

Report on the investigation of
contacts made by the
high speed craft

Norman Arrow

with quays in Portsmouth International Port,

Portsmouth, UK, 31 March 2010

and

with a mooring dolphin in Le Havre, France

29 August 2010

Marine Accident Investigation Branch
Mountbatten House
Grosvenor Square
Southampton
United Kingdom
SO15 2JU

Report No 7/2011
May 2011

Extract from
The United Kingdom Merchant Shipping
(Accident Reporting and Investigation)
Regulations 2005 – Regulation 5:

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

NOTE

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

© Crown copyright, 2011

You may re-use this document/publication (not including departmental or agency logos) free of charge in any format or medium. You must re-use it accurately and not in a misleading context. The material must be acknowledged as Crown copyright and you must give the title of the source publication. Where we have identified any third party copyright material you will need to obtain permission from the copyright holders concerned.

Front cover image courtesy of LD Lines

All reports can be found on our website:

www.maib.gov.uk

For all enquiries:

Email: maib@dfi.gsi.gov.uk

Tel: 023 8039 5500

Fax: 023 8023 2459

CONTENTS

Page

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

SYNOPSIS 1

SECTION 1- FACTUAL INFORMATION AND ACCIDENT IN PORTSMOUTH 2

1.1	Particulars of <i>Norman Arrow</i> and accidents	2
1.2	Narrative – Accident in Portsmouth	4
1.3	Damage	9
1.3.1	<i>Norman Arrow</i>	9
1.3.2	Berth 3	10
1.4	Electronic evidence	11
1.5	<i>Norman Arrow</i>	11
1.5.1	Construction and sea trials	11
1.5.2	Bridge layout	11
1.5.3	Propulsion controls	17
1.6	Operation, management, and training	19
1.6.1	Operation	19
1.6.2	Management	20
1.6.3	Training	20
1.7	Deck officers	21
1.7.1	The master	21
1.7.2	The chief officer	21
1.8	HSC Code	21
1.9	MCA Guidance	23
1.10	Portsmouth International Port	23
1.10.1	Organisation	23
1.10.2	Trials and risk assessment	23
1.10.3	Pilotage	24
1.10.4	Notices to Mariners	24
1.11	Previous accidents	24
1.11.1	<i>Norman Arrow</i>	24
1.11.2	HSC HD1	24
1.12	Post-accident actions	25
1.12.1	The Marine Accident Investigation Branch	25
1.12.2	The MCA	25
1.12.3	LD Transmanche Ferries and Portsmouth International Port	25

SECTION 2 – ACCIDENT IN LE HAVRE 26

2.1	Narrative	26
2.1.1	Departure from Portsmouth	26
2.1.2	Arrival in Le Havre	26
2.1.3	The contact	28
2.1.4	Post-contact	28

2.2	The damage	29
2.3	Wind	31
2.4	Le Havre Port	31

SECTION 3 - ANALYSIS **32**

3.1	Aim	32
3.2	Manoeuvrability	32
3.3	Visibility	32
3.4	Ergonomics	33
3.5	Team organisation and management	33
3.6	Operational limitations	34
	3.6.1 Assessment	34
	3.6.2 Use of tugs	35
3.7	Assessment of compliance	36

SECTION 4 - CONCLUSIONS **37**

4.1	Safety issues identified during the investigation which have not resulted in recommendations but have been addressed	37
-----	--	----

SECTION 5 - ACTIONS TAKEN **39**

5.1	Actions taken following the accident on 29 August 2010	39
	5.1.1 Maritime and Coastguard Agency	39
	5.1.2 LDTF	39

SECTION 6 - RECOMMENDATIONS **41**

FIGURES

Figure 1	Chart Extract of Portsmouth International Port
Figure 2	Manoeuvring station - <i>Norman Arrow</i>
Figure 3	<i>Norman Arrow</i> contact with finger jetty of berth 2
Figure 4	<i>Norman Arrow</i> on finger jetty of berth 2, heading 217°
Figure 5	<i>Norman Arrow</i> manoeuvring back to berth 3
Figure 6	Caisson 1
Figure 7	Damage to <i>Norman Arrow</i>
Figure 8	Caisson 2
Figure 9	Bridge location

- Figure 10** Bridge visibility shadow area at sea surface
- Figure 11** Location of control stations
- Figure 12** CCTV monitors from different height of eye
- Figure 13** CCTV camera locations
- Figure 14** 'Wing baskets' fitted to sister vessels
- Figure 15** Toed-out configuration (Vectoring)
- Figure 16** Toed-in configuration (Azimuth)
- Figure 17** Le Havre port
- Figure 18** *Norman Arrow* - approach to the orange dolphin
- Figure 19** *Norman Arrow* - damage to hull and flooded engine room

ANNEXES

- Annex A** Pilot's passage plan
- Annex B** Table of principal manoeuvres
- Annex C** CCTV stills - Portsmouth International Port
- Annex D** HSC Code – type-rating requirements
- Annex E** PIP berthing trials extract
- Annex F** Portsmouth International Port – Risk Assessments
- Annex G** Local Notice to Mariners 63/02
- Annex H** Windage diagram
- Annex I** Master's standing orders

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

AB	-	Able Bodied seaman
Caisson	-	(As used in this report) A free standing structure used for mooring a vessel
CCTV	-	Closed circuit television
CHA	-	Competent harbour authority
CoC	-	Certificate of competency
DHM	-	Deputy Harbour Master
DNV	-	Det Norske Veritas
Dolphin	-	A free standing post used for mooring a vessel
DPA	-	Designated Person Ashore
ECDIS	-	Electronic chart display and information system
gt	-	gross tonnage
HSC	-	High speed craft
ICS	-	International Chamber of Shipping
IMO	-	International Maritime Organization
ISM	-	International Safety Management (system)
Knot	-	measurement of speed; nautical mile an hour
kW	-	kilowatt
LD Lines	-	Louis Dreyfus Lines
LDTF	-	Louis Dreyfus Transmanche Ferries
LNTM	-	Local Notice to Mariners
m	-	metres
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note
MSN	-	Merchant Shipping Notice

PEC	-	pilotage exemption certificate
PIP	-	Portsmouth International Port
PTO	-	Permit to operate
QHM	-	Queen's Harbour Master
t	-	tonnes
VDR	-	Voyage data recorder
VHF	-	Very High Frequency (radio)

Times: All times used in this report are UTC+1hour unless otherwise stated

Image courtesy of LD Lines



Norman Arrow



SYNOPSIS

On 31 March 2010, the UK registered high speed ferry *Norman Arrow* was damaged when she struck fixed fendering in Portsmouth International Port while attempting to move between berths. Five months later, on 29 August, *Norman Arrow* was again damaged when she struck a mooring dolphin as she approached her berth in Le Havre, France. There were no injuries, but after both accidents the vessel had to be taken out of service and repaired in dry dock.

The accidents occurred as a result of an inability to manoeuvre the vessel as intended in the strong winds encountered. Contributing factors included:

- The lack of operational procedures for manoeuvring in port with respect to limiting wind speed and relative direction, and the use of tugs;
- The vessel's design restricted the ability of personnel on the bridge to see objects near to the vessel;
- Poor bridge ergonomics;
- Ineffective bridge team management and use of equipment; and
- The Maritime and Coastguard Agency's difficulty in assessing whether the visibility from *Norman Arrow*'s manoeuvring station met the requirements of the High Speed Craft Code.

Norman Arrow is one of the largest high speed craft in the world, and these two accidents in relatively quick succession underline the potential difficulty of manoeuvring such light-displacement, high-sided craft at slow speed in confined areas and strong winds. The accidents also highlight the need for flag and port states to fully take into account changes in vessel design when determining operating limitations.

After the first accident, recommendations were made to the Maritime and Coastguard Agency, Louis Dreyfus Lines, and Portsmouth International Port, which were aimed at improving the vessel's safe operation, particularly in port. In view of these recommendations, and the actions identified by the Maritime and Coastguard Agency's formal investigation undertaken following *Norman Arrow*'s accident in Le Havre, no further recommendations are made in this report.

SECTION 1- FACTUAL INFORMATION AND ACCIDENT IN PORTSMOUTH

1.1 PARTICULARS OF *NORMAN ARROW* AND ACCIDENTS

Vessel details

Registered owner	:	066 Fast Ferry Leasing Limited
Operator	:	LD Lines
Manager	:	Louis Dreyfus Transmanche Ferries
Port of registry	:	Dover
Flag	:	United Kingdom
Type	:	High Speed Craft
Built	:	2009, Hobart, Tasmania
IMO number	:	9501590
Classification society	:	Det Norske Veritas
Construction	:	Aluminium
Length overall	:	112.6 m
Beam	:	30.5 m
Gross tonnage	:	10503
Lightship tonnage	:	1490.61
Draught	:	2.7 m even keel
Engine power and/or type	:	4 x resiliently mounted MAN 28/33D marine diesel engines, each rated at 9000 kW
Service speed	:	35 knots
Other relevant info	:	4 x Wartsila LJX 1500SR water jets configured for steering and reverse

**Portsmouth
Accident details**

Category : Serious Marine Casualty

Time and date : 1619 on 31 March 2010

Location of accident : Berth 3, Portsmouth International Port

Persons on board : 24 crew and 1 pilot

Damage : Vessel: Starboard prow split, forepeak penetrated and shell plating of starboard number 1 void torn

No 3 berth: Damage to fixed fendering; one fender detached

**Le Havre
Accident details**

Category : Serious Marine Casualty

Time and date : 1126 on 29 August 2010

Location of incident : Bassin de la Manche, Le Havre

Persons on board : 30 crew, 1 pilot and 401 passengers

Damage : Port hull holed, port forward engine room flooded

1.2 NARRATIVE – ACCIDENT IN PORTSMOUTH

On 31 March 2010, the high speed craft (HSC) *Norman Arrow* was secured starboard side to berth 3 in Portsmouth International Port (PIP) (**Figure 1**). The line of the berth was 080°/260°. Due to inclement weather in the English Channel, the vessel had not sailed as scheduled. At 1500, the master was informed by PIP that *Norman Arrow* was required to move to berth 2 as another vessel was due onto berth 3 at 2100. The master opted to move the vessel as soon as possible, and ordered a pilot for 1600.

Reproduced from Admiralty Chart BA 2631 by permission of the Controller of HMSO and the UK Hydrographic Office

Figure 1

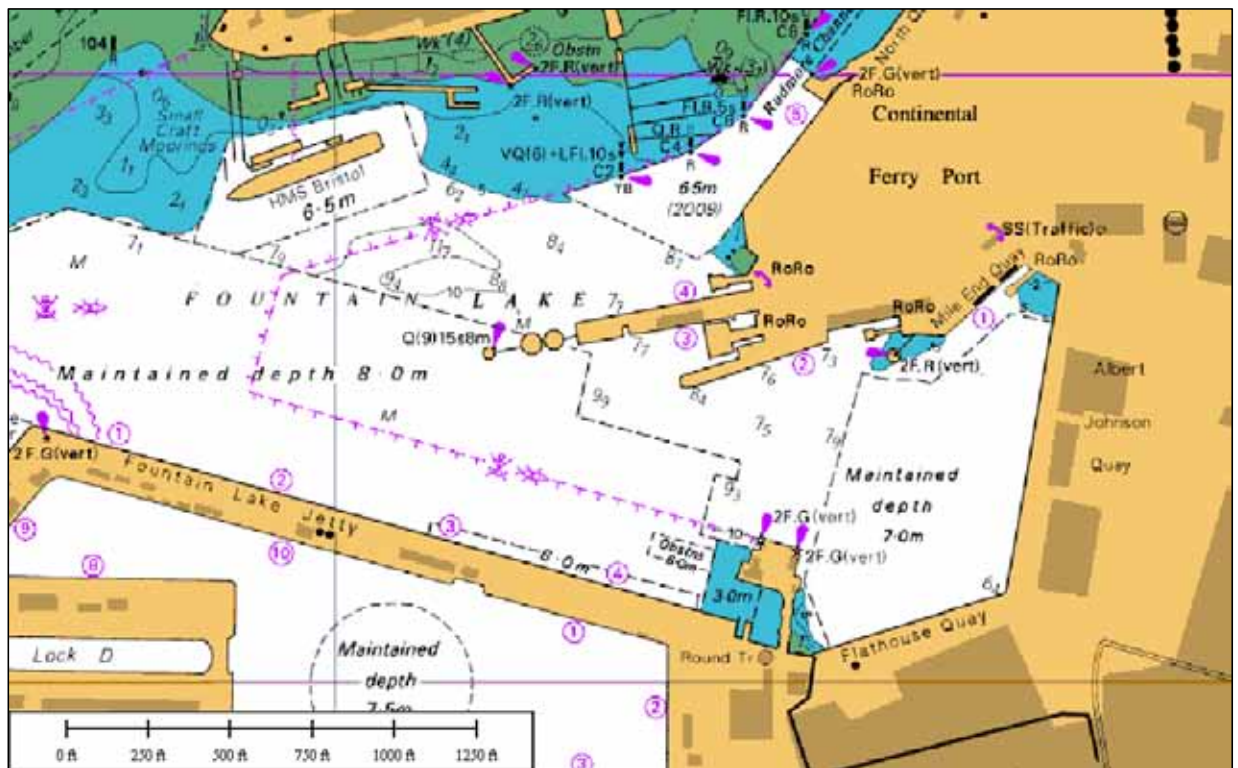


Chart extract of Portsmouth International Port

The pilot, who was the Deputy Harbour Master (DHM), arrived on *Norman Arrow's* bridge at 1545. The bridge team comprised the master, pilot, chief officer and chief engineer; two chief officers undergoing training and the ship's electrician were also present.

