Report on the investigation into the contact

made by the tanker

Vallermosa,

with the tankers

Navion Fennia and ***BW Orinoco***

at the Fawley Marine Terminal

on 25 February 2009

CONTENTS

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

AB	-	Able bodied seaman
ABP	-	Associated British Ports
ABS	-	American Bureau of Shipping
BP	-	BP Oil UK Limited
BPA	-	British Ports Association
BPJ	-	BP Hamble Terminal Jetty
BRM	-	Bridge Resource Management
BV	-	Bureau Veritas
Cable	-	0.1 nautical mile – 185.2m
CET	-	Central European Time
CHA	-	Competent Harbour Authority
DNV	-	Det Norske Veritas
DWT	-	Deadweight (tonnes)
ECDIS	-	Electronic Chart Display and Information System
ECS	-	Electronic Chart System
HMRC	-	Her Majesty’s Revenue and Customs
IAMI	-	International Association of Marine Institutions
IMO	-	International Maritime Organization
ISM	-	International Safety Management Code
kts	-	knots
kW	-	kilowatt
L	-	litre
LOA	-	Length overall
m	-	metre

MCA	-	Maritime and Coastguard Agency
nm	-	nautical miles
OCIMF	-	Oil Companies International Marine Forum
OOW	-	Officer of the Watch
RINA	-	Registro Italiano Navale
SHA	-	Statutory Harbour Authority
SIRE	-	Ship Inspection Report Programme (OCIMF)
SOG	-	Speed over the ground
STW	-	Speed through the water
t	-	tonnes
TOS	-	Traffic Organisation Service
UKMPA	-	United Kingdom Marine Pilots Association
UKMPG	-	United Kingdom Major Ports Group
UTC	-	Universal Co-ordinated Time
VDR	-	Voyage Data Recorder
VHF	-	Very High Frequency (radio)
VTS	-	Vessel Traffic Services
VTSO	-	Vessel Traffic Services' Officer

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

SYNOPSIS

On 25 February 2009, the oil product and chemical tanker, *Vallermosa,* loaded with a full cargo of 35,000t of jet fuel and bound for the BP Hamble Terminal in Southampton Water, made contact with two oil tankers which were discharging alongside at Fawley Marine Terminal. The accident caused structural damage to all three vessels, minor damage to the jetty and minor pollution.

The MAIB investigation has identified inter alia, that the following factors contributed to the accident:

- *Vallermosa*'s approach was unnecessarily aborted for administrative reasons.
- The pilot's effectiveness was reduced due to his heightened workload, frustration and increasing stress.
- The master and bridge team were not monitoring the pilot's actions sufficiently, despite their obligation to ensure the vessel's safety.

As a result of the accident, action has been taken by BP Oil UK to ensure berthing operations are not aborted for administrative reasons, and ABP Southampton has amended its procedures so as to prevent the late aborting of tankers calling at oil terminals, regardless of their size. Navigazione Montanari has taken action to improve, and monitor, the performance of its bridge teams.

Recommendations have been made to the UK Major Ports Group, British Ports Association and the UK Marine Pilots Association to jointly define their expectations of bridge team and pilot performance. The Maritime and Coastguard Agency has been recommended to provide the shipping industry with more detailed information on the expected levels of support which should be provided by bridge teams when a pilot is embarked. The International Association of Marine Institutions has been recommended to ensure that its members' Bridge Resource Management training includes the integration of pilots into bridge teams.

Vallermosa

Navion Fennia

BW Orinoco

SECTION 1 - FACTUAL INFORMATION

1.1 Particulars of *Vallermosa*, *Navion Fennia*, *BW Orinoco* and accident

Vessel details		*Vallermosa*
IMO Number	:	9251559
Registered owner	:	Navigazione Montanari S.p.A
Manager(s)	:	Navigazione Montanari S.p.A
Port of registry	:	Trieste
Flag	:	Italian
Type	:	Product tanker
Built	:	2003, Ulsan, South Korea
Classification society	:	RINA / Bureau Veritas
Construction	:	Steel
Length overall	:	176.0m
Gross tonnage	:	43,797
Engine power and / or type	:	Hyundai B&W 8580kW
Service speed	:	15.0 kts
Other relevant info	:	Becker Rudder, 800kW bow thruster

Accident details		
Time and date	:	1040 UTC 25 February 2009
Location of incident	:	Fawley Marine Terminal, Solent, UK
Persons on board	:	23 crew, 1 pilot
Injuries / fatalities / pollution	:	Nil
Damage	:	Structural damage to bow.

