from them any general comments regarding safety on board.

Of the 130 passengers sent a questionnaire, 42 were completed and returned. It was not felt necessary to repeat the process with passengers on board *Northern Merchant*, because of the limited information that could have been provided.

The general consensus of opinion of those passengers who completed the questionnaire was that after the collision, although they were firmly requested to be seated, there was insufficient information provided by the master and officers as to the immediate outcome of the collision. This lack of information led to many passengers becoming uncertain and confused. The cabin staff, it was felt, knew no more than the passengers, which only added to the uncertainty. Many passengers began donning lifejackets in a reaction to members of the crew running around, presumably checking for damage and water ingress. It was also felt that had the cabin staff been more composed, this would have calmed the situation.

It was 10 minutes after the first announcement before the master made another, to inform the passengers the vessel would be proceeding at slow peed to Dover as a result of the collision. During this period, the passengers were desperate for further information.

All felt they should have been informed of the situation regarding the status of the vessel much sooner than they were.

1.14 ERGONOMICS

At the centre console on the bridge of *Diamant*, both the master and mate were seated with an ARPA radar directly ahead of them. From their seated positions they had access to all controls related to the navigation of the vessel.

During passage, especially in restricted visibility, it was normal practice for the navigating officer to inform the master, who normally had the conduct of the navigation, the information provided by his radar as it was being displayed in respect to distance, bearing and CPA of vessel targets. In addition to this, the master monitored his own radar, as well as the course and speed of the vessel.

Other equipment being monitored by either the master or the navigating officer were the GPS, echo sounder, MF and VHF radios. Any engineering problems the chief engineer detected were also reported to the master.

In June 2001, the Accident Investigation Board in Finland published a combined report (No 1/2001 M) into three accidents which all resulted in the grounding of the vessels concerned. As a result of these investigations, it was found that the ergonomics of each vessel's bridge was a contributing factor to the accident.

1.15 VOYAGE DATA RECORDERS (VDR)/ AUTOMATIC IDENTIFICATION SYSTEMS (AIS)

<u>VDR</u>

VDR or "Black Box" for ships is a means of capturing and recording vital information which should lead to a clearer understanding of the cause of accidents. This type of device has been in use in the aviation industry for many years.

The International Maritime Organization (IMO) defines the purpose of VDRs as follows:

> *The purpose of a voyage data recorder (VDR) is to maintain a store, in a secure and retrievable form, of information concerning the position, movement, physical status, command and control of a vessel over the period leading up to, and following, an incident having an impact thereon. Information contained in a VDR should be made available to both the Administration and the shipowner. This information is for use during any subsequent investigation to identify the cause(s) of the incident.*

The use of VDRs will enable analysis of all accidents or near misses and not just the "doomsday" scenario. They will provide hard information on such accidents, so that a more thorough investigation can be carried out than has been possible hitherto, and lessons can be learned to avoid a recurrence.

AIS

AIS is a shipboard broadcast transponder system in which ships continually transmit their identity, position, course, speed and other data to all other nearby ships and shoreside authorities on a common VHF radio channel. The primary operating mode for AIS is autonomous ship-to-ship reporting which, among other things, is intended to improve situational awareness for officers of the watch, provide unambiguous identification of radar targets, detect a change in another ship's heading in real time without waiting for ARPA calculations, and give real time information about another ship's movements, ie increase or decrease in speed and rate of turn.

AIS is also designed to operate as a means for coastal states to obtain information about a ship and her cargo as well as a traffic management tool when integrated with a VTS system.

As far as accident investigation is concerned, if integrated with a recording device, AIS can be interrogated after an event and provide real time heading, course and speed as well as other useful information.

Unfortunately, neither *Diamant* nor *Northern Merchant* were fitted with VDR or AIS. However, from 1 July 2002, or during their next refit, similar vessels are required to have these items fitted.

1.16 HSC CODE

The International Code of Safety for High Speed Craft, HSC Code, has been derived from a previous Code of Safety for Dynamically Supported Craft (DSC) adopted by IMO in 1977. The revised code has been prepared in recognition of the growth in size and type of high-speed craft now existing, and is intended to facilitate future research and development on fast sea transportation.

The Code requirements also reflect the additional hazards which may be caused by the high speed, compared with conventional ship transportation. Thus, in addition to the normal requirements (including lifesaving appliances, evacuation facilities, etc provided in case of an accident occurring), further emphasis is placed on reducing the risk of hazardous situations arising. Some advantages result from the high-speed craft concept (eg the light displacement provides a large reserve buoyancy in relation to displacement). The consequences of other hazards, such as collision at high speed, are balanced by more stringent navigational and operational requirements and specially developed accommodation provisions.

As far as navigational equipment is concerned, Chapter 13 entitled *Navigational Equipment* states, in part:

13.3 Speed and distance measurement

13.3.2 Speed and distance measuring devices on craft fitted with an automatic radar plotting aid should be capable of measuring speed and distance through the water.

13.5 Radar installations

13.5.1 Craft should be provided with at least one azimuth-stabilised radar operating in the X band (3cm).

13.5.2 Craft of 500 tons gross tonnage and upwards or craft certified to carry more than 450 passengers should be provided with at least 2 radar installations.

13.5.3 At least one radar should be equipped with facilities for plotting which are at least effective as a reflective plotter.

13.5.4 Adequate communication facilities should be provided between the radar observer and the person in immediate charge of the craft.

13.5.5 Each radar installation provided should be suitable for the intended craft speed, motion characteristics and commonly encountered environmental conditions.

13.5.6 Each radar installation should be mounted so as to be free as practicable from vibration.

13.6 Electronic positioning systems

Where the area of operation of a high speed craft is covered by a reliable electronic positioning-fixing system, the craft should be provided with the means to fix its position using such system.

13.7 Other navigational aids

The information provided by navigational systems should be so displayed that the probability of misreading is reduced to a minimum and should be capable of giving readings to an optimum accuracy.

1.17 SIMULATION

In June and July of 2002, the MAIB carried out simulated sea trials of the Incat 81 – Lynx 3 (Sindel modelling) in the multi-purpose simulator at Warsash Maritime Centre.

The data supplied for the ship modelling was limited, but is understood to have represented the characteristics of turning manoeuvres in a realistic manner.

The purpose of these trials was to determine whether the most appropriate emergency course of action had been taken in this accident, whether an alternative course of action could have prevented the collision and the best course of action to take in any a similar situation in the future. The results of the model tests are detailed in **Annex 5**.

1.18 SUBSEQUENT ACTION

Since the collision, both V Ships and Sea Containers Ltd have issued fleet safety notices as a direct consequence.

V Ships, in its circular **(Annex 6)**, has emphasised the need to proceed at a safe speed at all times and the importance of complying fully with company policy with respect to the Collision Regulations. It has warned that failure to comply fully with the Collision Regulations will result in disciplinary action.

All masters were required to hold a meeting with navigating officers to review this accident to ensure that bridge watchkeepers are fully aware of their responsibilities when in charge of the vessel's navigation. These meetings were to consider all areas of navigation safety but would include discussion on the following areas:

> Navigation in restricted visibility, controlling the speed and direction of the ship, collision avoidance and the use of VHF radio, collision avoidance and radar.

All masters were required to confirm receipt of the circular and action taken.

Sea Containers Ltd has taken the following steps:

- Re-created the accident on a two-bridge simulator to try to understand the cause, and to help formulate additional training courses,
- Thoroughly checked and reviewed the training given to both masters and navigating officers,
- Contacted radar manufacturers regarding the understanding of some issues shown during simulation,
- Issued a fleet memorandum, addressing the possibility of subconsciously applying Part 2 of the Steering and Sailing Rules in a reduced visibility situation,
- Stressed the need for caution and highlighted the applicable guidance in its Route Operating Manual.

SECTION 2 - ANALYSIS

2.1 AIM

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

2.2 ACTIONS TAKEN BY *DIAMANT*

2.2.1 Safe speed

It is appreciated that the criteria for determining a safe speed, especially aboard high-speed craft, are open for debate and, no doubt, can be interpreted in many different ways. However, a prudent approach, especially in an area such as the Dover Strait, could be to travel at no greater a speed than that in relation to the visibility and stopping distance of the vessel, having regard to the additional factors listed in Rule 6 (a).

Diamant, in accordance with her trial data, in an emergency situation, was able to come to a complete stop at her operating speed in 463 metres. Therefore, given the circumstances, it could be assumed that *Diamant*'s speed at the time of the collision cannot be considered a safe speed in visibility of less than 463 metres. However, she was fitted with operational radar, which enabled the bridge team to detect other vessels beyond the visible range. What is unknown is how much further this was. A speed, greater than that in relation to the visibility and stopping distance of the vessel, can only be guaranteed a safe speed if there is an assured detection of all vessels at sufficient range so as to be able to avoid a collision in accordance with the Collision Regulations. Such assurance relies on those additional factors listed in Rule 6 (b), as well as the time required for detection, reaction and implementation of evasive action in the prevailing circumstances with an adequate safety margin to cater for the unexpected, and the heightened potential for damage to the vessel and injury to her crew and passengers in the event of an accident at high speed.