A brief conversation between the master and pilot included an assessment of the prevailing wind strength, which had decreased throughout the day; at that time it was from 283°, gusting up to 26 knots. The plan for the move was not discussed in detail, but the master confirmed to the pilot that he did not require a tug to assist in the manoeuvre. The pilot requested a pilot card. However, no card was provided, and the pilot was not briefed on the vessel's manoeuvring characteristics. The pilot had prepared a passage plan for the intended berth shift (**Annex A**) but this was not shown to the master.

For the move, the master stood at the manoeuvring station (**Figure 2**), from where he was able to see the vessel's sides and stern via closed circuit television (CCTV) monitors. The chief officers and pilot stood close to the master, with the pilot standing on the outer edge of the group. The aft lines were let go at 1617, and 1 minute later the master ordered the forward lines to be cast off.

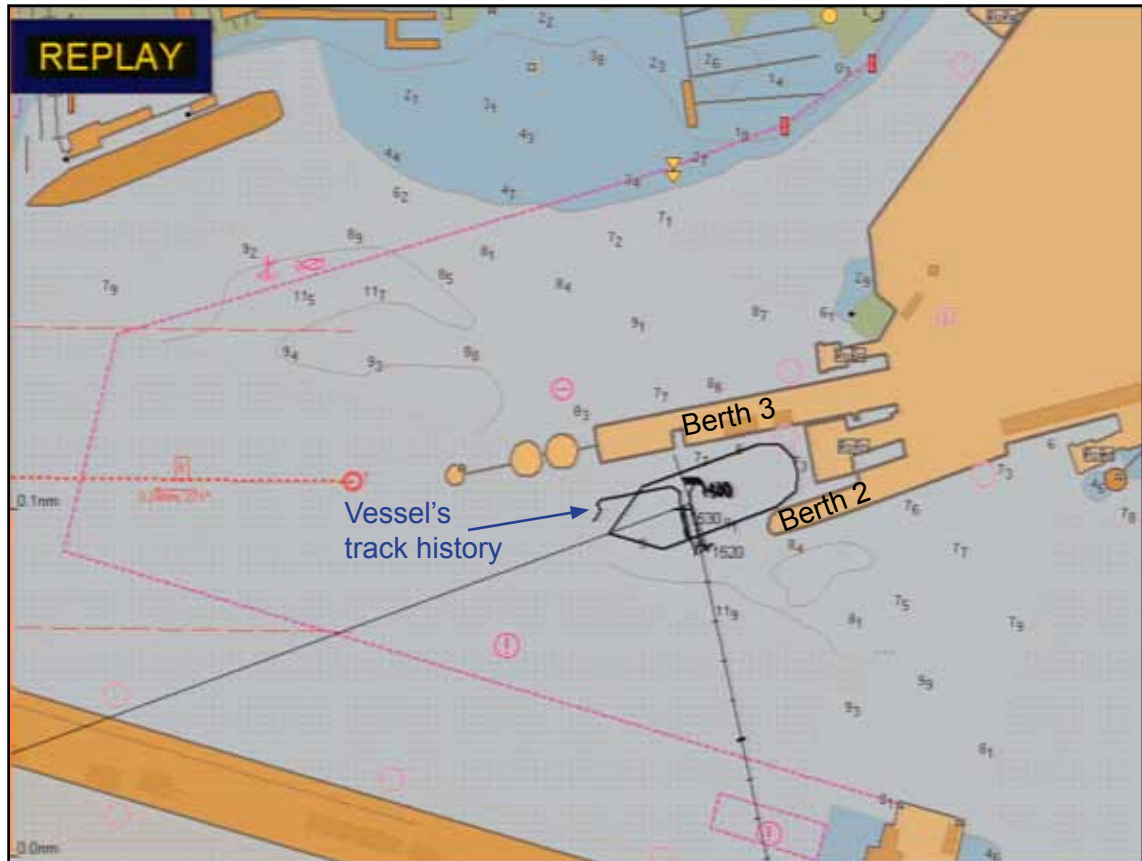
Figure 2



Manoeuvring station - *Norman Arrow*

While the lines were being recovered, the master adjusted the vessel's water jets to try and keep the HSC parallel and close to the berth. The wind had now increased to 31 knots, and started to blow the vessel's bow to the south. Unseen by the bridge team, the forward mooring party had to veer the lines on two occasions before the shore linesmen could free them from the shore bollards.

By this time, *Norman Arrow's* heading had passed 250° and the vessel continued to swing very quickly to port until, at 1619, her port side made contact with the northern side of the western end of the finger jetty of berth 2 (**Figure 3**). *Norman Arrow's* bow continued to swing to port, but the master was able to manoeuvre the vessel to prevent her stern from hitting berth 3.

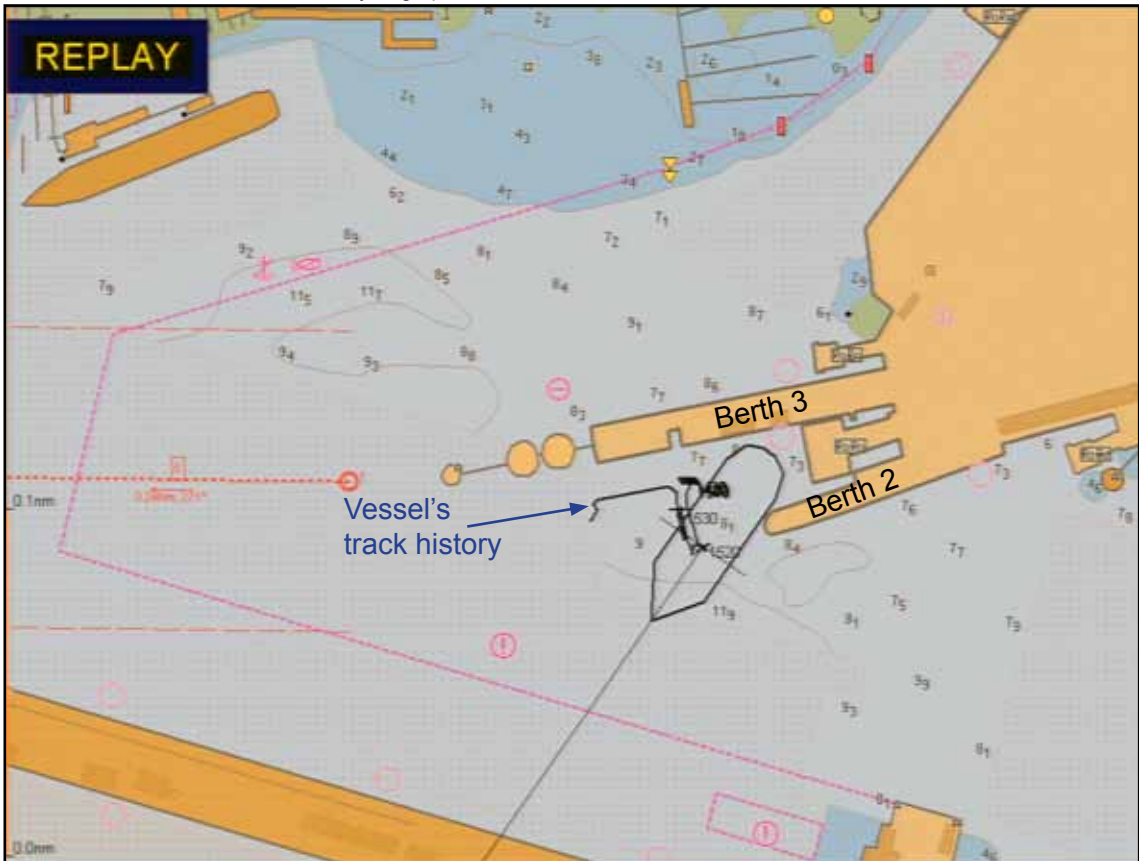


Norman Arrow contact with finger jetty of berth 2

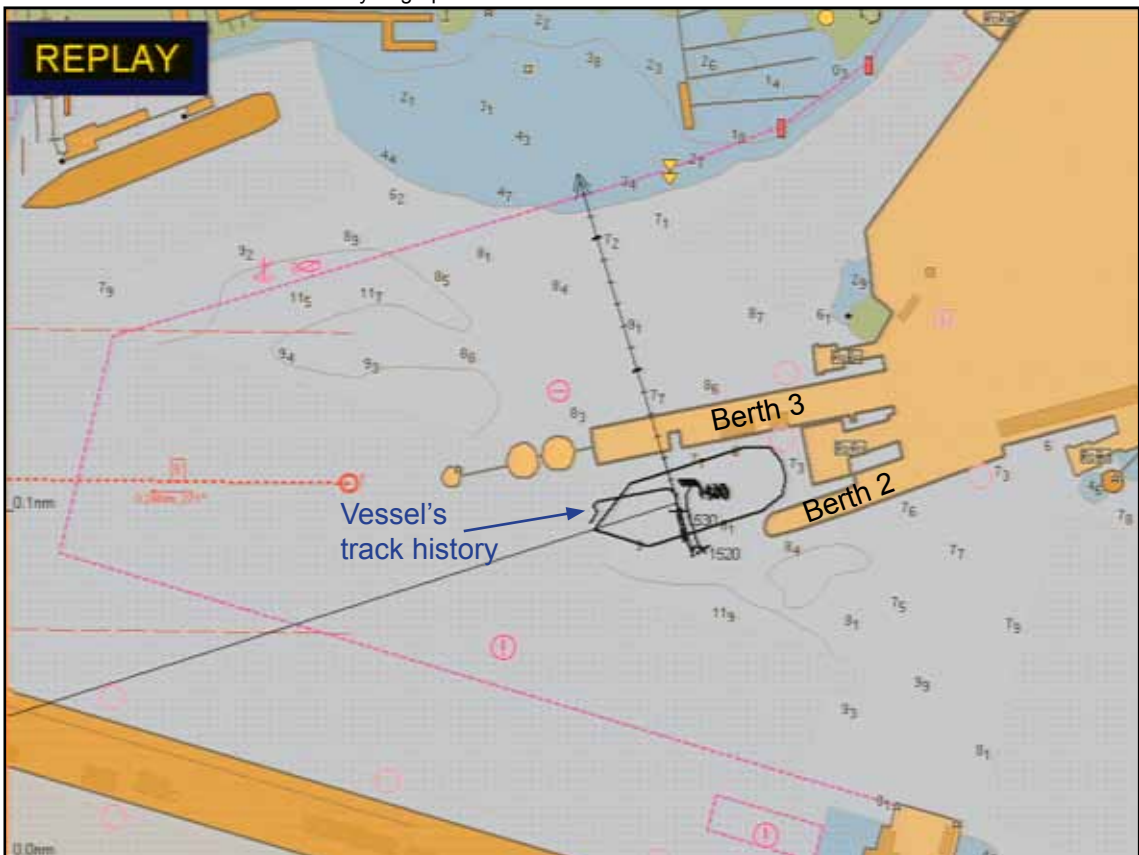
The master immediately asked the pilot for tug assistance. Accordingly, the pilot passed this request to the Queen's Harbour Master (QHM) using very high frequency (VHF) radio and was informed that the duty tug would arrive in 20 minutes. While the master waited for the tug, he attempted to manoeuvre the vessel's bow back towards berth 3, but was unable to do so. *Norman Arrow* remained balanced on the end of the finger jetty, and was now oscillating around a heading of 217° (**Figure 4**). The wind was now 294° at 37 knots.

At 1624, the master requested that the pilot arrange for the tug to assist as soon as possible. The pilot repeated the master's request to QHM and was advised that the tug would assist *Norman Arrow* on completion of the task she was undertaking.