Vessel details		*Navion Fennia*
IMO Number	:	9020687
Registered owner	:	Navion Fennia Ltd.
Manager(s)	:	Teekay Shipping Norway A.S.
Port of registry	:	Nassau
Flag	:	Bahamas
Type	:	Oil Tanker
Built	:	1992
Classification society	:	DNV
Construction	:	Steel
Length overall	:	231.27m
Gross tonnage	:	51,136

Accident details		
Time and date	:	1040 UTC 25 February 2009
Location of incident	:	Fawley Marine Terminal, Solent, UK
Persons on board	:	21 Crew
Injuries / fatalities / pollution	:	Nil
Damage	:	Structural damage to port quarter.

Vessel details		*BW Orinoco*
IMO Number	:	9324320
Registered owner	:	Glenridge Company S.A.
Manager(s)	:	BW Fleet Management Pte Ltd.
Port of registry	:	Panama
Flag	:	Panama
Type	:	Oil Tanker
Built	:	2007
Classification society	:	ABS
Construction	:	Steel
Length overall	:	228.6m
Gross tonnage	:	43,797

Accident details

Time and date	:	1040 UTC 25 February 2009
Location of incident	:	Fawley Marine Terminal, Solent, UK
Persons on board	:	25 crew
Injuries / fatalities	:	Nil
Pollution	:	Minor jet fuel pollution
Damage	:	Structural damage to stern structure and lifeboat davit.

1.2 NARRATIVE

1.2.1 Background

The oil product and chemical tanker *Vallermosa* was chartered to BP Oil UK Limited (BP) to carry a cargo of 35,000t of Jet Fuel A1 from Rotterdam to BP Hamble Terminal's jetty (BPJ) in Southampton Water.

Vallermosa completed loading in Rotterdam at 0106 CET on 24 February, and the ship cleared harbour at 0648 that morning. Following an uneventful voyage, the vessel anchored at 2212 the same day at the Nab Anchorage No.10, south-east of the Isle of Wight **(Figure 1)**[1], to await her berth at the next high water.

1.2.2 Weather and tidal data

Vallermosa was scheduled to berth alongside BPJ at high water, predicted for 1101 on 25 February 2009, 4.4m above Chart Datum, 2 days before spring tides. The wind was west-south-west at around 8 to 10 kts, with good visibility. *Vallermosa* experienced a following tidal flow of around 1.0 kt as she entered the Thorn Channel, which reduced during the remaining passage to approximately 0.5 kt.

1.2.3 Events leading to the accident

The BP Hamble Terminal marine supervisor, who normally ensured that customs documentation was correct, was on leave at the time and this task had been delegated to the terminal's loading master. He arrived at BPJ at around 0700 on 25 February. He opened an email from the customs agent, received at 1612 the previous evening, which requested confirmation of the cargo's country of origin, and replied stating that the cargo originated in Rotterdam.

At 0736 *Vallermosa* departed the anchorage for the 21nm passage to the berth. The master conned the ship east of Nab Tower to embark the pilot, and at 0800 the third officer (3/O) took over from the chief officer as the officer of the watch (OOW).

At 0820, the pilot embarked *Vallermosa*, arriving on the bridge at 0824. The pilot explained to the master that the vessel would berth at high water, port side alongside, and that two tugs had been booked to provide assistance during the berthing operation. The pilot handed the master a copy of the ABP Southampton Port Passage Plan and Pilotage Document **(Figure 2)** showing the expected passage times, under keel clearances and expected tidal streams; the master then signed the Pilotage Document. The master informed the pilot that *Vallermosa* had a draught of 10.8m, was fitted with a Becker rudder, an 800kW bow thruster and that, when the engine was operated astern, the vessel would be affected by transverse thrust. The master passed a copy of the Pilot Card **(Figure 3)** to the pilot, which he then signed.