There can be no guarantee that *Diamant* would be able to detect all vessels at sufficient range so as to be able to avoid a collision in accordance with the Collision Regulations. *Diamant* was, therefore, travelling at a potentially unsafe speed.

A N Cockcroft and J N F Laeijer in their publication *A Guide to the Collision Avoidance Rules* state:

> *The word 'safe' is intended to be used in a relative sense. Every vessel is required to proceed at a speed which could reasonably be considered in the particular circumstances. If a ship is involved in a collision it does not necessarily follow that she was initially proceeding at an unsafe speed. In clear visibility, collisions can generally be attributed to bad look out, or to wrongful action subsequent to detection, rather than to a high initial speed.*

They also state:

> *in restricted visibility a vessel making proper use of radar will normally be justified in going at a higher speed than that which would be acceptable for a vessel which does not have the equipment but not usually at the speed which would be considered safe for good visibility.*

The master's decision to proceed at 29 knots in such conditions was borne out of an apparent general high-speed craft philosophy that, because of their manoeuvrability, a high speed can be a safe speed. However, it would be dangerous to assume this in all scenarios.

Recognising that there is always a possibility that small vessels and other floating objects might not be detected by radar at an adequate range (Rule 6(b)(iv)), it follows that a speed which relies on radar for detecting vessels at a sufficient range so as to be able to avoid collision, in accordance with the Collision Regulations, should not be regarded as a safe speed.

However, the practicality of following the above criterion in conditions of severely restricted visibility is questionable (eg the need to maintain steerage in conditions of zero visibility). Additionally, the commercial viability of shipping would be in danger of being undermined if the criterion was strictly applied, particularly in areas prone to restricted visibility.

In view of the above, a more pragmatic approach might be appropriate, such that a degree of reliance on radar for detection might be acceptable following a reasoned assessment of the risks in doing so.

2.2.2 Initial situation

When the bridge team on board *Diamant* first became aware that they would be involved in a passing situation with *Northern Merchant*, in this case resulting in a CPA of 3 cables, they either did not recognise it as a developing close quarters situation, or, if they did, not one that involved a risk of collision. The fact that no action was taken in accordance with Rule 19(d) supports this. In effect, they were using their clear visibility criterion for determining a close quarters situation and /or risk of collision. They did not recognise the need for an increased CPA in restricted visibility. Had they determined it to be a close quarters situation and/or risk of collision, they should have acted in accordance with Rule 19(d), which could, having passed South Goodwin light vessel, have been an alteration of course to starboard towards the amply available sea-room to the north. In addition, they also had the option of slowing down. However, as they did not consider that Rule 19(d) applied, they decided to maintain course and speed. This raises the issue of what constitutes a close quarters situation.

A N Cockcroft and J N F Laeijer state:

> *The distance at which a close quarters situation first applies has not been defined in miles, and is not likely to be, as it will depend upon a number of factors. The 1972 Conference (IMO Revision of the Collision Regulations) considered the possibility of specifying the distance at which it would be begin to apply but after lengthy discussions it was decided that this distance could not be quantified.*

On the other hand, the Seafarers International Research Centre (SIRC), in a paper dealing with near miss encounters in the Dover Strait (Belcher P (2002) *"Overtaking in the Dover Strait, an analysis of near miss encounters")* states:

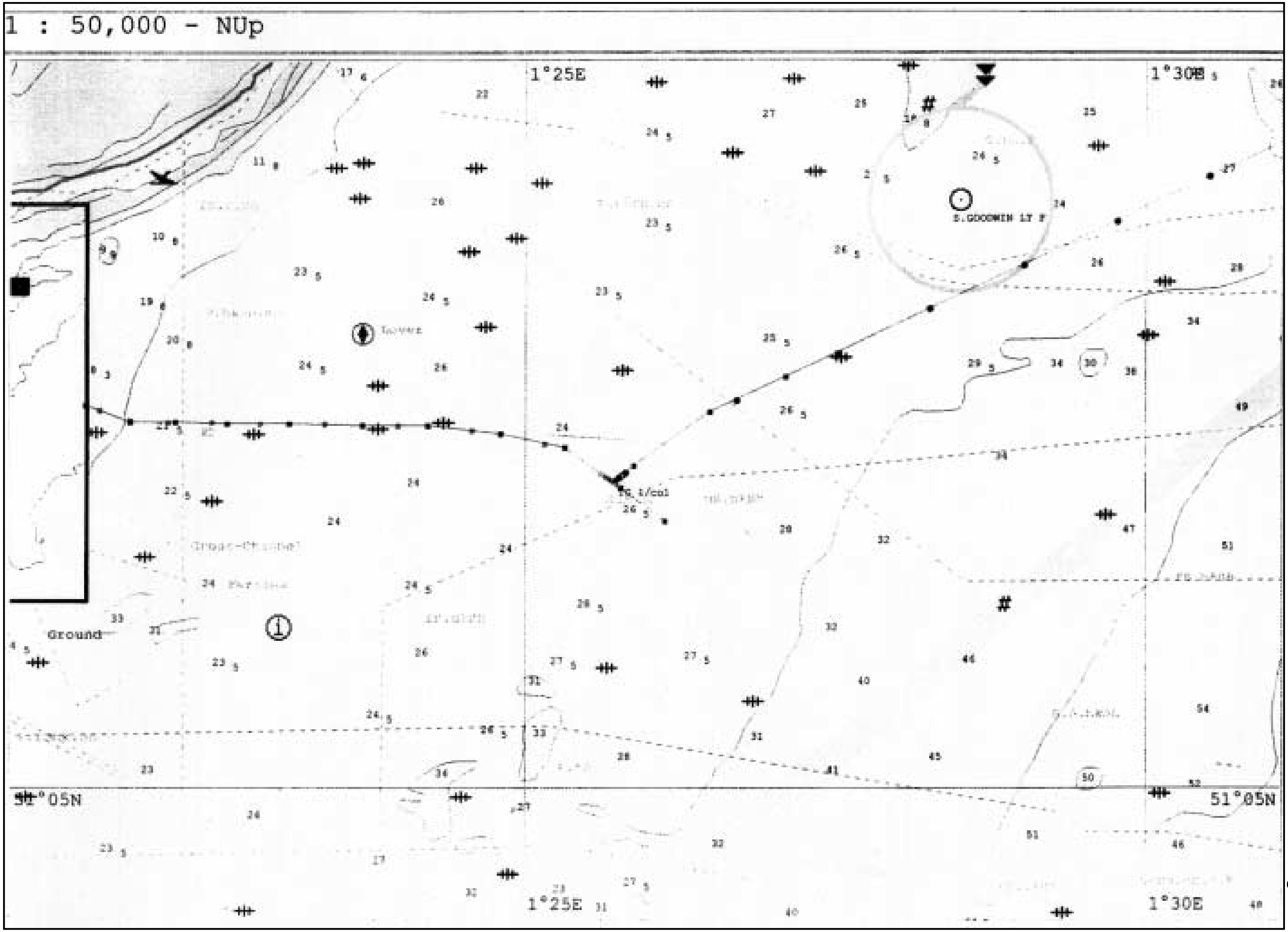
> *From a review of literature on ships' domains (Fuji and Tanka, 1971, Goodwin, 1977, Coldwell, 1983, Zhao, etal., 1993) it has been found that the domain required for a ship in congested waters can be approximated to a circular space with a radius of 8 cables. They also state: It might be argued that a criteria of a minimum passing distance of 8 cables is too stringent a measure for such a busy area. However, a passing distance of 3 cables or less, is on anyone's measure, a very dangerous occurrence that could lead to a collision with only a very slight change in circumstances.*

The speed at which a vessel is travelling will have a direct influence on the range at which a close quarters situation exists. The faster the speed, the more reaction and implementation distance will be required.

Why was an experienced high-speed craft master content with a CPA of 3 cables in visibility of 50 to 150 metres in such a busy seaway as the Dover Strait?

Crossing the Dover Strait several times a day on the same route, passing the same vessels in approximately the same positions, thereby anticipating their movements led to a certain degree of complacency. Margins of 3 cables became an accepted practice in clear visibility and, then, in all conditions of visibility.

The bridge team's assumption that it was a green-green situation was incorrect, as *Northern Merchant* continued to show her port side throughout the accident **(Figure 7)**. Their assumption was based on their anticipation of *Northern Merchant*'s likely passage. In not monitoring the ARPA course and speed display following their initial appraisal, contrary to Rule 7(b), they failed to maintain a full appraisal of the situation, contrary to Rule 5 of the Collision Regulations. Instead, reliance was placed solely on her CPA; the master neither requested, nor was offered, the ARPA's course and speed reading.



Construction of radar plot

Figure 7

Being under the impression that the situation was green-green, it seems the master anticipated that *Northern Merchant* would stand-on, for the following reasons: a perceived “unwritten rule” that high-speed craft will keep clear of all others, a general view by regular users of the Dover Strait that a CPA of 3 cables was acceptable and, given that acceptance, an alteration of course by *Northern Merchant* was unlikely.