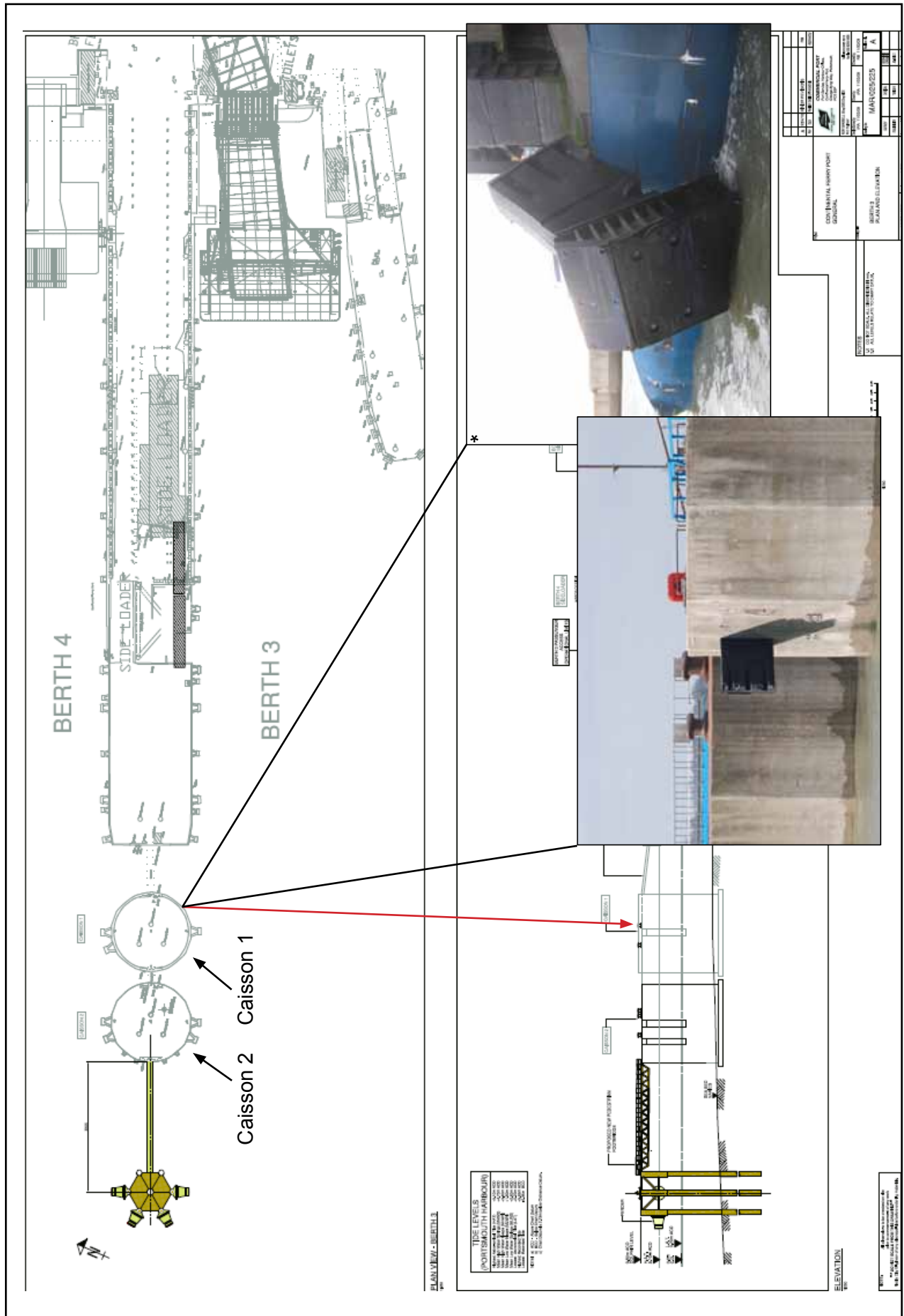
By 1632, the wind had decreased to 20 knots, and the master was able to manoeuvre the vessel off the finger jetty (**Figure 5**). He advised the pilot and chief officer that he intended to manoeuvre *Norman Arrow* into the tidal basin to await the tug. As the vessel moved ahead, her bow came very close to the fenders on caisson 1 and her starboard prow became wedged between the back plate of the first fender and the caisson wall. The fender was detached from the wall and lodged on the starboard prow (**Figure 6**).



Norman Arrow on finger jetty of berth 2, heading 217°



Norman Arrow manoeuvring back to berth 3



Caisson 1

As *Norman Arrow* continued to move ahead, the forward mooring party reported that the starboard prow was approaching fender 1 on caisson 2. Although the master took avoiding action, he was unable to prevent *Norman Arrow* from striking the fender. The master then manoeuvred the vessel into the tidal basin where the duty tug was secured. *Norman Arrow* moored on berth 2 at 1710 without further incident.

1.3 DAMAGE

1.3.1 *Norman Arrow*

Norman Arrow's starboard prow was torn and indented; its tip was set inboard and split open. The shell plating forward of the collision bulkhead was punctured and gouged (**Figure 7**).

Photographs courtesy of PIP and DNV

Figure 7



Damage to *Norman Arrow*

Det Norske Veritas (DNV), *Norman Arrow*'s classification society, gave the vessel permission to sail to Dunkerque, subject to:

- Frame 86 plugs and frame 83 hatch and plug remaining secured in place
- Frame 83 being temporarily shored up
- Monitoring of the damaged areas during the voyage
- A speed limitation of 15 knots.

The vessel arrived in Dunkerque on 2 April 2010, and returned to service at Le Havre 3 days later.

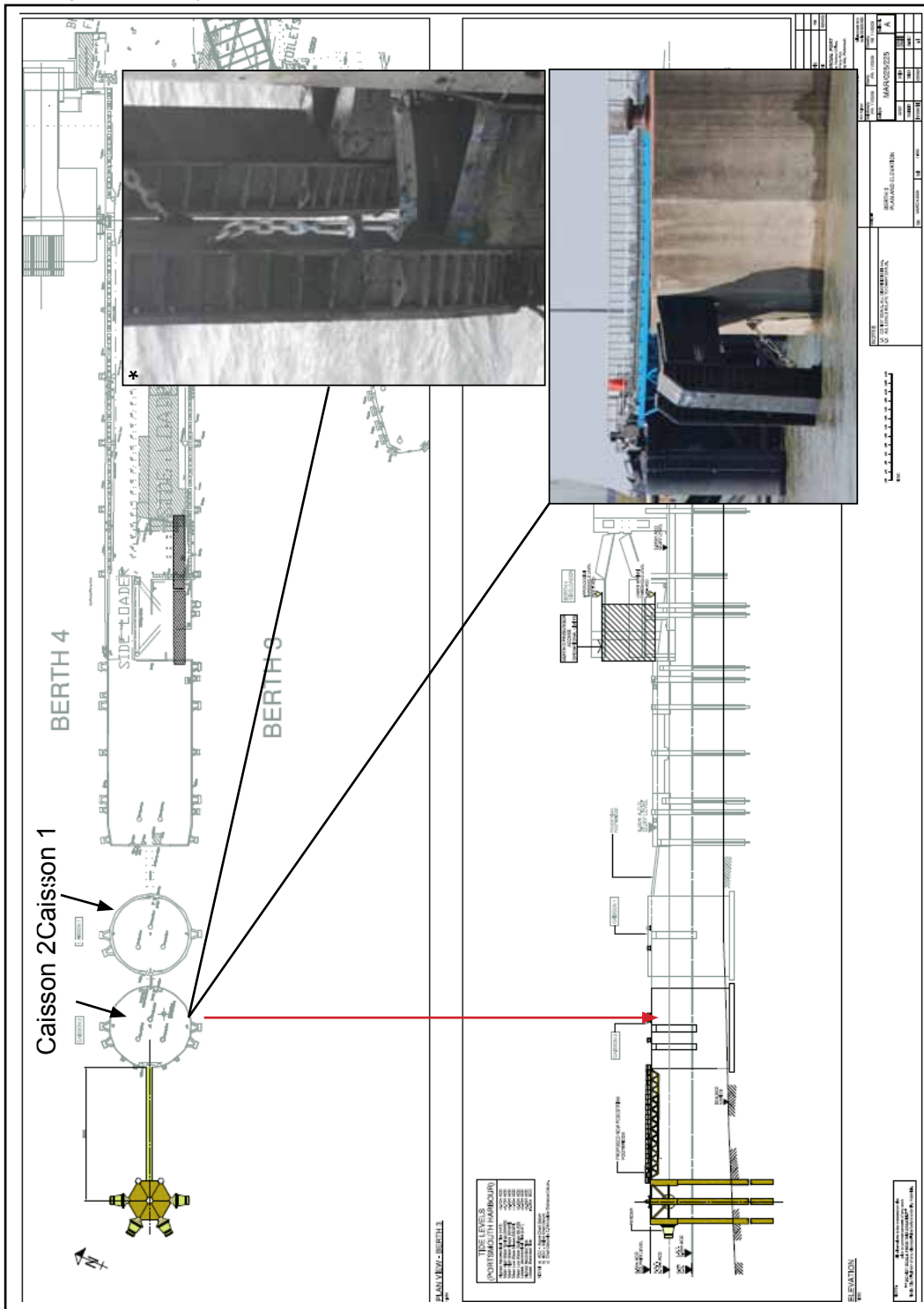
1.3.2 Berth 3

Fender 1 on caisson 1 was totally removed (**Figure 6**), leaving only a support beam attached to the quay.

The base plate of fender 1 on caisson 2 (**Figure 8**) was bent and a support chain was severed. Fender 2 on caisson 2 was slightly displaced from the perpendicular.

*Photograph courtesy of PIP

Figure 8



1.4 ELECTRONIC EVIDENCE

Norman Arrow was fitted with a Kelvin Hughes voyage data recorder (VDR). The data recorded included the water jet angles, bucket and engine settings, relative wind direction and speed, the vessel's rate of turn and heading, and the bridge audio. A table of the key data relevant to the accident that was recorded on the VDR is at **Annex B**. Still photographs from the port's CCTV footage are at **Annex C**.

1.5 NORMAN ARROW

1.5.1 Construction and sea trials

Norman Arrow, an Incat 112 m wave-piercing catamaran, was the third vessel of her class and model built by Incat Tasmania PTY, in Hobart, Tasmania. She was one of the largest passenger/freight catamarans in the world and was capable of speeds in excess of 40 knots.

The vessel was constructed using marine grade aluminium and had a cross-section area of approximately 1500 square metres. She was not fitted with designated tug push points and her mooring bollards were limited to 10t for towage.

Norman Arrow completed her sea trials during March 2009; windage data was not included in the sea trial report. On completion of sea trials and subsequent classification society survey, *Norman Arrow* departed Hobart on 2 May 2009 for passage to the UK.

1.5.2 Bridge layout

Norman Arrow's bridge was located on the centreline above the passenger accommodation (**Figure 9**). The bridge was fully enclosed and, unlike a conventional ferry, did not have bridge wings extending to the vessel's sides. From within the bridge, an all round 360° view was possible, but the view of the sea surface close to the vessel was obscured by her superstructure (**Figure 10**).

Two control stations were used to manoeuvre *Norman Arrow*. The "at sea" station was forward-facing and sited on the centreline of the vessel (**Figure 11**). The "manoeuvring" station was aft-facing and was sited immediately abaft the "at sea" station. *Norman Arrow* was fitted with a CCTV system that allowed personnel at the manoeuvring station to monitor the areas around the vessel's sides and stern, but not the forward prows. The CCTV system had seven cameras (**Figure 12**). It was originally provided with three CCTV monitors, but two additional CCTV monitors were fitted by Louis Dreyfus Armateurs at the request of the vessel's masters. **Figure 13** shows the location of the pan and tilt cameras and their viewing areas; however, it was not possible to view the whole of the indicated arcs at the same time and the vessel's masters had their own preferences for the positioning of the cameras when manoeuvring close to berths.