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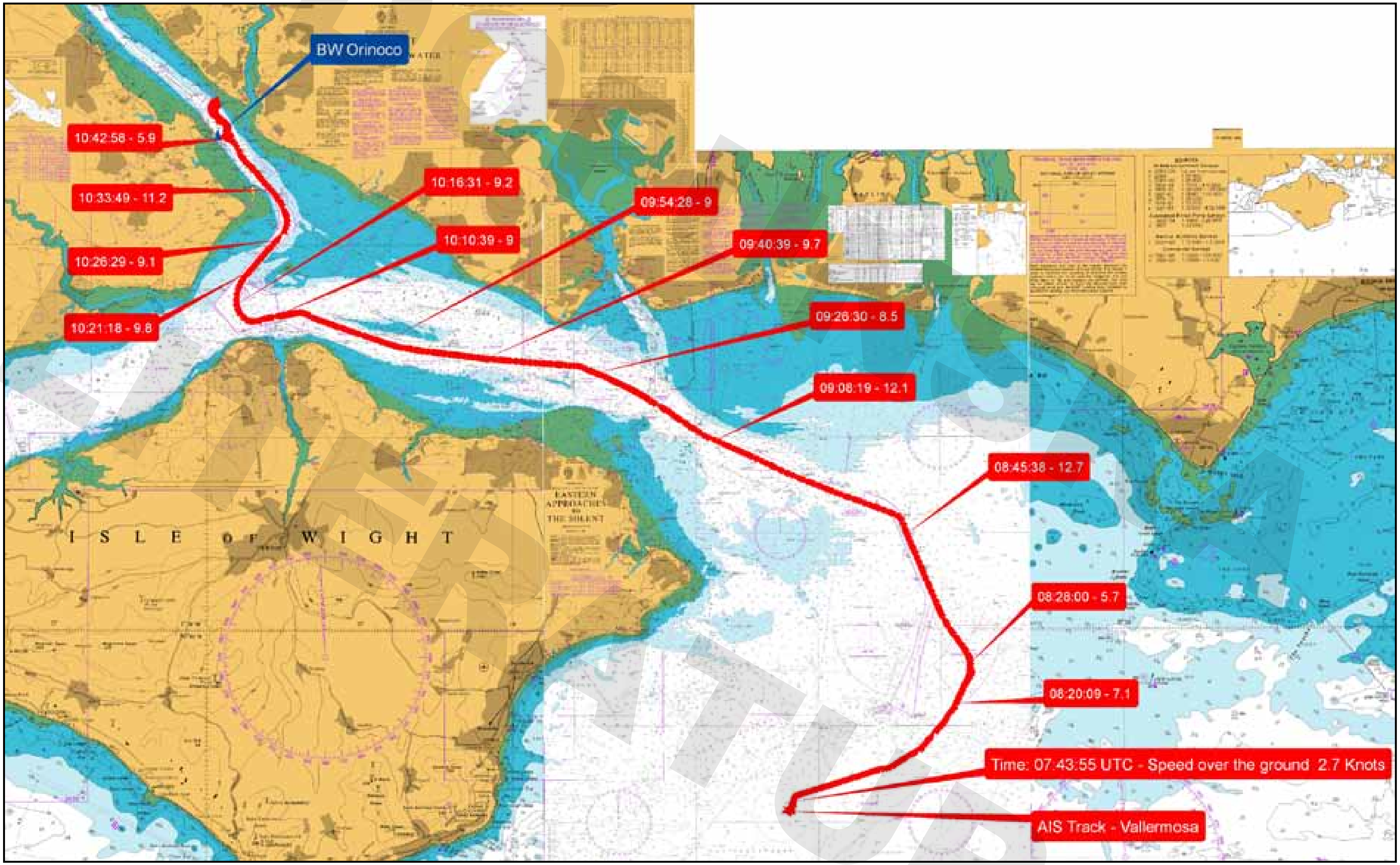
[1] Figures 1 and 5 indicate the vessel's position at the times stated within the narrative.