2.2.3 Later situation

Having committed himself to a CPA of 2 to 3 cables, when *Northern Merchant*’s echo began to arc, because of side-lobing, as her aspect began to change when she altered course to starboard, *Diamant*’s master, mainly because of his green-green interpretation, always assumed the danger to be on his own starboard side. As a consequence, he altered course to port, initially by a few degrees only, in an attempt to regain confirmation of the situation and, in turn, increase the CPA and reduce the side-lobing on the radar display. He never considered an alteration of course to starboard. He assumed this would present *Diamant*’s port side to the approaching *Northern Merchant*.

At that time, there was a doubt as to whether a close quarters situation was developing. A prudent course of action then would have been to apply Rule 2(a): assume a close quarters situation and/or risk of collision and take all way off the vessel in accordance with Rule 19(e).

Only when *Northern Merchant*’s port side began to loom out of the fog, did *Diamant*’s master consider any emergency evasive action. Until that point, he had always been under the impression that both vessels would pass green-green. However, an alteration of course to starboard was no longer an option as it probably would have resulted in a more severe collision. *Diamant* was already slowly altering course to port, and it would have been much easier to manoeuvre the vessel into an emergency port turn.

Given the options available at the point when *Northern Merchant* appeared out of the fog, *Diamant*’s master’s decision to continue altering course to port in an emergency turn probably reduced the severity of the collision compared with an alteration of course to starboard.

2.2.4 Situational appraisal

A crucial factor in the bridge team’s assumption that *Diamant* would pass *Northern Merchant* green-green was their reliance on the CPA only. The master neither requested, nor was offered, the ARPA’s course and speed reading. Had he either obtained, or been provided with, this information, he probably would have realised that both vessels continued to be involved in a crossing situation. This, of course, assumes that the course and speed readings obtainable from the radar were accurate.

The accuracy of any triangular calculation carried out by the equipment must be suspect at high speed, as a large WO vector, which is derived from own ship's speed and course, will potentially produce more inaccuracies in the CPA. In this context, the fitting of high-speed rotating radar scanners would have provided a quicker and more precise update of the information being displayed on the radar screens and, in turn, could have led to a more accurate appreciation of the situation, especially in relation to alteration of course and CPA. Had the bridge team elected to make full use of the equipment, it might have enabled the collision to be avoided. Having said that, *Diamant* was fitted with the required radar installations in accordance with the HSC Code.

Both the master and the chief officer should have been aware of the accuracy parameters of their radars. With a required CPA accuracy of 7 cables or below in a crossing situation, and 5 cables or below in an end-on situation, it is possible that small displayed ARPA CPAs could in fact be zero. For this reason alone a CPA as small as 3 cables should always be avoided unless the CPA accuracy has been confirmed and is within satisfactory parameters.

The radar information being displayed on board *Diamant* was water-based, the correct format for anti-collision avoidance, while the information displayed on board *Northern Merchant*'s radars was ground-based. It is unknown what effect this had as a contributing factor to the collision, if any, but, given the set and drift at the time of the accident, it is believed it would have been negligible.

MAIB research involving other high-speed craft operators has shown that the use of electronic charts is beneficial in terms of confidence and geographical awareness. In this respect, many high-speed craft bridge teams place a degree of dependence on this equipment.

A fully operational electronic chart can provide instantaneous, at a glance, information, complementing that provided by radar. It allows the user to appreciate more fully the surrounding geographical area.

2.2.5 Ergonomics

Because of the bridge instrumentation layout, and the various information being received by both the master and chief officer, were there shortcomings in the way this information was being processed, interpreted, and conveyed?

Naturally, at high speeds there will be a shorter time to process the information, which, in turn could lead to a possible overload. This, coupled with equating small text on a radar screen, maintaining a visual lookout involving long distance sight, different lighting levels, different readout methods and the same data being displayed in different places, could lead to confirmation bias and the possibility of watchkeepers disregarding what they are being told. However, in this case it was probably a matter of the bridge team not making full use of the information being provided, and the problem being one of procedure rather than ergonomics.

2.2.6 Company procedures

A *Route Operating Manual,* which detailed company procedures and instructions in accordance with ISM Code requirements, was on board *Diamant*. Under collision avoidance, it stated that action to be taken to avoid a collision should be early, positive and large enough to be easily detected. It also made reference to CPAs ideally being 1 mile ahead and 5 cables abeam, albeit, in open waters. These distances were derived for the purpose of avoiding the need to comply with Sections II and III of the Steering and Sailing Rules. However, if those sections did become applicable, because of traffic density and other circumstances, then they were to be followed.

With regard to radar, it advised risk of collision should be frequently checked by visual means, and warned that the data read from ARPA should be treated with caution and not be relied upon implicitly.

Dover Strait is far from open waters. Therefore, the company should have in place procedures for coastal waters, with particular regard as to what constitutes a close quarters situation and/or risk of collision, and whether its vessels should keep clear of all other vessels (ie 1 mile ahead and 5 cables abeam) even if the Steering and Sailing Rules apply and there is no risk of collision.

2.2.7 Action when other vessel (*Northern Merchant*) became visible

When *Northern Merchant* became visible out of the fog, *Diamant*'s master made an emergency manoeuvre to port, using what he thought was assistance from astern propulsion on the port engines. However, the action taken in principle was incorrect because the port buckets were to port with the port engines astern, and therefore, acted against the alteration of course to port.

Other emergency options were available as detailed by the Sindel model tests carried out by Warsash Maritime Centre. The six simulations carried out, with varying degrees of helm and engine movements, showed the minimum amount of advance and transfer achievable was insufficient to prevent a collision at a distance of 150 metres; the maximum reported visibility at the time. To prevent a collision, any emergency action would have to have been taken at a distance greater than 400 metres.

The model tests showed that the most effective action, given available sea room, was to use full power on both engines and maximum helm. Having said that, there was very little difference between the modelled manoeuvres.

2.2.8 Action after the collision

Passengers' reactions as to how the accident was handled were somewhat critical. The one factor about which they were all agreed, was that they felt they were not kept sufficiently informed as to what was happening. This led to uncertainty and confusion. It was also felt, generally, that the cabin staff lacked any knowledge regarding the situation.

The common factor in such accidents is that those on the bridge are very often heavily occupied in handling post-accident events. In such circumstances, it is necessary to prioritise what is required, and it may be that keeping the passengers informed is not necessarily considered to be of the highest priority at the time. It is also possible that those on the bridge might themselves be suffering from various states of shock. In addition, post-accident stress can result in those on the bridge temporarily losing their concept of the passage of time. What they believe is an interval of only 1 or 2 minutes may in fact be 5 to 10 minutes. It is not, therefore, a case that those on the bridge are unaware of the need to inform people of what is happening. The person best placed to make the initial calm and authoritative broadcast is very often someone not directly involved in handling the accident or its immediate aftermath. The potential difficulty with this, however, is that such a person may not be fully familiar with all the necessary facts to enable him/her to make such an announcement. It would mean that those on the bridge would have to divert precious time to brief someone.

Nonetheless, management should give thought to how this requirement can be met.

A number of people, both passengers and crew were severely shaken. Everyone wanted to know what had happened, whether they were safe, and what was going to happen next. In the aftermath of this accident, such information was, at best, patchy.

Providing regular and accurate information in an authoritative and calm manner is among the most important of all requirements in any passenger-carrying vessel involved in an emergency. The need is extremely well known but, as this accident demonstrates, it is often overlooked. The difficulties are recognised, especially when the communication channels are likely to be clogged. It does, however, need to be addressed by management.

2.3 ACTION TAKEN BY *NORTHERN MERCHANT*

2.3.1 Initial and later situations

As with *Diamant, Northern Merchant* was also travelling at a potentially unsafe speed. However, the master rarely reduced speed in restricted visibility.

Applying the same reasoning to *Northern Merchant*'s speed, as to that of *Diamant,* in relation to stopping distances, it would have taken *Northern Merchant,* being a conventional craft, a greater distance than *Diamant* to come to an emergency stop.

Again, the master's decision to travel at full speed (20 to 21 knots) was based on normal operating practice. A reduction in speed was not considered, apart from allowing *Calais* more sea room to enter Dover harbour. After *Calais* was clear, the master resumed full speed. The visibility was never a factor.

When the bridge team on board *Northern Merchant* first became aware that they would be involved in a close quarters situation with *Diamant*, they should have acted in accordance with Rule 19(d) of the Collision Regulations.

It is accepted that, eventually, the master did alter course to starboard. However, the initial alteration of course was only by 7° to 10°. As an alteration of course, under the circumstances, it was inadequate and in contravention of Rule 8 of the Collision Regulations. Only when the master realised that *Diamant* was taking no avoiding action did he increase the alteration by ordering 20° starboard helm. However, this alteration, apart from not being readily apparent, was far too late.

The question which will be asked of *Northern Merchant*'s action is: Why did the master initially only alter course by 7° to 10°, virtually standing on, with a CPA of 2 cables?

Being aware that the other vessel was a high-speed craft the master, in keeping with the perceived "unwritten rule", fully expected *Diamant* to keep clear and, once past South Goodwin light vessel, to alter course to starboard. When this did not happen, only then did he consider taking substantial avoiding action. Unfortunately, the application of only 20° starboard helm was insufficient to avoid a collision.

2.3.2 Company procedures

Northern Merchant carried a *Ship Operating Manual,* which detailed company procedures and instructions in accordance with ISM Code requirements. In it, under *prevention of collision*, it stated the need to review Rules 2, 6 and 19 of the *Collision Regulations* and that these Rules took precedence over commercial pressure and the requirements of the vessel.