Figure 9

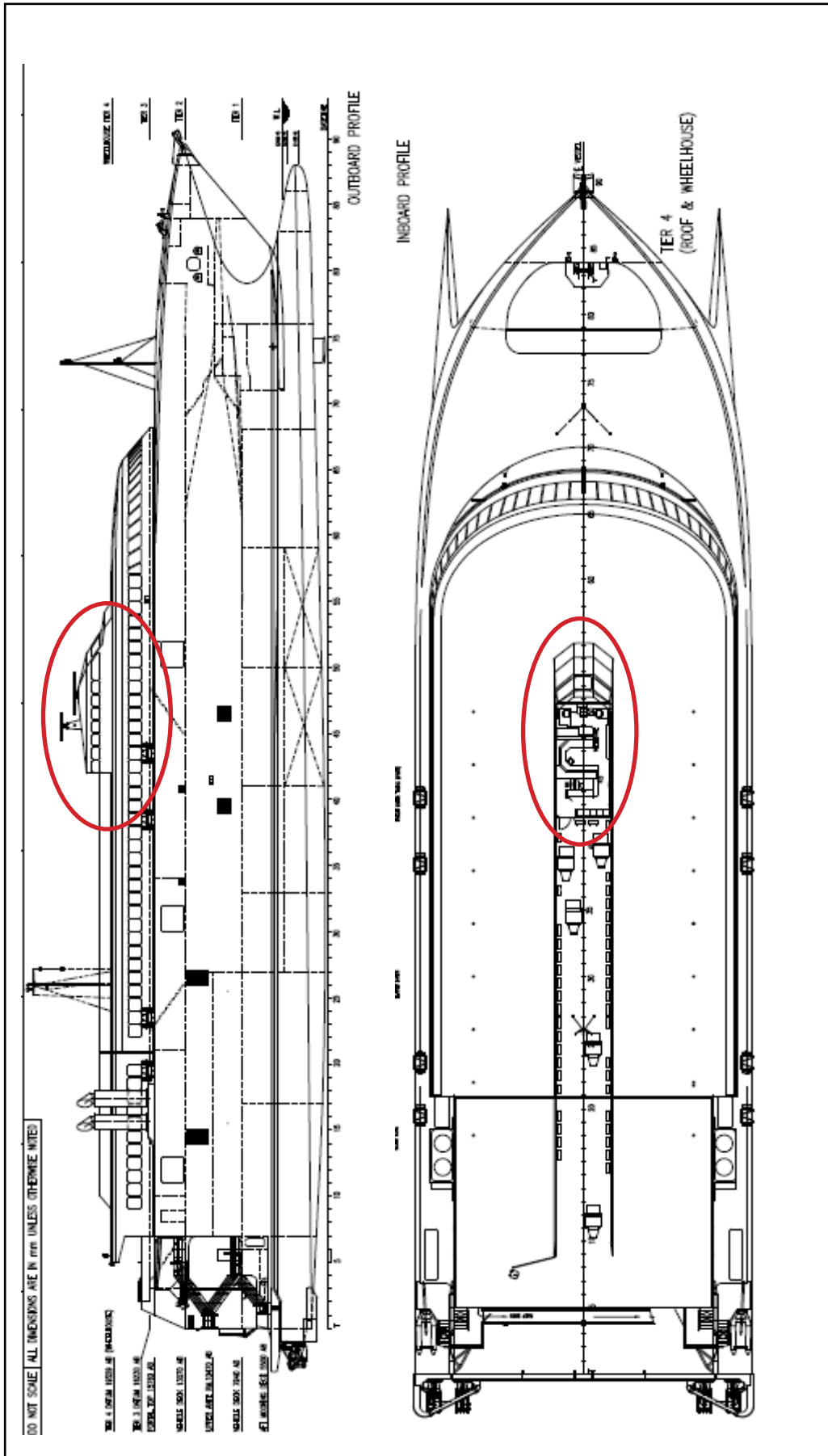
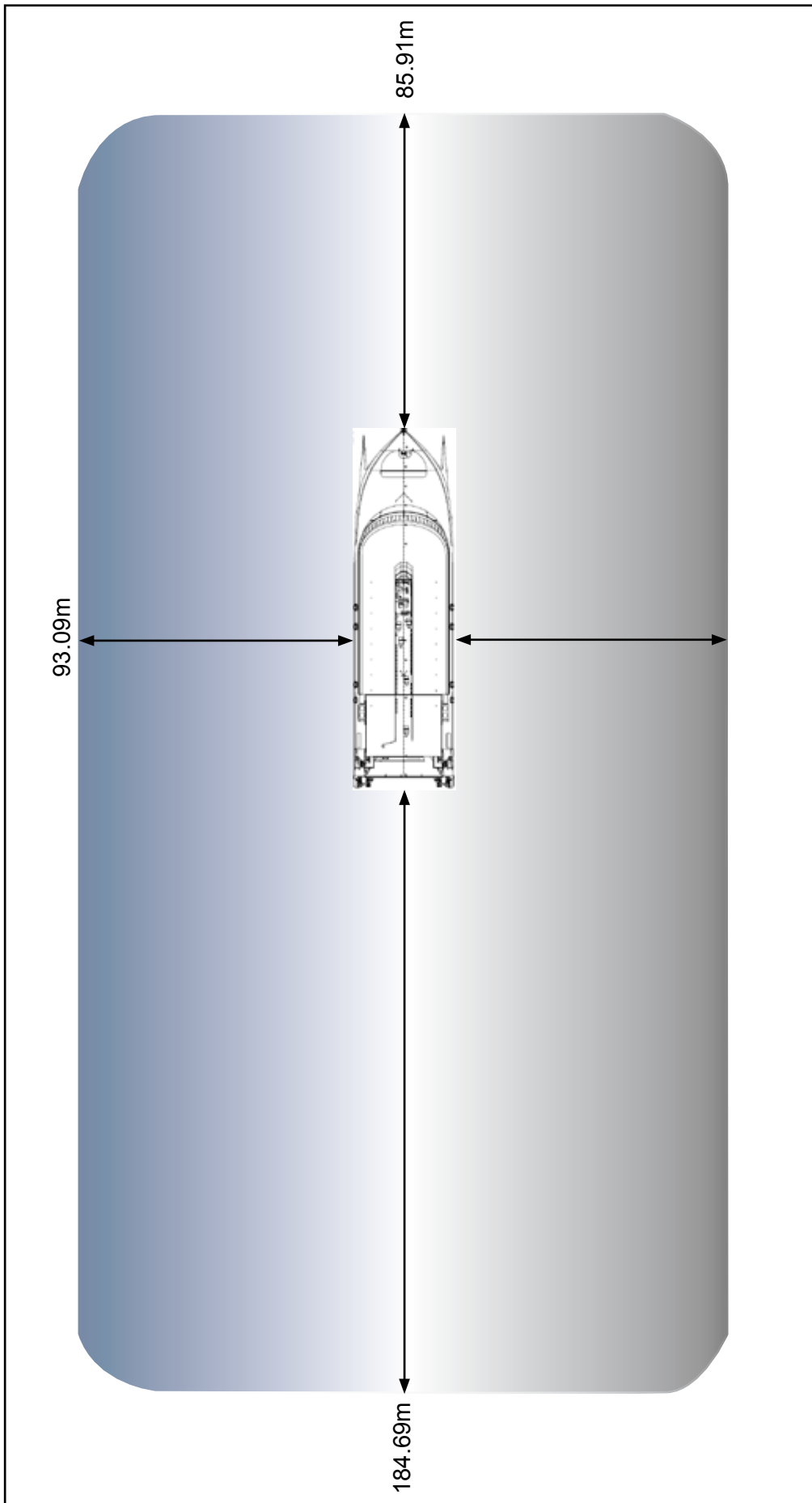


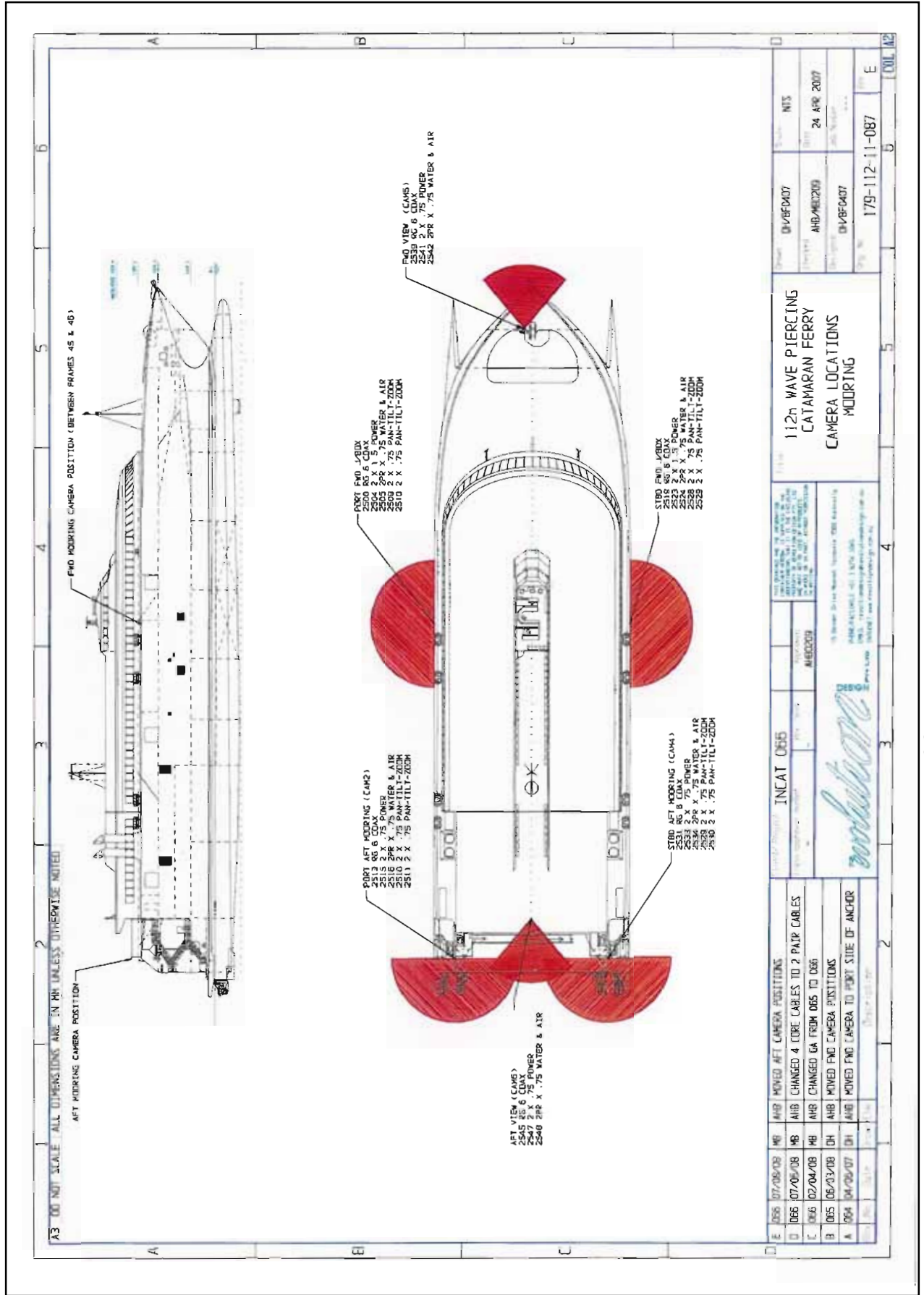
Figure 10



Bridge visibility shadow area at sea surface



CCTV monitors from different heights of eye

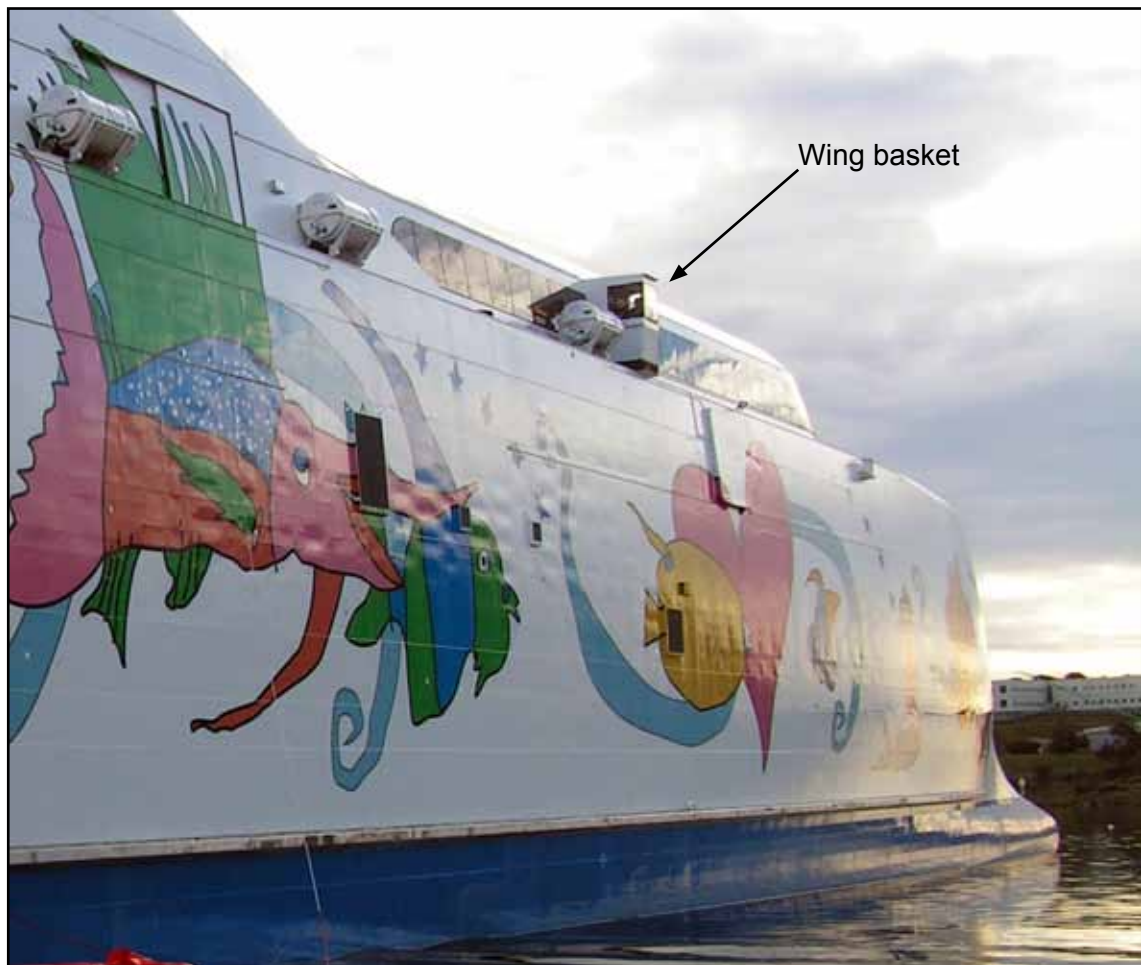


CCTV camera locations

An anemometer showing the relative wind direction and speed was sited on the forward bulkhead. The electronic chart display and information system (ECDIS) was sited on the forward console. The displays could be seen by the officer of the watch seated at the “at sea” station, but not from the “manoeuvring” station unless the officer turned away from the propulsion controls.