Figure 1

AIS data courtesy of MCA

Reproduced from Admiralty Chart BA 2450 by permission of the Controller of HMSO and the UK Hydrographic Office



Route taken by *Vallermosa*

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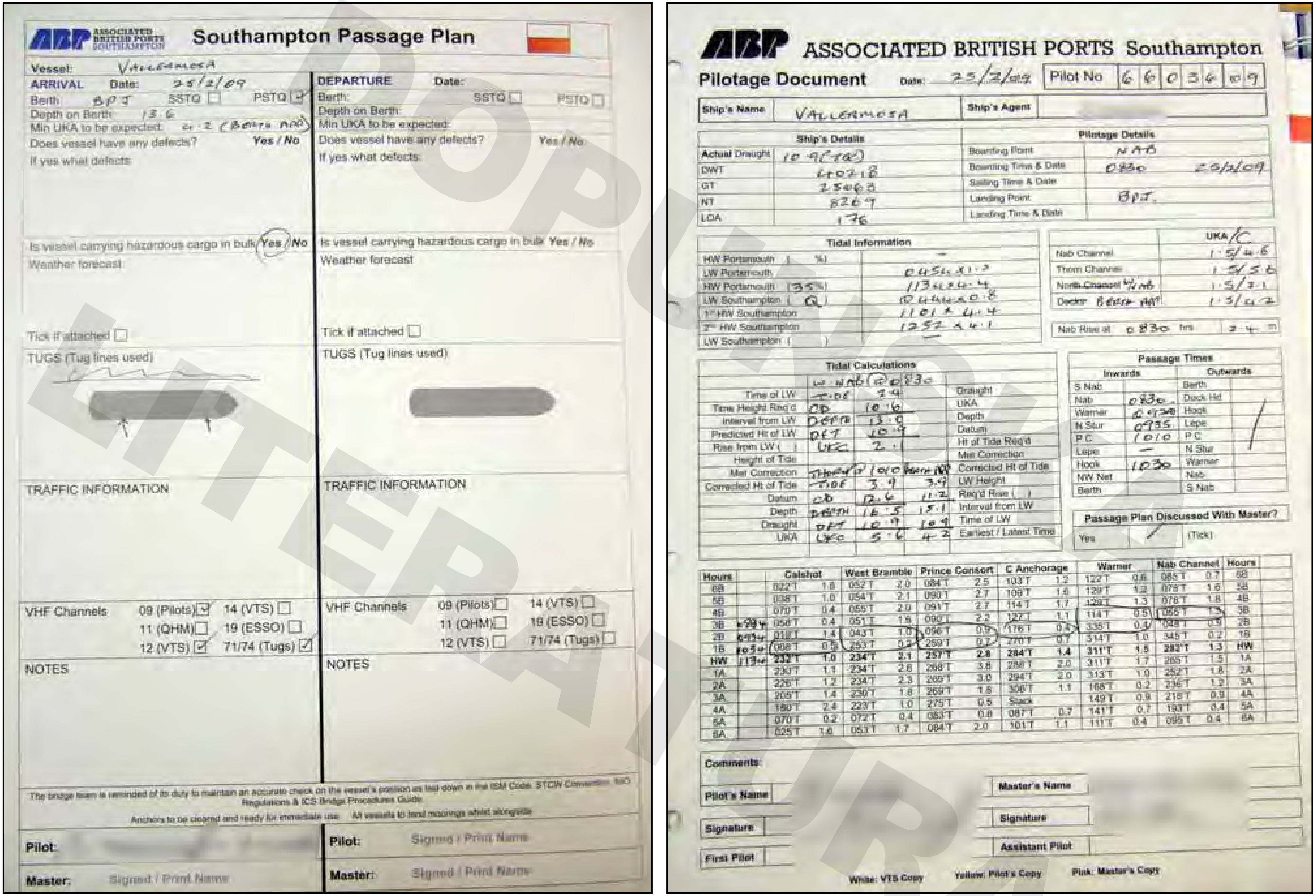
Figure 2