Under fog and restricted visibility, it stated that main engines must be slowed and precautions carried out in accordance with the ICS Bridge Procedures Guide.

However, rather than quote adherence to the Collision Regulations, it would be far more beneficial to masters and watchkeepers if procedures and guidance were in place as to what constitutes compliance with the regulations, in particular with regard to close quarters situations and safe speed.

2.4 RISK ASSESSMENT

Fortunately, this accident resulted in no fatalities, or indeed injuries. However, the outcome could have been quite different. Had the collision been anything other than a glancing blow, undoubtedly there would have been substantial injuries, and quite possibly fatalities, to passengers and crew.

The dangers of travelling at high speed, in areas of high traffic density and restricted visibility, are self-evident, as has been highlighted in this case.

Given the speeds at which high-speed craft operate, it would be prudent for operators to carry out risk assessments for these craft in restricted visibility. From an assessment of the risks involved and the consequences of potential accidents, guidance and instructions could be established, including what might be deemed a safe speed and what constitutes a close quarters situation under these conditions. This would help to improve their safe operation.

2.5 HIGH-SPEED CRAFT OPERATION

2.5.1 The perceived "unwritten rule"

A perceived "unwritten rule" exists to the effect that high-speed craft will keep clear of all other craft irrespective of the situation. In this context, MAIB research has shown that high-speed craft, in general, will avoid, whenever possible, any situation where Sections II and III of the Steering and Sailing Rules would come into force.

While the value of this action can perhaps be seen as credible, given the speed and manoeuvrability of these vessels, a problem arises when other vessels, which also acknowledge this perceived "unwritten rule", develop an expectation that high-speed craft will keep clear in all instances, and, in doing so, where the Steering and Sailing Rules do come into force, fail to take action in compliance with them.

The danger of this assumption is obvious, and at best, can only lead to confusion. While using speed and manoeuvrability to avoid a situation developing is perhaps acceptable, providing such action is substantial and carried out in ample time, applying the same principle in a developing situation only adds to the expectation by conventional craft that high-speed craft will keep clear regardless.

This assumption has been a major contributory factor of this accident. Had it not existed, it is very likely *Northern Merchant*'s master would have taken avoiding action much earlier than he did.

There is an argument that a change to the Collision Regulations is now necessary to accommodate the uniqueness of high-speed craft. A suggestion, which has been put forward, and taken on board by some operators, is a simple addition to Rule 18 *Responsibilities between Vessels* section (e), to mention high-speed craft, and for it to apply in the same way as it does to seaplanes on the water; that is, they shall in general, keep well clear of all vessels and avoid impeding their navigation. In circumstances, however, where risk of collision exists, they shall comply with the Steering and Sailing Rules.

The problem, of course, is then defining "high-speed craft". It has been suggested that this might be phrased along the lines of "a vessel of special construction designed to travel at high speed". There would then be a requirement for these craft to keep clear of all other vessels in sight. However, in conditions of restricted visibility, as in this case, Rule 19 would, of course still apply.

MAIB research has shown that most high-speed craft operators would not welcome a change to the Collision Regulations. In line with these views, the MAIB does not support changing the Collision Regulations in respect to high-speed craft.

2.6 THE ROLE OF CNIS

One of the principles of seafaring is the freedom to navigate not only on the high seas, but also in the territorial waters and narrow channels of other states. The concept of freedom of navigation originates from the belief that shipmasters know best how to navigate safely. This is very different from airline captains, who have to submit flight plans before departure and can be told by air traffic control precisely what to do and when to do it.

The CNIS is an information service to mariners and is not required to take any active intervention, because the responsibility for safe navigation of the vessels remains with the masters of the vessels concerned.

The CNIS regards the Dover Strait as having freedom of navigation for vessels of all nations, and it is the shipmaster's responsibility to navigate his vessel according to international regulations, which in this case are the *International Regulations for Preventing Collisions at Sea* (*Collision Regulations*). As described in Section 1.12, if the master does not obey Rule 10 of the Collision Regulations and the transgression is observed by CNIS, then he will be reported. If that vessel enters a UK port he could be prosecuted, but, in any case, a report will be sent to the ship's flag state, under the IMO agreements, to carry out any such action as it sees fit.

Nevertheless, collisions do occur in the radar surveillance area of the CNIS, and it has been questioned as to whether CNIS has, or should have, an intervention role to prevent them.

2.6.1 Vessel control

A difference between a coastal VTS (CNIS) and a port/harbour VTS is in the amount of control of shipping. A port/harbour VTS can, for example, direct a ship to leave an anchorage at a certain time, to slow down her speed or to enter a certain channel; this is not the remit of CNIS. A port/harbour VTS could have about ten ship movements at any one time, whereas CNIS can, typically, have at least 250 echoes on its radar screens. Therefore, it would be difficult for CNIS to have the degree of control enjoyed by a port/harbour VTS, with that amount of traffic.

In the case of all types of VTS, giving execution details, such as specific helm and engine orders, is unacceptable, because they could be inappropriate, given the limited knowledge of the prevailing circumstances and the particulars of the vessels involved, and could result in legal action against the VTS. This view is supported by section 2.3.4 of IMO resolution A.857 (20) which states that *instructions should be result-orientated only*.

2.6.2 Limit of control

Despite CNIS being able to attach track numbers and other data to radar echoes, there are some limitations with radar surveillance. It must be remembered that radar is based on the transmission and reception of radio waves, and is subject to interference from atmospherics. In raw radar, the echo is dragged out by the rotation of the scanner, and the size of echo reflects the size of the vessel. In raw radar presentation, the operator can adjust the set for gain and for sea and rain clutter. However, when automatic control is selected, the CNIS radar echo returns are processed such that all echoes appear to be the same size. The system discriminates between a real echo and background noise. If it finds an echo of an object, it will update its decision every six sweeps of the scanner (every 30 seconds) and will automatically assign a track number and display a vector. However, in the case of a small echo moving up and down in a seaway, the system may drop the data it has assigned for it and, at a later time, give it new data when it has been reacquired.

Sometimes two echoes merge into one, and it appears to an observer that the two vessels might have collided. However, radar frequency length is such that it cannot discern that the two ships are, in fact, separate and are passing at close range to one other. In the restricted waters of the Dover Strait, the passing distances for vessels are far less than would be expected in open seas. When two echoes merge, the radar system drops one set of data. However, when the echoes separate, the system will, after 30 seconds, automatically attribute a new track number to one of the echoes. In this way, the track numbers are sometimes swapped, which can confuse the radar operator.

Even if a CNIS operator was to give warning by radio of an impending collision, the time taken for ships' officers to respond to the radio, which itself could cause confusion due to possible language differences and radio interference, could make matters worse, rather than improve the situation. Many vessels which pass through the area, at one time or another, come on to collision courses with other vessels. However, collisions are averted routinely, either by navigational alterations of course, or by deliberate avoiding actions under the Collision Regulations. Because of the high traffic density in the Dover Strait, the number of times when vessels are on collision courses is too frequent for CNIS operators to give warnings routinely, given CNIS's current available resources. Even when two vessels are on a collision course, the timing and type of avoiding action can be dictated by circumstances which the CNIS operator might not appreciate.

In conclusion (from the discussion above), it is not the role of CNIS to intervene routinely to prevent collisions between vessels, because of limitations of the radar surveillance system, the impracticalities and dangers of giving warnings and direct instructions, and the desire to maintain the principle of the freedom of navigation, and its available current resources.

2.7 VDR/AIS

Had both vessels been fitted with a VDR, a more thorough investigation, especially in relation to positions, courses, speeds and bridge team actions before the collision, could have been carried out. If AIS had been recordable, this also could have been used.

At the time of this accident, there was a reliance on what could be remembered, by those involved, after the event. Although interviews are normally carried out only hours after the event, what is remembered and said can sometimes differ from what actually happened. The fitting of VDR and AIS, if recordable, will help eliminate this factor.

2.8 SUBSEQUENT ACTION

The subsequent action taken by both V Ships and Sea Containers Ltd **(ref Section 1.18)** should contribute to reducing the possibility of a similar accident occurring in the future.