The control station arrangement for the previous two vessels of this class, *Natchan Rera* and *Natchan World*, included manoeuvring stations or wing baskets sited at the vessels’ sides (**Figure 14**). The side manoeuvring stations were also fitted with a talkback communications system that connected to the fore and aft mooring parties.

Figure 14



‘Wing basket’ fitted to sister vessels

1.5.3 Propulsion controls

Norman Arrow was fitted with four water jets: two on the port hull, and two on the starboard hull. Each water jet installation had an inlet duct, a pump impeller and a jetavator. The water entered the inlet duct and passed through the pump impeller, which was connected to the main engine by means of a gearbox and clutch

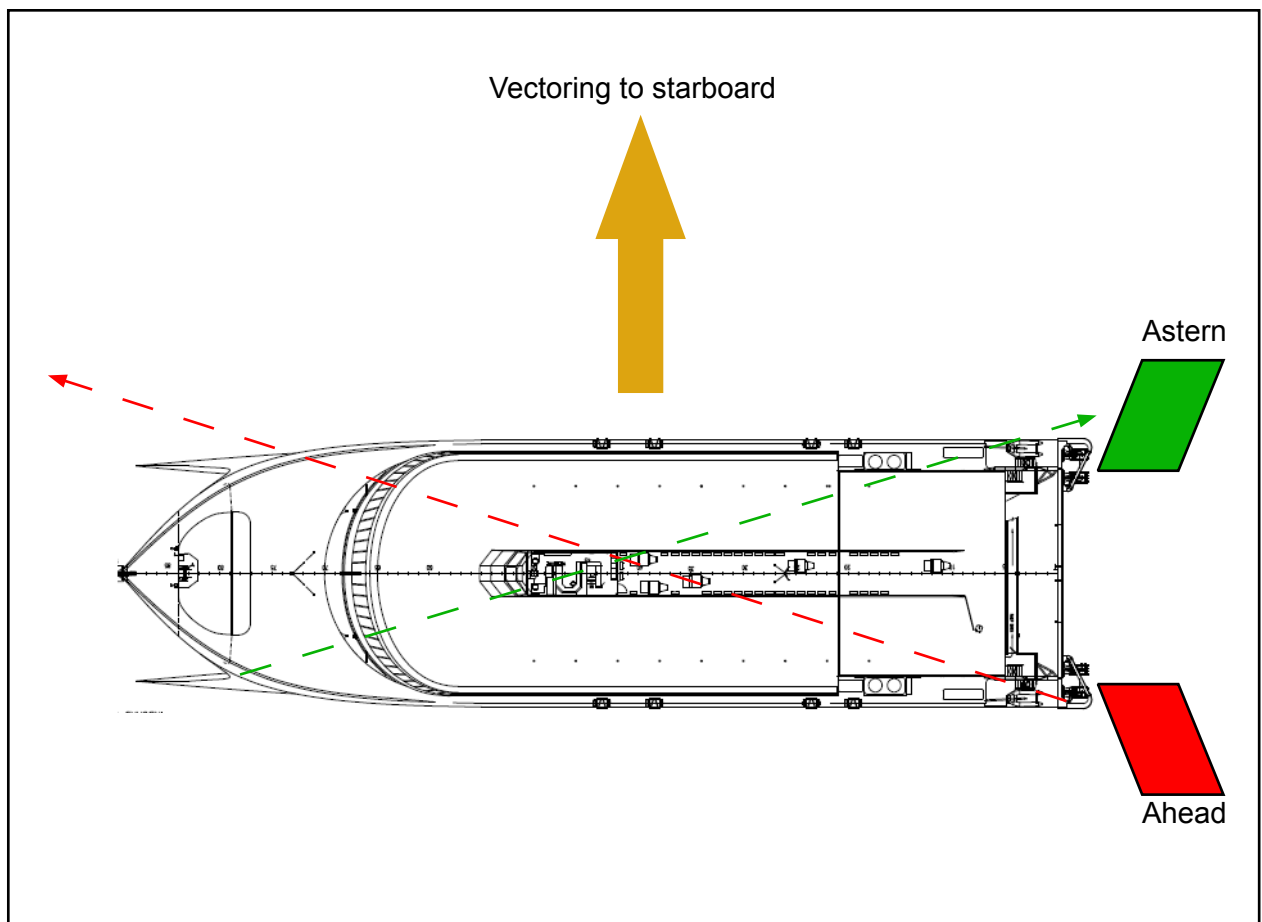
mechanism. The jetavators on each side of the hull were linked. Each jetavator contained a deflecting plate which allowed all or part of the flow to be deflected to provide astern movement. Full astern thrust was approximately 60% as effective as full ahead thrust.

When manoeuvring, the water jets and engines were controlled from the “at sea” or “manoeuvring” stations by means of a joystick. A secondary or back-up propulsion control system was available at both stations, which allowed the port and starboard jetavators to be manoeuvred independently via two joysticks.

Two basic water jet configurations were used to manoeuvre the vessel: vectoring and azimuth:

- In the vectoring mode, the water jets were turned outboard (toed-out). With the port jets operating ahead and the starboard jets operating astern (toed-out to starboard) (**Figure 15**), *Norman Arrow* moved bodily to starboard. When vectoring, the difference in the effectiveness of ahead and astern thrust was compensated by increasing the engine speed on the jetavators operating astern. *Norman Arrow* was vectored by moving the joystick to port or starboard (**Figure 2**).

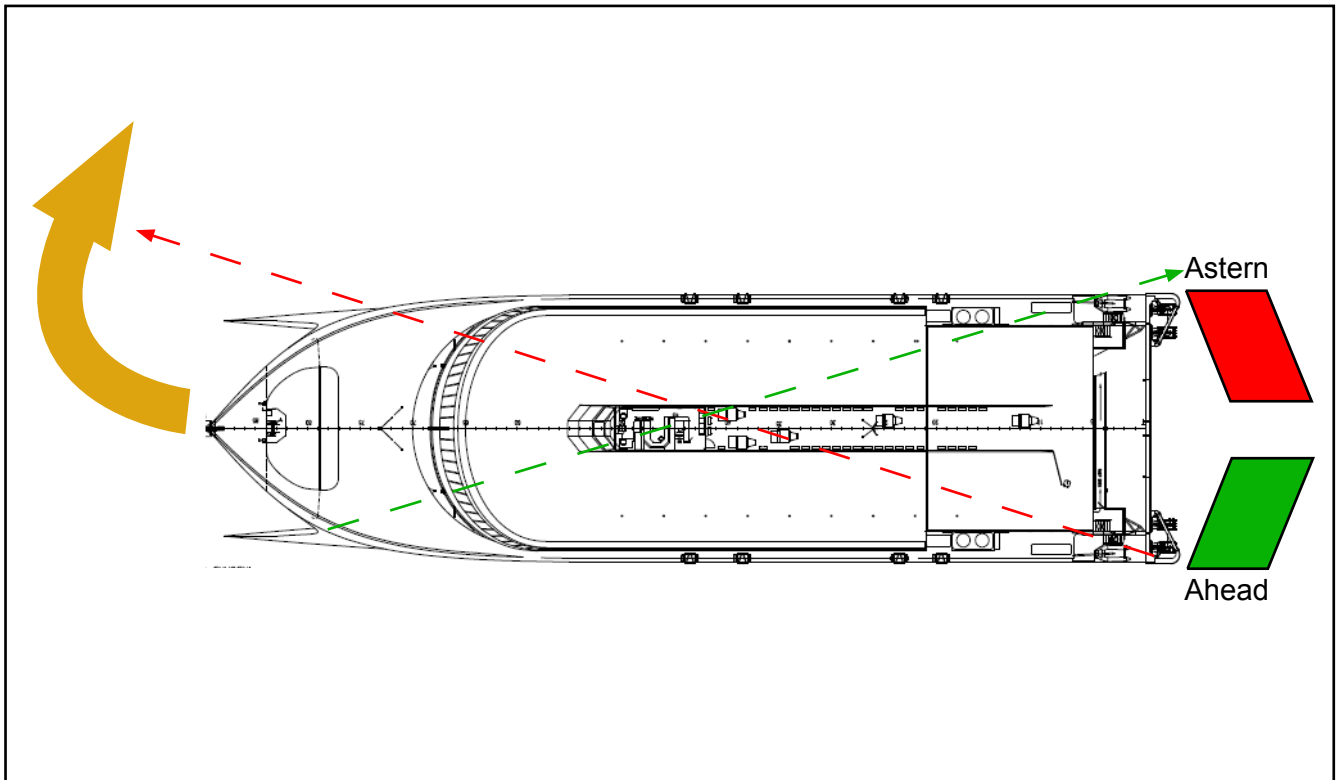
Figure 15



Toed-out configuration (Vectoring)

- In the azimuth mode, the water jets were turned inboard (toed-in). With the port jets operating ahead and the starboard jets operating astern (toed-in to starboard), the vessel's head turned to starboard (**Figure 16**). *Norman Arrow* was azimuthed by turning the spring-loaded azimuth dial at the manoeuvring station (**Figure 2**).

Figure 16



Toed-in configuration (Azimuth)

1.6 OPERATION, MANAGEMENT, AND TRAINING

1.6.1 Operation

Norman Arrow arrived in Dover on 26 May 2009 and subsequently conducted berthing trials in Dover and Boulogne. On 3 June 2009, the vessel was jointly inspected by the Maritime and Coastguard Agency (MCA) and the French maritime authority. The following day, a permit to operate (PTO) was issued by the MCA's Southampton marine office, which allowed the vessel to operate between Dover and Boulogne until 18 November 2009. The permit stated that *Norman Arrow* had a significant wave height limitation of 3.5m, but no wind limitations were specified. The vessel's Route Operations Manual identified significant wave height and shallow waters as the parameters determining the vessel's operating limits.

Factors taken into account by the MCA before issuing the PTO included:

- Louis Dreyfus Armateurs' familiarity and experience of operating HSC on the UK Register.
- Similarities between *Norman Arrow* and other HSC and the operational record of those vessels.
- Comparison between the management system and training regime proposed by Louis Dreyfus Armateurs for *Norman Arrow* with others already successfully employed by HSC operators.
- The previous experience of other HSC operators on the routes proposed.

Norman Arrow operated between Dover and Boulogne between 6 June 2009 and 10 November 2009, when the HSC was laid up in Boulogne for the winter. In preparation for a new service between Portsmouth and Le Havre, *Norman Arrow* completed berthing trials in both ports on 14 and 15 December 2009. A PTO for the Portsmouth to Le Havre route was issued by the MCA on 22 March 2010. The vessel commenced the new service 4 days later.

1.6.2 Management

Norman Arrow was owned by 066 Fast Ferry Leasing Limited. The vessel was managed by Louis Dreyfus Armateurs from 1 May 2009 until she was transferred to LD Transmanche Ferries (LDTF) on 1 January 2010. However, the overall supervision of safety management remained with Louis Dreyfus Armateurs, as did the role of Designated Person Ashore (DPA).

Norman Arrow was operated by Louis Dreyfus Lines (LD Lines) and was LD Lines' first HSC, although the fleet manager for LDTF had been involved in an HSC project with a previous employer. To help ensure that its new vessel was operated efficiently, LD Lines engaged an HSC consultant during the vessel's construction until delivery, and the five masters employed to work on board *Norman Arrow* were experienced in HSC operations.

1.6.3 Training

A type-rating syllabus for the certification of the officers and crew on board *Norman Arrow* was first submitted to the MCA by Louis Dreyfus Armateurs in May 2009. The MCA rejected this syllabus as it did not comply with the latest version of the HSC Code. A revised syllabus was re-submitted and was verbally approved by the MCA on 25 February 2010.

Three of the five masters employed on board *Norman Arrow* were designated as type-rating instructors and type-rating examiners. Although type-rating training had been conducted on board *Norman Arrow*, none of her masters and crew held MCA endorsed type-rating certificates for the vessel and route.

1.7 DECK OFFICERS

1.7.1 The master

The master was an experienced HSC officer and was the designated senior master of *Norman Arrow*. He had served on board similar craft for over 12 years and first joined *Norman Arrow* on 23 May 2009 in Malta, when the vessel was on passage to the UK. The master served on board the vessel when operating between Dover and Boulogne. He then worked on board LD Lines conventional ferries during the winter and re-joined *Norman Arrow* on 23 March 2010 for passage to Portsmouth, in readiness for the start of her new service. He held a master's unlimited SCTW II/2 certificate of competency (CoC) issued by South Africa, and a UK certificate of equivalent competency valid until 2012. He did not hold a pilotage exemption certificate (PEC) for either Portsmouth or Le Havre and had not completed the type-rating syllabus.

The master worked 1 week on, 1 week off and was due to go on leave on 1 April 2010. He generally worked from 0730 until 2130, and took a rest period of approximately 2 hours during the vessel's 4 hour layover in Le Havre. On 31 March 2010, the master had rested for 1-2 hours between a change of berth earlier that morning and the move at 1618, but he felt mentally exhausted.