ABP ASSOCIATED BRITISH PORTS SOUTHAMPTON

Southampton Passage Plan

Vessel: VALLERMOSA

ARRIVAL	DEPARTURE
Date: 25/2/09	Date:
Berth: BPT SSTQ ☐ PSTQ ☑	Berth: SSTQ ☐ PSTQ ☐
Depth on Berth: 13.6	Depth on Berth:
Min UKA to be expected: 4.2 (BERTH APP)	Min UKA to be expected:
Does vessel have any defects? Yes / No	Does vessel have any defects? Yes / No
If yes what defects:	If yes what defects:
Is vessel carrying hazardous cargo in bulk Yes / No	Is vessel carrying hazardous cargo in bulk Yes / No
Weather forecast	Weather forecast
Tick if attached ☐	Tick if attached ☐
TUGS (Tug lines used)	TUGS (Tug lines used)
TRAFFIC INFORMATION	TRAFFIC INFORMATION
VHF Channels 09 (Pilots) ☑ 14 (VTS) ☐ 11 (QHM) ☐ 19 (ESSO) ☐ 12 (VTS) ☑ 71/74 (Tugs) ☑	VHF Channels 09 (Pilots) ☐ 14 (VTS) ☐ 11 (QHM) ☐ 19 (ESSO) ☐ 12 (VTS) ☐ 71/74 (Tugs) ☐
NOTES	NOTES

The bridge team is reminded of its duty to maintain an accurate check on the vessel's position as laid down in the ISM Code, STCW Convention, IMO Regulations & ICS Bridge Procedures Guide.

Anchors to be cleared and ready for immediate use. All vessels to tend moorings whilst alongside.

Pilot:	Pilot: Signed / Print Name
Master: Signed / Print Name	Master: Signed / Print Name

ABP ASSOCIATED BRITISH PORTS Southampton

Pilotage Document

Date: 25/2/09 Pilot No 6 6 0 3 6 09

Ship's Name: VALLERMOSA Ship's Agent:

Ship's Details		Pilotage Details		
Actual Draught	10.9 (TOD)	Boarding Point	NAB	
DWT	40218	Boarding Time & Date	0830	25/2/09
GT	25063	Sailing Time & Date		
NT	8269	Landing Point	BPT.	
LOA	176	Landing Time & Date		

Tidal Information	
HW Portsmouth (%)	–
LW Portsmouth	0454 x 1.2
HW Portsmouth (35%)	1134 x 4.4
LW Southampton (Q)	0444 x 0.8
1st HW Southampton	1101 x 4.4
2nd HW Southampton	1252 x 4.1
LW Southampton ( )	

	UKA /C
Nab Channel	1.5/4.6
Thorn Channel	1.5/5.6
~~North Channel~~ W/NB	1.5/3.1
~~Docks~~ BERTH APP	1.5/4.2

Nab Rise at 0830 hrs 2.4 m

Tidal Calculations				
	W NAB @ 0830			
Time of LW	TIDE	2.4		Draught
Time Height Req'd	CD	10.6		UKA
Interval from LW	DEPTH	13.0		Depth
Predicted Ht of LW	DFT	10.9		Datum
Rise from LW ( )	UKC	2.1		Ht of Tide Req'd
Height of Tide				Met Correction
Met Correction	THORN @ 1010		BERTH APP	Corrected Ht of Tide
Corrected Ht of Tide	TIDE	3.9	3.9	LW Height
Datum	CD	12.6	11.2	Req'd Rise ( )
Depth	DEPTH	16.5	15.1	Interval from LW
Draught	DFT	10.9	10.9	Time of LW
UKA	UKC	5.6	4.2	Earliest / Latest Time

Passage Times			
Inwards		Outwards	
S Nab		Berth	
Nab	0830	Dock Hd	
Warner	0920	Hook	
N Stur	0935	Lepe	
PC	1010	PC	
Lepe	–	N Stur	
Hook	1030	Warner	
NW Net		Nab	
Berth		S Nab	

Passage Plan Discussed With Master? Yes ✓ (Tick)