SECTION 3 - CONCLUSIONS

3.1 CAUSES AND CONTRIBUTING FACTORS

1. *Diamant*'s potentially unsafe speed. [2.2.1]

2. An apparent general high-speed craft philosophy that, because of their manoeuvrability, a high speed can be a safe speed in all scenarios. [2.2.1]

3. A failure of *Diamant*'s bridge team to recognise 2 to 3 cables as a close quarters situation. [2.2.2, 2.2.3]

4. A green-green passing assumption made by *Diamant*'s bridge team. [2.2.2]

5. Complacency of *Diamant*'s bridge team in its acceptance of small CPAs with other vessels. [2.2.2]

6. A failure of *Diamant*'s bridge team to make continued use of the ARPA's course and speed display. [2.2.2]

7. An expectation, by the master of *Diamant*, that *Northern Merchant* would stand-on. [2.2.2]

8. A perceived "unwritten rule" that high-speed craft will keep clear of all other craft. [2.2.2]

9. Arcing of *Northern Merchant*'s echo because of side-lobing. [2.2.3]

10. *Diamant*'s master's decision to alter course to port. [2.2.3]

11. A failure by *Diamant*'s bridge team to act in accordance with Rules 2(a) and 19(e). [2.2.3]

12. The lack of an effective risk assessment and instructions on board *Diamant* as to what constituted a close quarters situation and a safe speed in coastal waters. [2.2.6]

13. *Northern Merchant*'s potentially unsafe speed. [2.3.1]

14. *Northern Merchant*'s master's practice of rarely reducing speed in restricted visibility. [2.3.1]

15. A decision of *Northern Merchant*'s master to alter course to starboard initially by only 7° to 10°. [2.3.1]

16. *Northern Merchant*'s master's subsequent decision to alter course by ordering only 20° starboard helm. [2.3.1]

17. *Northern Merchant*'s master's expectancy that *Diamant* would keep clear and alter course to starboard, once clear of the South Goodwin light vessel. [2.3.1]

18. A lack of company procedures and guidance on board *Northern Merchant* as to what constituted a close quarters situation and safe speed in coastal waters. [2.3.2]

3.2 OTHER FINDINGS

1. Under certain conditions it is possible that small displayed ARPA CPAs, could be zero. [2.2.4]

2. The most effective emergency action for *Diamant* to take was the use of full power on the engines and maximum helm. [2.2.7]

3. Providing regular and accurate information in a calm and authoritative manner is among the most important requirements in any passenger-carrying vessel involved in an emergency. [2.2.8]

4. A risk assessment, which identifies effective control measures for the operation of high-speed craft in restricted visibility, should enhance their safe operation. [2.4]

5. Other vessels which acknowledge the perceived "unwritten rule", develop an expectation that high-speed craft will keep clear in all instances, and, in doing so, where the Steering and Sailing Rules do come into force, fail to take action in compliance with them. [2.5.1]

6. A change to the Collision Regulations to specifically accommodate high-speed craft is not considered necessary by the MAIB. [2.5.1]

7. It is not the role of CNIS to intervene to prevent collisions. [2.6]

8. Had both vessels been fitted with VDR/AIS, a more thorough investigation could have been undertaken, especially in relation to positions, courses, speeds and bridge team actions. [2.7]

9. The subsequent action taken by both V Ships and Sea Containers Ltd should contribute to reducing the possibility of a similar accident occurring. [2.8]

SECTION 4 - ACTION TAKEN

Since the collision, both V Ships and Sea Containers Ltd have issued fleet safety notices as a direct consequence.

V Ships, in its circular **(Annex 6)**, has emphasised the need to proceed at a safe speed at all times and the importance of complying fully with company policy with respect to the Collision Regulations. It has warned that failure to comply fully with the Collision Regulations will result in disciplinary action.

All masters were required to hold a meeting with navigating officers to review this accident to ensure that bridge watchkeepers are fully aware of their responsibilities when in charge of the vessel's navigation. These meetings were to consider all areas of navigation safety but would include discussion on the following areas:

> Navigation in restricted visibility, controlling the speed and direction of the ship, collision avoidance and the use of VHF radio, collision avoidance and radar.

All masters were required to confirm receipt of the circular and action taken.

Sea Containers Ltd has taken the following steps:

- Re-created the accident on a two-bridge simulator to try to understand the cause, and to help formulate additional training courses,
- Thoroughly checked and reviewed the training given to both masters and navigating officers,
- Contacted radar manufacturers regarding the understanding of some issues shown during simulation,
- Issued a fleet memorandum, addressing the possibility of subconsciously applying Part 2 of the Steering and Sailing Rules in a reduced visibility situation,
- Stressed the need for caution and highlighted the applicable guidance in its Route Operating Manual.

1. A Chief Inspector's letter has been sent to Sea Containers Limited recommending the company to:

    a. Reiterate to masters and watchkeepers the non-existence of a perceived "unwritten rule".

b. Carry out a risk assessment for high-speed craft operation in restricted visibility to ensure their safe operation, including what might be deemed a safe speed and what constitutes a close quarters situation under these conditions.

c. Issue procedures and guidance to masters and watchkeepers as to what constitutes compliance with the Collision Regulations in coastal waters in particular with regard to safe speed and close quarter situations.

d. Re-examine current procedures for communication with passengers in the event of an emergency.

2. A Chief Inspector's letter has also been sent to V Ships Limited recommending the company to:

a. Reiterate to masters and watchkeepers the non-existence of a perceived "unwritten rule".

b. Issue procedures and guidance to masters and watchkeepers as to what constitutes compliance with the Collision Regulations, in particular with regard to safe speed and close quarter situations.

SECTION 5 - RECOMMENDATIONS

The Maritime and Coastguard Agency is recommended to:

1. Issue guidance to remind operators that Sections II and III of the Steering and Sailing Rules of the Collision Regulations must be strictly complied with, acknowledging that vessels are not prevented from taking sufficiently early action, ahead of the point at which those sections come into effect.

2. Issue guidance on how operators should determine a safe speed and a close quarters situation in restricted visibility by:

   - Listing the factors to take into account, in addition to those prescribed in Rule 6 of the Collision Regulations; and

   - Defining the extent to which reliance can be placed on radar for detection of small vessels and other floating objects.

Marine Accident Investigation Branch
April 2003

ANNEX 1

MGN 202

MARINE GUIDANCE NOTE

Maritime and Coastguard Agency

MGN 202 (M+F)

Navigation in Fog

Note to Shipowners, Masters, Skippers, Officers and Pilots

This note supersedes Marine Guidance Notice 46

Summary

Key Points

- Reliance on radar and VHF can lead to accidents, as over dependence on navigational aids is no substitute for good watchkeeping practices and the exercise of proper caution.

1. The Maritime and Coastguard Agency (MCA) is concerned that a number of casualties to ships have resulted from serious disregard for the basic principals of good seamanship and prudent navigation in bad visibility. Sensible use of radar and other aids to navigation greatly assists the conduct of ships in fog, but these aids have not reduced the need to comply fully with the Collision Regulations: to proceed at a safe speed, pay especial attention to good watch-keeping, and navigate with proper caution.

2. The following brief outline of three casualties shows how lack of sensible caution, combined with over-reliance on radar (and in one case VHF) leads to accidents.

3. A medium-sized cargo ship left port intending to proceed to sea, in fog so dense that the forecastle could not be seen from the bridge, a distance of 100 metres. To reach the sea it was necessary to navigate a river though a channel with depths at low water of about 1.8 metres; the vessel's draught was 8 metres and she sailed on a falling tide. The channel is in places narrow and several bends have to be negotiated. The tide runs at up to 4 knots, falls at a rate of as much as 0.5 metres in 10 minutes, and in places sets across the channel. Great care is therefore necessary at all times, and to attempt the passage on a falling tide in dense fog was very foolhardy, even with the aid of radar. Not surprisingly the ship stranded.

4. A large container ship was in transit through the Dover Strait Traffic Separation Scheme, and despite very thick fog she was steaming at about 18 knots. The bridge was manned by the Master, Officer of the Watch and a look-out. Both radar's (one of which was an ARPA) were being used, but although they were found to be in good working order, when inspected after the casualty it is apparent that not all possible echoes were being displayed, perhaps due to the masking effect of clutter: there was a force 5 breeze and a considerable sea running. When radar clutter is experienced even a careful search by both automatic and manual clutter controls may not reveal the presence of small craft, and this fact should have been recognised by those on watch. Nevertheless, and despite a close-quarter encounter with a fishing vessel in which the ship had to take last minute avoiding action to avert collision, she continued at 18 knots and, later, collided with a trawler which was not seen on either radar. The trawler was stopped and hauling her nets at the time; she was severely damaged though she was able to make port. As well as demonstrating the folly of high speed in fog, this accident emphasises the need for

fisherman while working, to maintain prudent navigation and watchkeeping.

5. In the third case two vessels, one British and one foreign, were approaching one another in fog, and the latter used VHF radio to call for a "red-to-red" passing. Unfortunately the command of English of the Officer on watch in the foreign ship was limited, for what he actually intended was to pass starboard to starboard. The call was acknowledged by the British ship, but neither vessel made use of phrases in the Standard Vocabulary or paid regard to the danger in the use of VHF in collision avoidance. (See MGN 167 (M+F) Dangers in the use of VHF Radio in Collision Avoidance). Despite this, collision might still have been avoided had the British ship made a full assessment of the situation with the help of her radar and slowed down, especially since the other ship had reduced her speed to 'dead slow' but she did neither and collision followed. Both ships were seriously damaged.

6. None of the casualties described led to loss of life, but clearly this was only due to good fortune. In all cases those responsible for the ship's navigation sacrificed seamen for expediency. They failed to recognise the limitations of aids to navigation; or to follow the requirements of the Collision Regulations and the advice of Marine Notices. It is worth stressing that the ships involved were all well-equipped vessels in the charge of men with sound qualifications; it was not skill or experience that was lacking, but the proper seaman like approach to the situation. Whatever the pressure on Masters to make a quick passage or to meet the wishes of owners, operators, charters or port operators, it does not justify ships and those on board them being put unnecessarily at risk. The MCA is concerned that proper standards must be maintained, and will take appropriate action which may lead to the loss of their certificates, against officers who in future jeopardise their ships, or the lives and property of others.