1.7.2 The chief officer

The chief officer held a master's unlimited UK STCW II/2 certificate of competency. He had 11 years previous experience as a deck officer on short sea ferries, of which 3 years were spent working on HSC. He had worked on board *Norman Arrow* since May 2009 and was promoted to master in August 2009. However, he still occasionally served as the vessel's chief officer. The chief officer also did not hold a PEC for either Portsmouth or Le Havre.

1.8 HSC CODE

The International Code of Safety for High Speed Craft 2000 (HSC Code) details the requirements for HSC certification, build, survey, manning and operation.

Paragraph 1.9 of the Code details the requirements for a PTO and includes:

1.9.2 The Permit to Operate High-Speed Craft shall be issued by the Administration to certify compliance with 1.2.2 and 1.2.7 and stipulate conditions of the operation of the craft and be drawn up on the basis of the information contained in the route operational manual specified in Chapter 18 of this Code.[sic]

1.9.3 Before issuing a Permit to Operate, the Administration shall consult with each port State to obtain details of any operational conditions associated with operation of the craft in that State. Any such conditions imposed shall be shown by the Administration on the Permit to Operate and included in the route operational manual.

1.9.4 A port State may inspect the craft and audit its documentation for the sole purpose of verifying its compliance with the matters certified by and conditions associated with the Permit to Operate. Where deficiencies are shown by such an audit, the Permit to Operate ceases to be valid until such deficiencies are corrected or otherwise resolved.

Chapter 15 of the Code specifies the ergonomics of the operating compartment as well as the field of vision required for navigators of HSC. Paragraphs 15.3.5 and 15.3.6 state:

The view of the sea surface from the operating station, when the navigators are seated, shall not be obscured by more than one craft length forward of the bow to 90° on either side. And,

The field of vision from the docking workstation, if remote from the operating station, shall permit one navigator to safely manoeuvre the craft to a berth.

Chapter 17 describes the requirements for handling, controllability and performance. Paragraph 17.5.4.1 details the particular aspects to which attention shall be paid when determining the operational limitations of an HSC. The aspects listed are: yawing, turning, automatic pilot and steering performance, stopping in normal and emergency conditions, stability in the non-displacement mode about three axes and in heave, trim, roll, plough in, lift power limitations, broaching, slamming, and bow diving.

Chapter 18 details the operational documentation requirements for HSC. Paragraph 18.1.3 states:

The Administration shall issue a Permit to Operate High-Speed Craft when it is satisfied that the operator has made adequate provisions from the point of view of safety generally, including the following matters specifically, and shall revoke the Permit to Operate if such provisions are not maintained to its satisfaction:

.1 the suitability of the craft for the service intended, having regard to the safety limitations and information contained in the route operations manual;

.2 the suitability of the operating conditions in the route operations manual.....

Paragraph 1.18.2.2 details the requirements for the route operations manual. Included in the information to be available in the manual are:

.2 operating limitations, including the worst intended conditions;

.3 procedures for operation of the craft within the limitations of.2;..

Chapter 18 also details the training and qualification requirements of crew (**Annex D**) and includes the need for the crew to be type-rated for the model of HSC craft and route on which they serve. The type-rating certificates must be approved by the flag state.

1.9 MCA GUIDANCE

Instructions provided to the MCA surveyors for the application of the HSC Code (2000) 2008 edition include:

To operate commercially, all high speed craft (HSC) must have a permit to operate (POHSC), setting out the safety limitations and conditions imposed on their operation. This is drawn up on the basis of the information contained in the Route Operational manual and the Type rating certificates for the Operating crew

And:

While significant wave height is usually the limiting factor as regards operation on route, safe manoeuvring in port is usually limited by wind speed.

And:

The Master and all officers having an operational role should hold a Route and Craft specific Type Rating certificate issued on behalf of the MCA (for UK flag vessels) and all other crew should complete type rating training before being employed on a craft – refer to MSN 1740 (M) Training certification of Officers and Crew on High Speed Craft

1.10 PORTSMOUTH INTERNATIONAL PORT

1.10.1 Organisation

The commercial port in Portsmouth is owned by Portsmouth City Council. The ferry port manager was responsible to the port manager for the safe operation of the commercial ferry port. He was assisted in the operational control of the ferry port by the deputy ferry port manager and the four duty port operation managers.

The harbourmaster was responsible for the safe movement of vessels within the berth limits; he also had overall responsibility for health and safety policy. The harbourmaster reported to the port manager, and was assisted by the DHM.

1.10.2 Trials and risk assessment

Vessels operating from PIP generally used berths determined by berthing trials. The trials were used to demonstrate that vessels were able to lie safely alongside and that linkspan and mooring bollard positions were suitable. The berthing trials did not take into account the manoeuvrability of the vessel. Extracts of the berthing trials report for *Norman Arrow* are at **Annex E**.

Risk assessments were conducted by PIP for the movement of vessels. While there was not a risk assessment specifically for the movement of an HSC in high winds, there was an assessment completed for swinging large vessels within the berthing areas. The risk assessments are at **Annex F**.

1.10.3 Pilotage

Portsmouth City Council is a Competent Harbour Authority (CHA) as defined in the Pilotage Act 1987. The Queen's Harbour Master (QHM) Portsmouth was responsible for the co-ordination of all naval and commercial shipping within the CHA area, whereas the Portsmouth City Council harbourmaster was only responsible for the waters within 100 m of the commercial port's berths. Three full-time pilots and one relief pilot were employed to assist vessels to and from the commercial port berths.

As none of *Norman Arrow's* masters held a PEC for Portsmouth, a pilot was required for all changes of berth. On 31 March 2010, *Norman Arrow* moved from berth 5 to berth 3 during the morning. The vessel left berth 5 at 0618 assisted by a tug and with a harbour pilot embarked. When *Norman Arrow* was in the tidal basin, the master ordered the tug to be released so it could assist an incoming ferry. However, the master soon experienced difficulty manoeuvring *Norman Arrow* in the prevailing winds, and waited until the tug was again available to assist before securing at berth 3 at 0725. On completion of the move, the pilot discussed the vessel's manoeuvre with the DHM.

The DHM had previously served in the Royal Navy for 31 years, and had been QHM Portsmouth before he joined PIP in 2005 as DHM/relief pilot. Although he had extensive ship-handling experience, he had no operational experience of HSC. When he boarded *Norman Arrow* during the afternoon of 31 March 2010, it was his first time on board.

1.10.4 Notices to Mariners

QHM Portsmouth Local Notice to Mariners (LNTM) 63/02 (**Annex G**) details the requirement for ro-ro ferries over 20,000 gt that are moving in Portsmouth Harbour to be provided with a harbour tug when wind speeds are in excess of 30 knots.

1.11 PREVIOUS ACCIDENTS

1.11.1 *Norman Arrow*

Norman Arrow's hull was pierced by bolts protruding from fenders in Boulogne on five occasions between June and October 2009. The penetrations occurred when the vessel was either manoeuvring onto the berth or was lying alongside.

1.11.2 HSC *HD1*

On 28 July 2007, the HSC *HD1* struck HSC *Condor Express* in St Helier, Jersey when attempting to berth. The accident occurred in winds of 18 knots and under pilotage; both vessels were damaged. An investigation was conducted by the Bahamas Maritime Authority, which concluded that the vessel's manoeuvring characteristics, bridge team management and requirements for the utilisation of a tug in prescribed wind conditions had not be sufficiently understood.

1.12 POST-ACCIDENT ACTIONS

1.12.1 The Marine Accident Investigation Branch

On 30 April 2010, the MAIB recommended the MCA to:

Take urgent action to ensure the safe operation of Norman Arrow; this should include the approval of the type-rating training and certification on board Norman Arrow to enable the vessel and her crew to meet the requirements of the HSC Code, or the withdrawal the vessel's permit to operate pending submission of an acceptable training system by the vessel's owners and the subsequent endorsement of all type-rating certification.

It also recommended LD Lines and PIP to:

Urgently assess Norman Arrow's suitability to operate at each of the berths within Portsmouth International Port in varying environmental conditions. As a minimum, such an assessment should determine appropriate limitations and control measures, taking into account the vessel's windage and manoeuvring characteristics, visibility from the vessel's bridge, the availability and use of tugs, and the fendering provided.

1.12.2 The MCA

Following the MAIB's recommendation, the MCA conducted a thorough review of the decision-making processes leading to *Norman Arrow's* introduction into service. In June 2010, having taken into account that the vessel had continued in service without further accidents, LDTF's immediate instigation of improvements to its bridge team management, and close scrutiny during scheduled ISM Document of Compliance and Safety Management Certificate audits, the MCA decided there were insufficient grounds to suspend the vessel's PTO.

1.12.3 LD Transmanche Ferries and Portsmouth International Port

Following the MAIB's recommendation, LDTF obtained a wind diagram for the vessel from Incat, which shows the vessel's station-keeping ability based on computer modelling (**Annex H**). Together with PIP, LDTF completed an assessment for the use of a tug in port, taking into account wind speed and direction for each of the berths used.

LDTF also identified that an additional camera, placed forward, would be beneficial to the officer in command when manoeuvring in close proximity to a berth or an obstruction. The camera was to be fitted at the vessel's next scheduled period in dry dock.

SECTION 2 – ACCIDENT IN LE HAVRE

2.1 NARRATIVE

2.1.1 Departure from Portsmouth

Norman Arrow departed PIP at 0827 on 29 August 2010, bound for Le Havre, with 401 passengers and 144 vehicles embarked. The bridge team comprised the master¹, chief officer² and chief engineer, who were seated in the bridge's forward seats (**Figure 11**) in accordance with the master's standing orders (**Annex I**). Also on the bridge was the vessel's senior master³, who had the day off but had remained on board to complete administrative tasks.

When the vessel was clear of the port, the chief officer took the conn. At 1006 he contacted Le Havre port on VHF radio to give 1 hour's notice of the vessel's arrival at the pilot boarding area. The port acknowledged this message and advised that the wind in Le Havre was from the west at 25 knots.

During the passage, the chief officer had set up the CCTV cameras for berthing in Le Havre in accordance with the master's preferences, to enable the master to monitor the vessel's sides and stern from the manoeuvring station (**Figure 13**).

2.1.2 Arrival in Le Havre

As the vessel approached Le Havre pilot station the master took the conn, leaving the chief officer to monitor the ECDIS and radar displays. The pilot, who was familiar with the vessel, boarded at 1058. He was soon advised, in French, by Le Havre port via VHF radio, that the wind was west-by-north at 25 knots. This VHF conversation was heard by the bridge team who interpreted it to mean that the wind was north-west at 25 knots. There was no exchange of information between the master and the pilot.

The pilot advised the master, in English, that *Norman Arrow* was required to follow a large tanker into the port. Accordingly, the vessel's speed was reduced and there was some light hearted discussion between the bridge team that this would delay the vessel's time of berthing.

At 1111, the pilot advised the master that the vessel could, if he wished, overtake the inbound tanker. The master agreed to this manoeuvre and increased speed. At 1118, as *Norman Arrow* entered the port, the pilot asked the master where he

¹ The master had been the chief officer on board *Norman Arrow* at the time of the accident in Portsmouth on 31 March 2010. He now held a PEC for Portsmouth but not for Le Havre.