7. The MCA also wishes to stress the responsibilities of Owners. It has long been established, and Section 100 of the Merchant Shipping Act 1995 and the ISM Code now expressly provide, that it is the duty of the Company to take all responsible steps to secure that the ship is operated in a safe manner. The Company must have established and implemented an effective safety management system which includes procedures to ensure safe operation of ships, as well as reporting accidents and non-conformities. In the well-known case of THE LADY GWENDOLEN, the Court of Appeal said that "excessive speed in fog is a grave breach of duty, and ship owners should use their influence to prevent it". Because of their failure to do so, it was held in that case that the owners could not limit their liability.

Furthermore under the Merchant Shipping (Distress Signals and Prevention of Collisions) Regulations 1996, where any of the Regulations is contravened, the owner, the operator, the master and any person for the time being responsible for the conduct of the vessel shall each be guilty of an offence.

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ANNEX 2

Ship Operating Manual *Northern Merchant* (extract)

PART FOUR - THE SHIP AT SEA

Attention is drawn to the Masters and Chief Engineers Standing Orders, the ICS Publication Bridge Procedures Guide'and to the relevant sections of the Ship Operating Manual.

i) BRIDGE WATCH KEEPING ARRANGEMENTS

The Master as the principal navigator onboard will maintain overall supervision of navigation. It is considered essential the Master maintains his navigational expertise by participating in all aspects of routine navigation as far as the prevailing circumstances permit.

The Master will delegate to his Officers both routine navigational duties and extra duties as the circumstances dictate.

When entering and leaving port two (2) certificated Deck Officers MUST be on the navigating bridge at all times, (of which one will be the Master).

ii) ENGINE ROOM WATCH KEEPING ARRANGEMENTS

The Chief Engineer is responsible to the Master and accountable to the Company for the administration of the Engineering Department.

A certificated Engineer Officer MUST be in the engine room or control room at all times when operating as a passenger vessel.

When entering and leaving port two (2) certificated Engineer Officers MUST be in the engine room or control room at all times. (of which one may be the Chief Engineer.)

iii) SPECIAL REQUIREMENTS IN BAD WEATHER AND FOG

Weather Forecasts, Charts and Reports

The Master must ensure he is frequently informed of changing weather patterns by the reception of weather forecasts and prognosis / analysis weather charts.

In heavy weather the Master must monitor the vessels speed and consider reducing speed commensurate with ship and passenger safety and comfort.

Prevention of Collision

We would bring to the Masters attention the need and requirement for Deck Officers to review the Rules for Preventing Collision at Sea 1972 in their entirety but with specific reference to the following:

Rule 2	-	Responsibility
Rule 6	-	Safe speed
Rule 19	-	Conduct of vessels in restricted visibility

We would stress that it is the bridge watchkeepers prime duty to ensure that these rules are complied with at all times on the vessel and that proper application of these Rules will take precedence over the commercial pressures or requirements of the vessel.

Fog and Restricted Visibility

Prior to entering fog or areas of reduced visibility the main engines must be slowed and precautions carried out as per the ICS Bridge Procedures Guide' and the Masters' standing orders.

iv) **RADIO COMMUNICATION, INCLUDING USE OF VHF**

The vessel is fitted with G.M.D.S.S. equipment.

This equipment is required to be switched on at all times and set up for reception of messages and for transmission of emergency signals.

A listening watch is to be maintained on Channel 16.

The use of the VHF for collision avoidance is not recommended unless there is positive identification of the other vessel.

v) **SECURITY PATROLS, FIRE PATROLS AND OTHER ARRANGEMENTS FOR SURVEILLANCE**

Security and Fire Patrols

Fire and security patrols must be carried out in accommodation, public spaces and vehicle decks on a regular basis. This may be in the form of a patrolman, closed circuit television cameras or a combination of both. A patrolman must make regular reports to the Safety Officer or watch Officer and if a clock system is used on patrol this should be checked by the Master.

ANNEX 3

Route Operating Manual *Diamant* (extract)

3.6.2 **Bridge Visits**

Bridge visits may be allowed at the discretion of the Captain and should be limited to a maximum of six persons at any one time. They should only take place in non pilotage waters and good weather conditions when the bridge is fully manned by a full watch of three officers. One officer should act as guide. Children must be accompanied by an adult.

When within pilotage waters or in poor visibility no passenger visitors or ships' crew except the operational crew, are allowed on the bridge. Professional personnel, i.e. MCA Inspectors, Surveyors etc. are permitted at the Captain's discretion, such visitors should not be allowed to distract the bridge crew and should remain on the opposite bridge wing to the one in use.

A system indicating that the Bridge is closed to visitors should be employed on each vessel. This can be by the display of a red light or sign at the door to the wheelhouse.

3.6.3 **Pilotage**

Pilotage waters are defined as areas of high traffic density approaching, departing and within port areas. Areas designated as 'pilotage' are contained in the Annex to the Manual.

While in pilotage waters all three officers should be on the bridge and manning their respective positions, i.e. Chief Engineer seated at the engine monitoring display and the Captain and First Officer at the Main Control and Radar position.

There should be no ambiguity between the Captain and First Officer as to which duties each will perform.

Whilst in pilotage waters no work should be undertaken on any system essential for the propulsion or navigation of the craft, which may interfere with the propulsion or navigation of the craft. Urgent remedial work on engines or control systems must be authorised by the Captain.

The cellphone telephones should be switched off and only used when other equipment fails or in emergencies

3.6.4 **Navigation - Planning and Execution**

Before commencing any voyage, a voyage plan will be decided upon by the Captain assisted by the First Officer. In drawing up the plan, due consideration will be given to the prevailing and forecast weather conditions and sea states, cargo stowage, passenger comfort and the mechanical status of the craft. When a craft is navigating a short sea route voyage, pre-worked plans are contained in the Annex.

Where appropriate the First Officer will advise the Captain of the courses to steer to comply with the current voyage plan. Alterations of course should be given clearly, in recognised notation and repeated by the Captain before being acted upon. The reason for alterations should be made clear at the same time, i.e. "Come to Starboard to two four zero for traffic" or "Come to Port to zero four five for track" etc. Frequently the reasons will be obvious, and perhaps previously agreed, but nevertheless, both the Captain and the Navigator must ensure that they understand each other and are taking the correct action at the time.

Commercial considerations must not take precedence over good seamanship. In poor visibility or if there is any doubt about the craft's position, or in the presence of other traffic/obstacles, speed should be reduced to that which is considered safe in the circumstances.

3.7.5 Collision Avoidance

The high speed of the craft makes it particularly important for collision avoidance alterations to be made early and positively, so that other vessels are aware, both visually and on radar, that effective action has been taken. Alterations should therefore be large enough to easily be detected, and made early enough to give adequate distance at the closest point of approach. In open waters the closest point of approach should be 1 mile ahead or 5 cables abeam or astern of the other vessel.

Care should be taken in the use of VHF for collision avoidance, especially at night or in poor visibility or when the identity of the other vessel cannot be guaranteed.

The International Regulations for Preventing Collision at Sea must be strictly complied with at all times.

Radars must be monitored continuously and checked frequently one against the other by visual means. The data read from the ARPA radar should be treated with caution and not implicitly relied upon.

3.7.6 Wake Wash Effect

Each and every vessel making way produces wash. Recent research has measured waves from traditional ferries of similar heights and higher than those produced from HSC. The difference is not the height but in the wave period. Wake wash from HSC has, in recent years, been highlighted as a problem. Research is ongoing to fully understand the difference between the wash effect from HSC. It is this difference that has switched the focus to HSC, the problem of wake wash has always existed.

MAIB Passenger Questionaire

Marine Accident Investigation Branch

Marine Accident - Passenger Questionnaire

- The Marine Accident Investigation Branch (MAIB), based in Southampton, is responsible for investigating any marine accident in the United Kingdom. The aim is to make travelling by sea safer by thorough investigation, gathering information from crew and passengers. Following the accident in which you have recently been involved could you please provide as much of the following information as possible?

Personal Details

Full name: ....

Address:. ....

....

....

Telephone: .... (Home) .... (Work/other)

Occupation: ....

Age: .... Gender: Male / Female

General Details

How many people were travelling with you ....

What were their names and relationship ....

....

What was your Port of Embarkation ....

Where were you when the accident occurred ....

(cabin/seat number or general area) ....

Foot passenger / bus / lorry / car ....

Description of Event

How and when did you realise something was wrong? ....

....

....

Please give a brief account of what you saw and heard: ....

....

....

Were you kept informed about what was happening? ....

....

Leaving the vessel

Did you hear any announcements made by the crew? YES / NO

Were they clear? YES / NO Were you able to follow the instructions? YES / NO

Were any of the following illuminated: Cabin lights / Emergency exit lights

Please indicate how you left the vessel: ....

....

Please describe any difficulties encountered.. ....

....

Injuries

Please briefly describe any injuries you suffered and how sustained ....

....

....

Were you hospitalised or incapacitated for more than 3 days? YES/NO

Fire

Please describe any fire or smoke ....

....

....

General comments

Is there anything else you feel would help in our investigation? ....

....

....

....

....

....

Thank you for helping with our investigation. Please give this questionnaire to the Police, an MAIB investigator, Coastguard or RNLI crewman or post to the following address:

Marine Accident Investigation Branch, First Floor, Carlton House, Carlton Place, Southampton, SO15 2DZ

If you have any questions, or any point you wish to discuss, please write to us at the above address or contact us by telephone/fax/email on: **Telephone (023) 8039 5500 Fax (023) 8023 2459 Email maib@dtlr.gov.uk**

DTLR
TRANSPORT
LOCAL GOVERNMENT
REGIONS

Thank You for your assistance.

ANNEX 5

Simulation - Manoeuvring Data

SEACAT SIMULATION

MANOEUVRING DATA – TURNING CIRCLES

Preparatory simulated sea trials of the Incat81 – Lynx 3 - have been carried out in the Multi Purpose Simulator at Warsash Maritime Centre.

The hydrodynamic data supplied for the ship modelling, in particular actual sea trial data, is very limited: nevertheless the test results would appear to represent the characteristics of turning manoeuvres in a realistic manner, although the precise distances measured may vary from the actual vessel's results at sea.

The turning data was recorded under three different turning actions:

1 Helm port 30
2 Helm port 30, Stop port engine
3 Helm port 30, Full astern port engine.

At the start of each manoeuvre the entry speed was 29 kts, and the vessel was turning slowly to port at 7° per minute.

Three sheets are attached:

Sheet 1	Plot from start to 82 secs
Sheet 2	Plot from start to 90° change of heading
Sheet 3	Plot from start to 60° change of heading

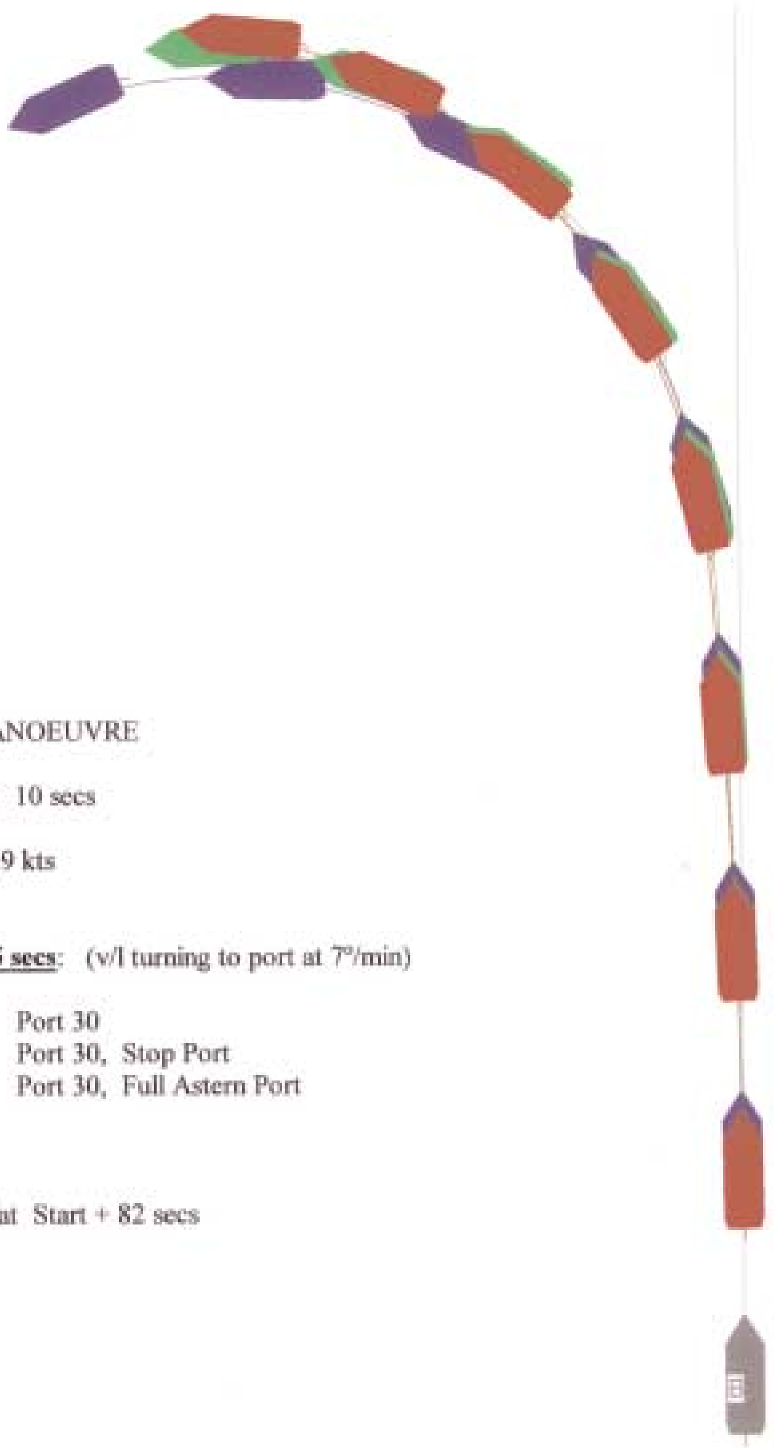
A further sheet 4 shows the plot for a crash stop, a) with helm port 30° and b) with helm starboard 30°, and compared with the turning circle achieved by 30° rudder only.

Two tables record the advance and transfer (metres):
Table 1 against time; Table 2 against change of heading.

Note:
These results are an indication only: greater reliability may be achieved after further modelling development.

30 July 2002

Exercise: \sys\Exercises\Channel.tsk [CHANNEL] 27/03/1999 18:00:00, Printed: Wednesday, July 24, 2002 12:10:39 PM



SEACAT MANOEUVRE

Plot intervals 10 secs

Entry speed 29 kts

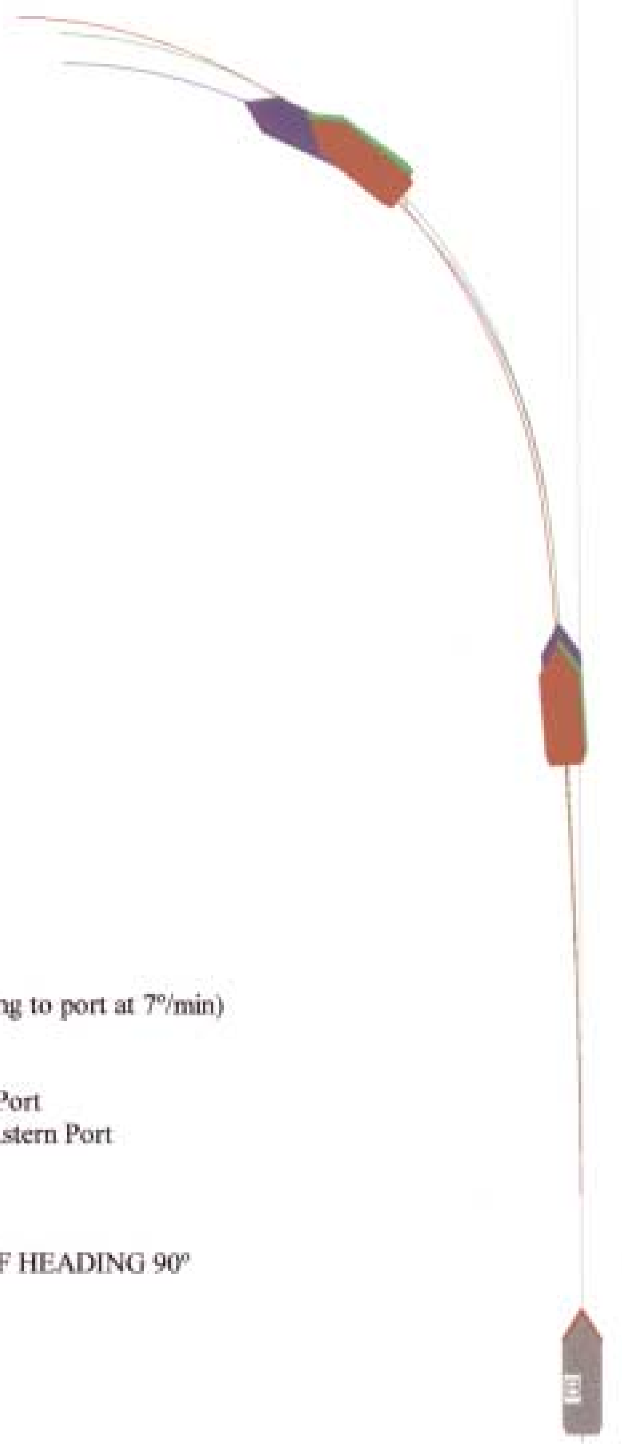
<u>At Start + 35 secs</u>: (v/l turning to port at 7°/min)

Blue:	Port 30
Green:	Port 30, Stop Port
Red:	Port 30, Full Astern Port

Plot stopped at Start + 82 secs

SHEET 1

Exercise: \sys\Exercises\Channel.tsk [CHANNEL] 27/03/1999 18:00:00, Printed: Wednesday, July 24, 2002 12:10:39 PM



SEACAT MANOEUVRE

Plot intervals 30 secs

Entry speed 29 kts

<u>At Start + 35 secs</u>: (v/l turning to port at 7°/min)

Blue:	Port 30
Green:	Port 30, Stop Port
Red:	Port 30, Full Astern Port

Plot stopped AT CHANGE OF HEADING 90°

SHEET 2.