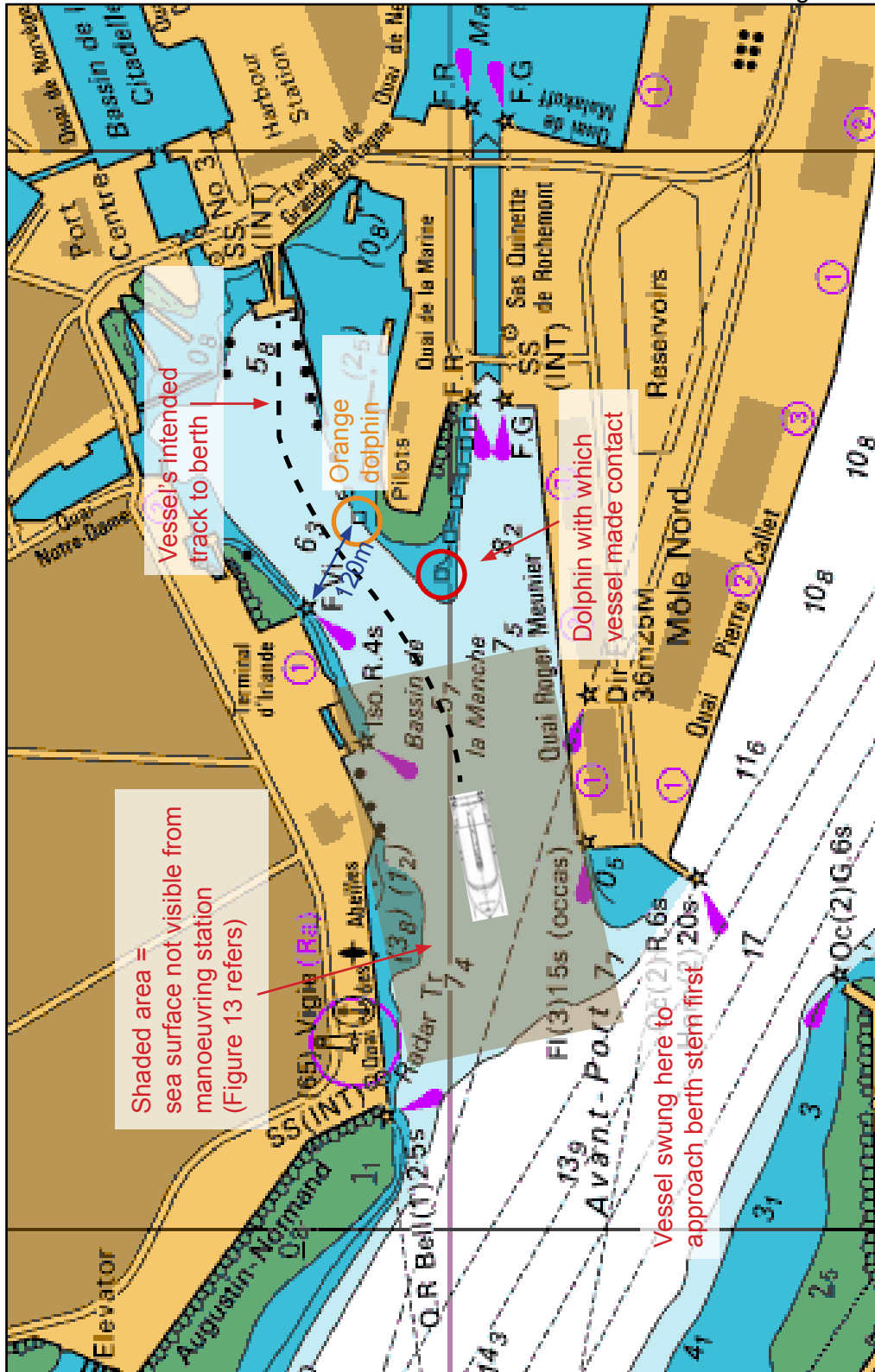
² The chief officer, who was Polish, held an STCW II/2 CoC as chief mate and a British certificate of equivalent competency for that rank. He had 20 years' experience as a deck officer on a variety of craft, including ferries, and had joined *Norman Arrow* as chief officer in March 2010, which was his first appointment to a high speed craft.

³ The senior master had been the master on board *Norman Arrow* at the time of the accident in Portsmouth on 31 March 2010. He now held a PEC for both Portsmouth and Le Havre (departures and internal moves only).

intended to swing the vessel. The master replied that he would manoeuvre off the Quai Roger Meunier (Figure 17). It was almost high water and the tidal stream in the inner harbour was negligible.

Chart data reproduced from 2990-0 (Le Havre and Entrance to Chenal De Rouen) by permission of the Service Hydrographique et Océanographique de la Marine (SHOM)

Figure 17



Le Havre port

As the vessel approached the intended position for the swing, the bosun went aft to the port quarter and an able bodied seaman (AB) went forward to take charge of the vessel's mooring parties. Both ratings carried radios to communicate with the bridge team. At this point, the master noticed that the flags located on the end of the Quai Roger Meunier were indicating that the wind was from the south-west, rather than the north-west as he expected.

2.1.3 The contact

The master moved to the manoeuvring station (**Figure 2**) and then commenced turning *Norman Arrow* to port. He was navigating the vessel by monitoring visual marks on the shore and by occasionally looking over his shoulder at the ECDIS and radar. By 1122, the vessel had turned through 180° and was moving stern-first towards her berth (**Figure 17**).

One minute later, when *Norman Arrow* was travelling at a speed of 3.2 knots astern, the bosun reported that the vessel's stern was about 100m from the first orange dolphin (**Figure 17**). Two minutes later, the bosun reported that the vessel was about 8m from the orange dolphin (**Figure 18**). The chief officer advised the master that the vessel was being set down onto the dolphin by the wind. The master stopped the astern thrust and gave a short thrust ahead. He then announced that he would vector the jets (**Figure 15**) to move the vessel bodily to starboard.

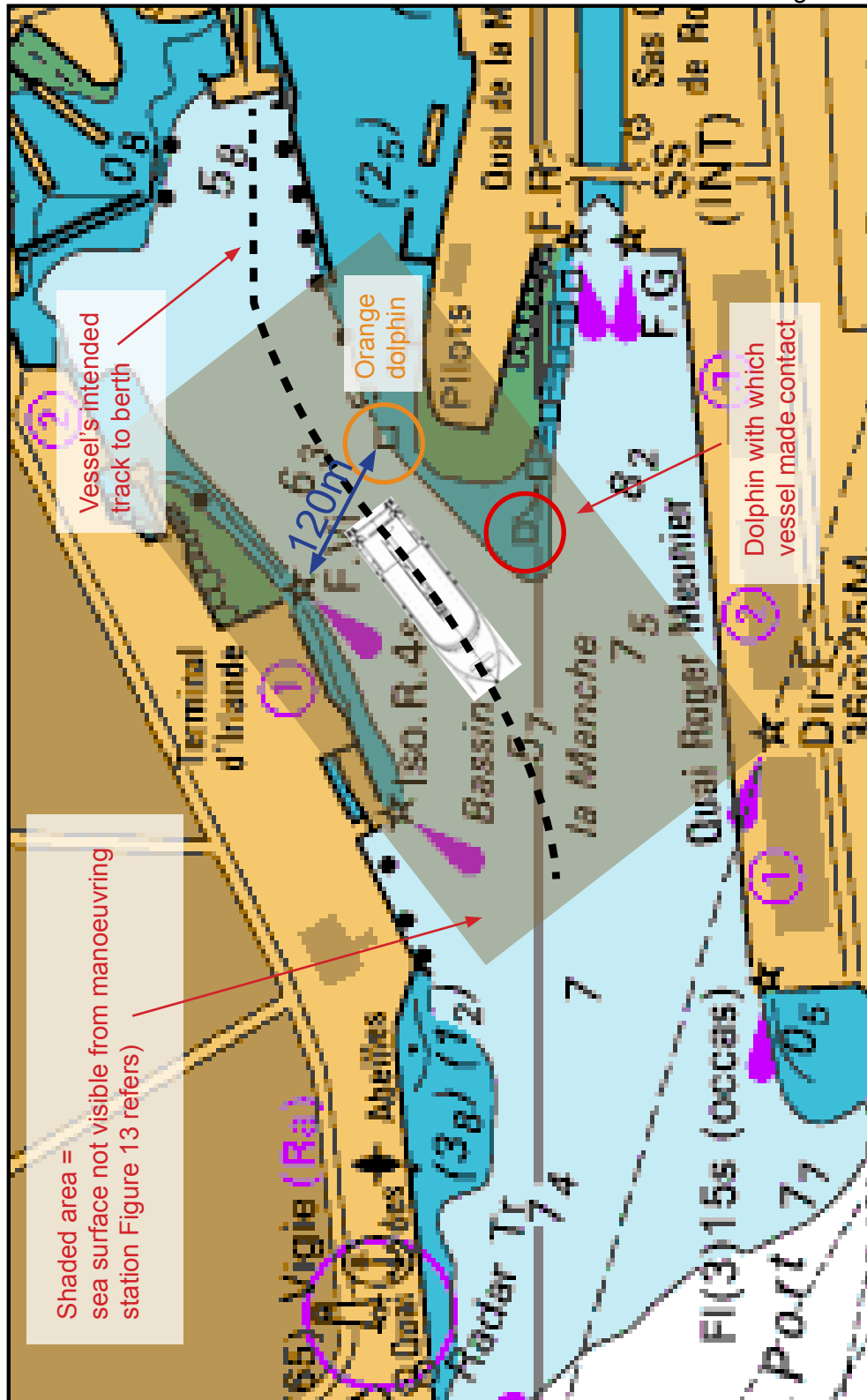
A short time later, the bosun reported that *Norman Arrow* was 6m from the orange dolphin and was 8m from the "other dolphin to port". The bosun then counted down the distance off the second dolphin until *Norman Arrow* landed on the dolphin at 1126.

2.1.4 Post-contact

Shortly after *Norman Arrow* hit the dolphin, the master handed over the conn to the senior master. At 1127, the chief engineer reported that water was entering the port forward engine room, and informed the senior master that he would have to stop the engine as the space was flooding rapidly. The senior master acknowledged the chief engineer's report and informed the pilot that he intended to swing the vessel to port, around the dolphin, and return to the swinging area. The pilot informed the port of the accident and, at the request of the senior master, asked that a tug be dispatched to assist *Norman Arrow*.

The senior master placed the engine controls into back-up mode to try and increase the effect of the water-jets. He also asked the pilot if the wind was from the north-west; the pilot advised that it was from the west-by-north. By 1132, the senior master had manoeuvred the vessel off the dolphin and was heading east; the vessel then proceeded astern towards the outer harbour.

At 1151 a tug was made fast, and *Norman Arrow* then proceeded to her berth, arriving there at 1215.



Norman Arrow - approach to the orange dolphin

2.2 THE DAMAGE

Norman Arrow's port hull was heavily indented and holed about 1m below the waterline, in way of the forward engine room. Water entered through three holes, and the space flooded to cover the engine access platform (**Figure 19**). The extent of the damage was such that the vessel was withdrawn from service for the remainder of the summer season.



Norman Arrow hull damage and flooded engine room

2.3 WIND

Observations from La Heve meteorological station (3 miles north of Le Havre port) were:

Time	Direction	Strength
0800	NW	9 knots
0900	WNW	7 knots
1000	W	25 knots
1100	W	20 knots
1200	W	23 knots

2.4 LE HAVRE PORT

Le Havre is a large port on the Normandy coast and has facilities for various vessel-types. The berthing trials undertaken by *Norman Arrow* in the port proved that the vessel could operate safely from her intended linkspan. Informal discussions between the harbourmaster, pilots and tug operators concluded that the vessel might require a tug in winds exceeding 25 knots, but this requirement was not formalised.

Pilotage is compulsory for vessels over 70m in length; although a PEC may be issued once a master has made a minimum of 25 visits to the port and has passed an examination set by the harbour authority.

The pilot was a French national who had acted as pilot on *Norman Arrow* on several previous occasions. He was able to communicate with the bridge team in English.

The senior master had been issued with a PEC for movements within and departures from Le Havre on 27 August 2010. However, he did not hold a PEC for the vessel's arrival, and consequently *Norman Arrow* was required to embark a pilot.

SECTION 3 - ANALYSIS

3.1 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. While the circumstances of the accidents in Portsmouth and Le Havre differ, the analysis is intended to focus on the safety issues that are common to both.

3.2 MANOEUVRABILITY

The contacts made by *Norman Arrow* with fixed structures in both Portsmouth and Le Havre resulted from the inability to manoeuvre the vessel as intended in the wind conditions experienced. As a twin-hulled, light displacement, and shallow draught vessel with a cross-sectional area of about 1500m², *Norman Arrow* was vulnerable to the effects of the wind when manoeuvring at slow speed.

In PIP, the wind was 46° on the vessel's starboard bow at 26 knots when the forward lines were let go, and *Norman Arrow* was immediately set onto the finger jetty. In Le Havre, the wind was also between 40° and 50° on her starboard bow at 27 knots when she was set towards the dolphins. It is evident from these events, and consistent with the data at **Annex H**, that the wind conditions experienced on both occasions exceeded the vessel's ability to maintain her heading and position.

The use of the back-up manoeuvring mode enabled *Norman Arrow* to manoeuvre away from the dolphin and into open water in Le Havre. However, it is unlikely that earlier use of the back-up mode would have prevented the vessel's initial contact with the dolphin once leeway had developed given the difficulty of manoeuvring the bow up into the wind.

3.3 VISIBILITY

From *Norman Arrow*'s bridge, the masters were able to see the waterline approximately 86m forward of the bow, 93m abeam, and 184m astern (**Figure 10**). Therefore, although this field of vision complied with the requirements of the HSC Code, the masters were constrained in their ability to see key events and obstructions close to the vessel. When shifting berths in PIP, the master could not see: the difficulties experienced by the shore linesmen when letting go the forward lines; the finger jetty which was less than 5m off the port side; the caissons; or the vessel's starboard prow. Likewise, in Le Havre the master could not see the dolphins, the northerly of which he intended to pass at a distance of about 25m (**Figure 17**).

Unlike many HSC, the bridge on the Incat 112 does not extend to the vessel's sides. While this design undoubtedly reduces wind resistance and therefore noise when at high speed, the resulting adverse effect on visibility is clear. The provision of CCTV mitigated the reduced field of vision to some extent. However, the system did not provide depth of vision, had limited arcs, and the need to train the cameras significantly limited the CCTV's usefulness when manoeuvring in port.

3.4 ERGONOMICS

Norman Arrow's aft-facing manoeuvring station allowed the master to face aft to control the vessel when approaching a linkspan stern-first, which was usual practice. However, when leaving a berth, the master also had to face aft to operate the propulsion controls. Therefore, when approaching and departing a berth, the master had to turn around to view key equipment such as the anemometer, radar and ECDIS, which were fitted only at the 'at sea' station. While this was not an impossible task, it was less than desirable and was potentially distracting, particularly when manoeuvring in close proximity to dangers not visible from the bridge.