Exercise: \sys\Exercises\Channel.tsk [CHANNEL] 27/03/1999 18:00:00, Printed: Wednesday, July 24, 2002 12:10:39 PM

SEACAT MANOEUVRE

Plot intervals 35 secs

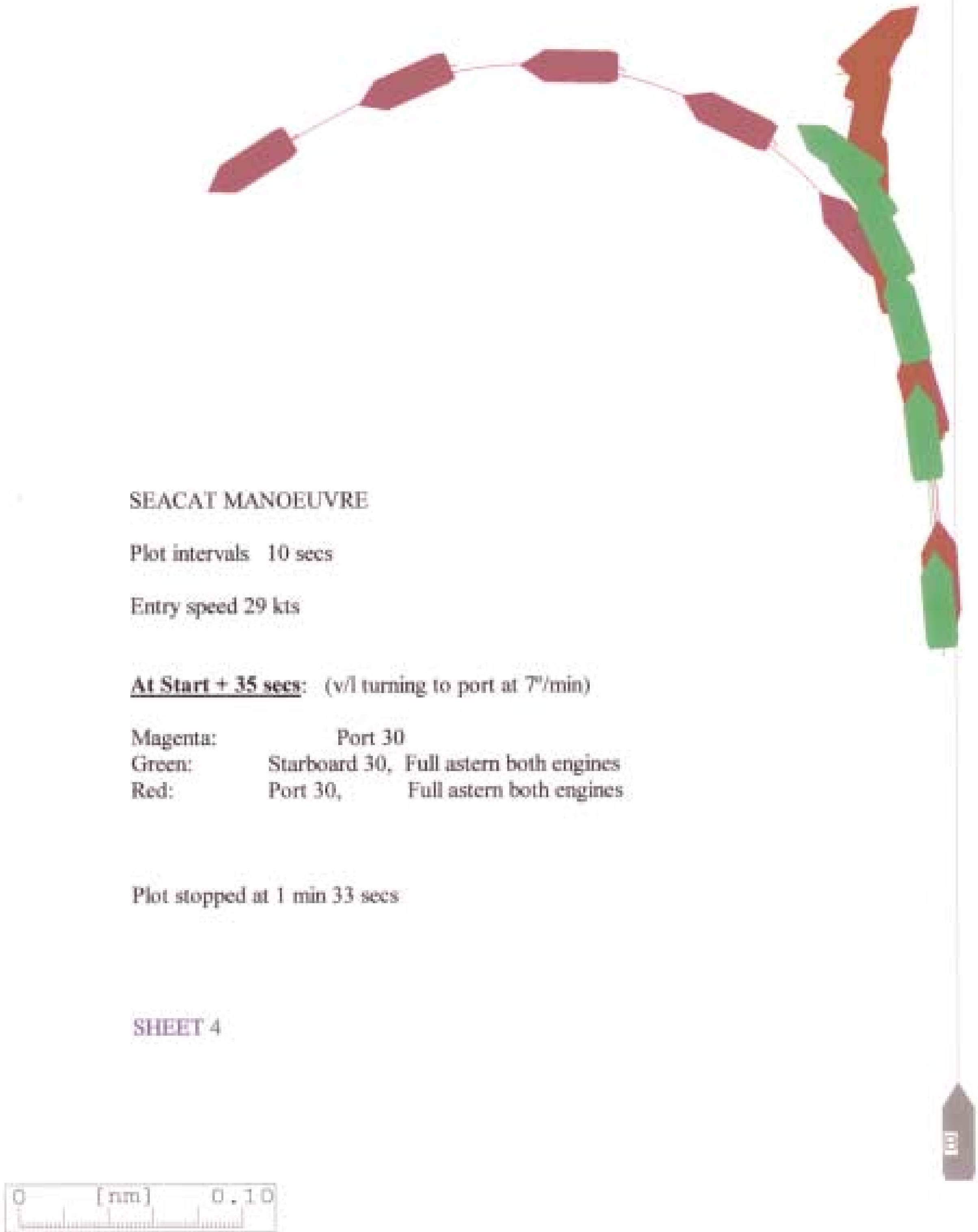
Entry speed 29 kts

<u>At Start + 35 secs</u>: (v/l turning to port at 7°/min)

Blue:	Port 30
Green:	Port 30, Stop Port
Red:	Port 30, Full Astern Port

Plot stopped AT CHANGE OF HEADING 60°

SHEET 3



SEACAT MANOEUVRE

Plot intervals 10 secs

Entry speed 29 kts

<u>At Start + 35 secs</u>: (v/l turning to port at 7°/min)

Magenta: Port 30
Green: Starboard 30, Full astern both engines
Red: Port 30, Full astern both engines

Plot stopped at 1 min 33 secs

SHEET 4

	Tests 1, 4				Tests 2, 5				Tests 3, 6			
	PORT 30 @ 00 secs				PORT 30 @ 00 secs STOP P 05 secs				PORT 30 @ 00 secs STOP Port 05 secs Full Ast Port 11 secs			
Time (secs)	Change of HDG	SP	ADV	TR	Change of HDG	SP	ADV	TR	Change of HDG	SP	ADV	TR
00	-	29.8	-	-	-	29.7	-	-	-	29.8	-	-
25	55	26.7	310	149	43	23.0	301	112	45	21.7	290	128
32	71	26.7	360	172	56	22.8	353	172	55	20.9	346	180
38	85	26.5	369	315	67	22.4	384	231	70	20.4	364	245
48					86	22.0	410	336	85	19.9	398	337

Change of Hdg	Time (Secs)	Speed	Advance	Transfer	Time (Secs)	Speed	Advance	Transfer	Time (Secs)	Speed	Advance	Transfer
0	00	29.8	-	-	00	29..7	—	-	00	29.8	-	-
55	25	26.7	310	149	31	22.8	340	185	32	20.9	346	180
85	38	26.5	369	315	47	22.0	362	378	48	19.9	398	337

ANNEX 2

V Ships - Fleet Memo

CIRCULAR LETTER NO.	: CL/GLW/SAF/2002-01
SECTION	: SAFETY
ISSUE DATE	: 9TH JANUARY 2002

TO : ALL MASTERS AND NAVIGATING OFFICERS

SUBJECT : COLLISION IN DOVER STRAITS

A collision incident has occurred between a managed Ro-Pax vessel and a High Speed Passenger craft in UK waters. Fortunately the collision was minor and there were no injuries to passengers or crew of either vessel. The potential however for catastrophe was immense. The initial Coastguard casualty report on the incident stated:

Quote

At 09:53 a.m. this morning Dover Coastguard was alerted to a minor collision between two ferries just off the UK coastline.

The Dover to Dunkirk freight and passenger carrying ferry Northern Merchant with 59 passengers and 43 crew members, was in collision with the Hoverspeed Sea Cat Diamant which was on its way from Oostende to Dover. The Sea Cat had a total of 148 people on board. The incident, which caused minor damage with no reported injuries, occurred in dense fog 3 miles south east of Dover harbour. Visibility was estimated at 200 - 300 yards. After initial assessment the two vessels proceeded onto their ports of destination for further inspection.

Unquote

The UK Marine Accident Investigation Branch (MAIB) is investigating this incident and enquiries are ongoing. We have been advised that the MCA are considering whether to bring criminal proceedings against the Masters concerned. Until the investigation has completed the cause and fault of the incident cannot be determined or commented on.

We note however that the collision occurred in dense fog and would remind you of the importance of proceeding at a safe speed at all times. (Rule 6 – regulations for prevention of collision at sea). In this instance Rules 7, 8 and 19 also need to be considered.

The company procedures clearly emphasise the need to proceed at a safe speed at all times.

Regarding this incident, at present there is no indication that the Master did not follow procedures however we consider it is prudent to remind Masters and Navigating Officers of the importance of fully complying with Company Policy with respect to compliance with the regulations for prevention of collision at sea as clearly laid down in the Safety Management System. They must, repeat must be followed or else disciplinary action will be taken.

You are therefore required, to hold a meeting with your Navigating Officers to review this incident and to ensure that all bridge watch-keepers are fully aware of their onerous responsibilities when in charge of the vessel's safe navigation. This meeting should consider all areas but must include discussion on the following areas:

1. Navigation in restricted visibility
2. Controlling the Speed and direction of the ship
3. Collision avoidance and use of VHF radio
4. Collision avoidance and radar

You should also refer to the International Chamber of Shipping Bridge Procedures Guide (BPG) and the Nautical Institute guides "Bridge Watchkeeping" and "Bridge Team Management" for further guidance.

Please confirm to your vessel DPA:

1. Receipt and understanding of this letter.
2. That the required meeting has been held with all bridge watch-keepers.
3. That all watch-keepers have confirmed that they are fully aware of their watch-keeping responsibilities however with particular reference to the items raised in this letter.

Nigel Adams
Divisional Director – Risk, Safety & Quality
V.Ships Ship Management Division.