The bridge team's efficiency when manoeuvring was further impeded by the need for the officer conning the vessel to keep hold of the spring-loaded azimuth control. The extent to which the CCTV monitors would block the master's view astern would depend upon his height of eye (**Figure 12**).

3.5 TEAM ORGANISATION AND MANAGEMENT

Given the difficulty in manoeuvring *Norman Arrow* at slow speeds in winds over 25 knots, the lack of near-field visibility and poor bridge ergonomics, effective teamwork was essential to the vessel's safe operation when navigating in and out of ports. However, several omissions and deficiencies indicate that the organisation and management of the bridge team and outstations was not effective during either accident.

First, little information was exchanged between the masters and pilots, and no pilot card was provided. In Portsmouth, the pilot did not discuss or show his plan to the master, and in Le Havre the pilot had to prompt the master to indicate where he intended to swing the vessel. It is possible, in view of the routine nature of the moves, and the vessel's unconventional steering and propulsion, that the pilots' presence was deemed by both the masters and pilots to be a regulatory necessity rather than a positive contribution to safety. This approach is likely to have led to the pilots adopting a more passive role than might otherwise have been the case.

Second, the bridge teams and the ratings in charge of the mooring parties had not been briefed by the masters. Consequently, when the masters became pre-occupied controlling the propulsion from the manoeuvring station, they were not sufficiently supported while following the plan or challenged when things started to go wrong. The ICS Bridge Procedures Guide is clear in this respect:

A bridge team which has a plan that is understood and is well briefed, with all members supporting each other, will have good situational awareness. Its members will then be able to anticipate dangerous situations arising and recognise the development of a chain of errors, thus enabling them to take action to break the sequence.

Finally, connected with the lack of briefings, was the limited information flow on the bridge, and between the bridge and the mooring parties. In Portsmouth, the master was not made aware of the difficulty being experienced in releasing the forward lines. Similarly, in Le Havre, the master was not aware that the vessel was being set to the south until the bosun reported that the dolphin was only 8m away and it was too late for effective avoiding action to be taken.

Although earlier warning was possible through regular reporting of the distances off the dolphins and through the provision of position and set/drift information derived from the ECDIS and radar, this information was neither requested nor offered. In view of the blind zone, which extended to 93 m on the beam for objects on the sea surface, a good flow of information from those personnel better placed to monitor close-in hazards was pivotal to the vessel's safe navigation.

3.6 OPERATIONAL LIMITATIONS

3.6.1 Assessment

The factors the HSC Code requires to be considered when determining operational limitations largely focus on a vessel's operation at speed in open water. The effect of the wind on an HSC's manoeuvrability in the confines of a port or harbour is not addressed. Therefore, it is not surprising that the operational limitations contained in *Norman Arrow's* Route Operations Manual were limited to significant wave height and shallow water.

However, given the increasing size of HSC, together with the likelihood of encountering strong winds at any time of the year and the vulnerability of aluminium hulls to damage, the need to assess the potential effects of the wind on HSC manoeuvrability in port areas is compelling.

Although *Norman Arrow* is one of the largest HSC, no windage information was provided by Incat on completion of her sea trials. Consequently, no information regarding the possible effect of wind forces, or the use of tugs, was available

to the vessel's masters until the data at **Annex H** was obtained following the accident in Portsmouth. Without such data, it is impossible to accurately determine the operational limits for an HSC manoeuvring at slow speed in port.

Furthermore, the berthing trials conducted prior to the vessel commencing her services between Dover and Boulogne, and Portsmouth and Le Havre, were not used by the vessel's manager or the relevant port officials to assess and take account of the HSC's handling characteristics and limitations. Berthing trials have traditionally been used only to prove a vessel's suitability to use particular berths. However, a lesson to be learned from the consequences of these two accidents is that berthing trials are also opportunities for ship managers and harbourmasters to review the control measures required to safeguard vessel movements.

With respect to the operation of *Norman Arrow*, a review of guidance concerning the conditions when tug assistance was required, how tugs should and should not be used, and the limiting conditions above for which sailings or arrivals should be cancelled, was warranted. Although in Le Havre a wind speed of 25 knots was considered a suitable threshold for *Norman Arrow* to require tug assistance, it was not formally implemented, and the LNTM issued by QHM Portsmouth did not apply to vessels below 20000 gt.

3.6.2 Use of tugs

In view of the lack of designated 'push points' and the relative weakness of the mooring bitts on board *Norman Arrow*, the use of tugs to assist the vessel when manoeuvring needed to be carefully considered. It is almost certain that both these accidents could have been avoided had tug assistance been requested and provided. Specifically, a tug secured forward would have been extremely useful in supplementing the vessel's propulsion to counter the effects of the wind on both occasions.

In the absence of guidance from either the vessel's manager or the harbourmasters detailing the circumstances when a tug or tugs must be used, the decision on whether a tug was needed rested with the vessel's masters and pilots. In PIP, although tug assistance had been necessary for *Norman Arrow* to move between berths in windy conditions during the morning of 31 March 2010, the master and pilot opted not to use a tug for the second move. This decision was questionable, particularly as the pilot embarked during the morning's move had discussed the manoeuvre with the DHM, and the wind conditions were similar. It is possible that the master's decision-making on this occasion was impaired by mental fatigue to some degree. However, it is probable that the decisions not to use tugs in Portsmouth and Le Havre were more influenced by the masters' and pilots' perceptions that the intended manoeuvres were of a routine nature and the associated risks were low. Suitable guidance from the company or ports might have alerted them to the associated risks of strong winds.

3.7 ASSESSMENT OF COMPLIANCE

The responsibility for assessing the compliance of an HSC with the general requirements of the HSC Code, rests with a vessel's flag state and the port states in which the vessel operates. The HSC Code is intended to be applied in its entirety, and generally this is interpreted to mean that builders and operators must not apply individual sections of the Code selectively. For their part, flag states exercise some discretion when considering equivalences to individual provisions of the Code and when granting specific exemptions.

Nonetheless, while recognising the basis on which the MCA issued the PTOs for *Norman Arrow* (paragraph 1.6.1), the safety issues raised by the vessel's contacts in Portsmouth and Le Havre, cast doubt on the effectiveness of the MCA's PTO validation process. In particular, although the existing MCA guidance highlights that safe manoeuvring in port is usually limited by wind speed, this factor was not taken into account despite the vessel's readily apparent cross-sectional area, the absence of wind operating limits in the vessel's Route Operations Manual, and the lack of a bow thruster. The problems concerning the near-field visibility from the bridge, and bridge ergonomics were also not considered. Furthermore, although the MCA justifiably exercised its discretion regarding the crew's vessel and route-specific type-rating, the time taken to approve the type-rating training syllabus was excessive, particularly in view of the vessel's change of route in March 2010.

Given *Norman Arrow's* size, design and handling characteristics, the determination of the vessel's operational limitations in port, rather than open water, was not a straightforward task. In particular, the requirement of the HSC Code that, *The field of vision from the docking workstation, if remote from the operating station, shall permit one navigator to safely manoeuvre the craft to a berth* is extremely subjective. In hindsight, to be effective, any assessment of this requirement had to be holistic and take into account not only the visibility from the manoeuvring station, but also: the lack of 'wing baskets' as fitted on *Norman Arrow's* sister ships; the positioning, accuracy and suitability of other aids to berthing, such as ECDIS and CCTV; and the accuracy of verbal reports of distances from outstations. The ability of the bridge team and outstations to mitigate the adverse consequences of the limited visibility from the bridge and the poor bridge ergonomics, was also an extremely important consideration.

Given the shadow area around *Norman Arrow* (**Figure 10**), it is difficult to see how the vessel could be safely manoeuvred to or from a berth by eye. Safe manoeuvring in port can only be achieved if other aids are available and are fully utilised. In addition, appropriate procedures and protocols must be followed by masters and crew who have been adequately trained. Flag and port state assessment of such aspects of an HSC operation probably cannot be successfully achieved through documentary and equipment audit alone. The effectiveness of type-rating training, and manoeuvring procedures and protocols, must also be verified through practical demonstration.

SECTION 4 - CONCLUSIONS

4.1 SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION WHICH HAVE NOT RESULTED IN RECOMMENDATIONS BUT HAVE BEEN ADDRESSED

1. The wind conditions experienced during both accidents exceeded the limit of the vessel's ability to maintain her heading and position, despite the manoeuvrability provided by her water-jet propulsion. [3.2]
2. The field of vision from the bridge was restricted such that the masters could not see objects at sea surface level within 93m of the vessel's beam and within 184m astern. [3.3]
3. The provision of a CCTV system did not fully mitigate the restricted near-field visibility from the bridge. [3.3]
4. The difficulty of manoeuvring the vessel in confined waters was increased by poor bridge ergonomics. [3.4]
5. There was little information exchanged between the masters and the harbour pilots. [3.5]
6. The bridge and mooring teams were not briefed on the intended manoeuvres, and the information flow both on the bridge, and between the bridge and the mooring parties was limited. [3.5]
7. Given the increasing size of HSC, together with the likelihood of encountering strong winds at any time of the year and the vulnerability of aluminium hulls to damage, the need to assess the potential effects of the wind on HSC manoeuvrability in port areas is compelling. [3.6.1]
8. No information regarding the possible effect of wind forces was available to *Norman Arrow's* masters until this data was obtained from Incat following the contact in Portsmouth. [3.6.1]
9. The berthing trials conducted prior to the vessel commencing her services between Dover and Boulogne, and Portsmouth and Le Havre, were not used by the vessel's manager or the ports to assess, and take account of *Norman Arrow's* handling characteristics and limitations. [3.6.1]
10. It is almost certain that both accidents could have been avoided had tug assistance been requested and provided. However, no guidance was available to the masters regarding the conditions in which tugs must be used. [3.6.2]

11. The safety issues raised by *Norman Arrow's* contacts in Portsmouth and Le Havre cast doubt on the effectiveness of the MCA's PTO validation process. [3.7]
12. The time taken by the MCA to approve the vessel's type-rating training syllabus was excessive. [3.7]
13. Risks to the vessel's safe operation in ports posed by the combined effects of limited near-field visibility from the bridge, and poor bridge ergonomics, were extremely difficult for a surveyor to evaluate. [3.7]
14. To be effective, any assessment of the adequacy of the visibility from the manoeuvring station had to take into account the positioning, accuracy and suitability of other aids to berthing such as ECDIS and CCTV, the accuracy of verbal reports of distances from outstations, and the effectiveness of the bridge team and outstations. [3.7]
15. The effectiveness of type-rating training, and manoeuvring procedures and protocols, must be verified through practical demonstration. [3.7]

SECTION 5 - ACTIONS TAKEN

5.1 ACTIONS TAKEN FOLLOWING THE ACCIDENT ON 29 AUGUST 2010

5.1.1 Maritime and Coastguard Agency

The MCA withdrew *Norman Arrow*'s PTO pending an internal investigation. On completion of the internal investigation, additional requirements were set for LDTF and *Norman Arrow*, which must be met before a PTO is re-issued. The conditions included:

- The insertion of a windage diagram in the Route Operations Manual. Information should include the effect of wind relative to the vessel's heading, turning limitations, and guidance on the use of tugs and the decision to sail.
- The establishment of communications protocols between the master and chief officer, and the bridge and mooring stations.
- The verification of the training through a practical demonstration of a berthing in order to show the attending surveyor(s) that the master and chief officer are fully familiar with the vessel's procedures, including communications protocols, and that they have a clear understanding of the effect of wind on the handling characteristics of the craft.
- The fitting of ECDIS at the manoeuvring station and the provision of procedures for its use in passage planning and track monitoring.
- The provision of a CCTV system which meets the requirements of the vessel's masters.
- The training of lookouts to identify hazards and accurately estimate distances.

5.2 LDTF

LDTF has:

- Commenced an internal investigation and a management review of its safety management system.
- Reviewed and updated the route operating manual to include: a revised communications protocol; amended passage and berthing plans taking into account varying wind conditions; guidance on manoeuvring: and requirements for the use of tugs.
- Conducted a thorough review of its type-rating syllabus and developed systems to ensure that a deck officer's manoeuvring experience in each port in differing conditions is documented. Sections on communications and lookout while manoeuvring have also been expanded.

- Arranged for its deck officers to undertake Bridge Team Management training before *Norman Arrow* resumes service in May 2011.
- Reminded its staff to hold pre-arrival briefings.
- Installed an additional ECDIS monitor at the manoeuvring station.
- Identified a system to enable wind information from an anemometer by a berth to be passed to the bridge team during manoeuvring.
- Installed two additional cameras to assist in berthing manoeuvres; the existing centre camera is also being upgraded.
- Provided distance measuring devices to assist the crew when manoeuvring.

SECTION 6 - RECOMMENDATIONS

In view of the recommendations already made by the MAIB, and the actions already taken, or in progress, no further recommendations are made as a result of this investigation.

Marine Accident Investigation Branch

May 2011