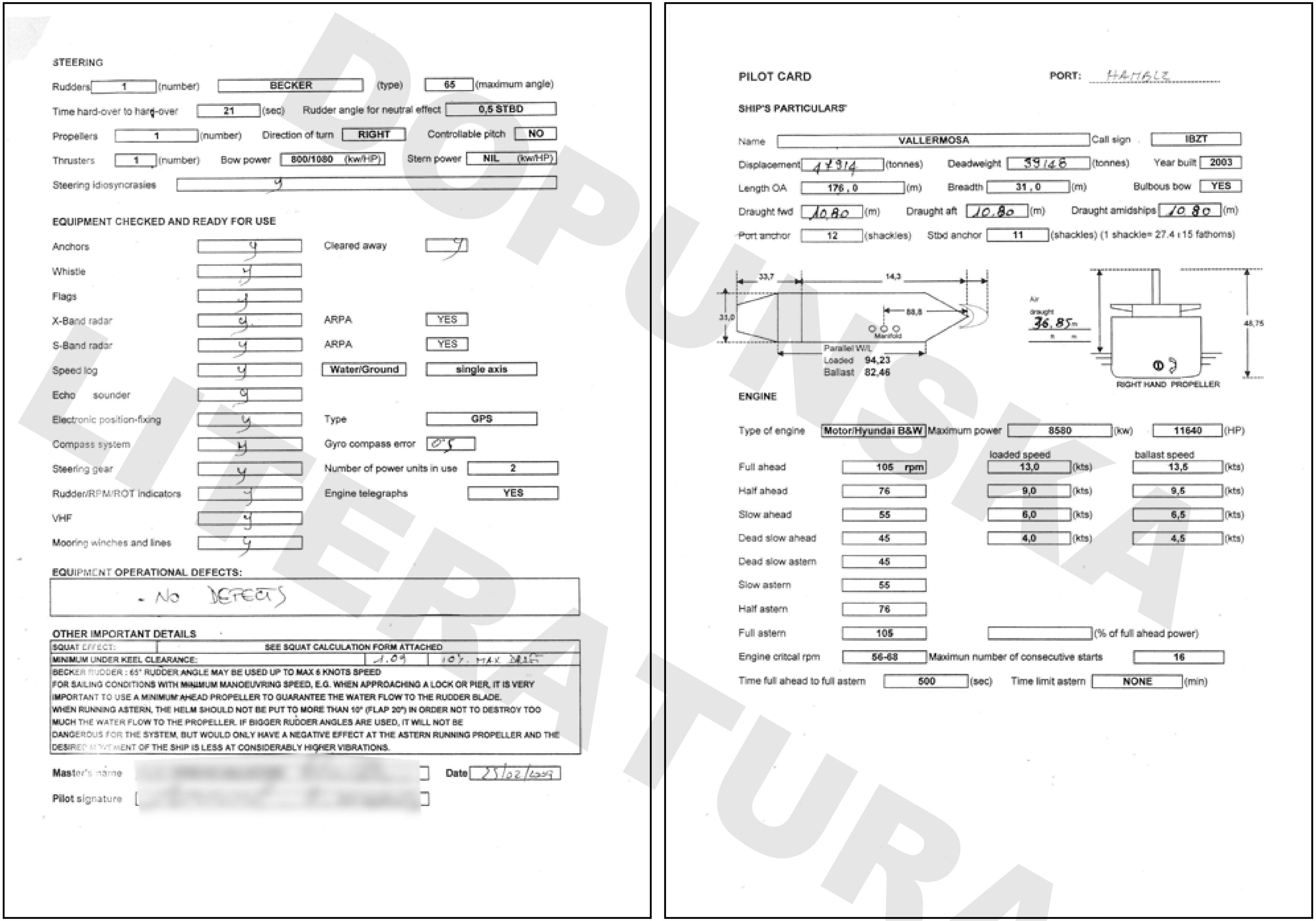
Hours		Calshot		West Bramble		Prince Consort		C Anchorage		Warner		Nab Channel		Hours
6B		022T	1.8	052T	2.0	084T	2.5	103T	1.2	122T	0.6	085T	0.7	6B
5B		038T	1.0	054T	2.1	090T	2.7	109T	1.6	129T	1.2	078T	1.6	5B
4B		070T	0.4	055T	2.0	091T	2.7	114T	1.7	129T	1.3	078T	1.8	4B
3B	0834	058T	0.4	051T	1.6	090T	2.2	127T	1.1	114T	0.5	065T	1.3	3B
2B	0934	018T	1.4	043T	1.0	096T	0.9	176T	0.4	335T	0.4	048T	0.9	2B
1B	1034	008T	0.5	253T	0.2	259T	0.7	270T	0.7	314T	1.0	345T	0.2	1B
HW	1134	**232T**	**1.8**	**234T**	**2.1**	**257T**	**2.8**	**284T**	**1.4**	**311T**	**1.5**	**282T**	**1.3**	**HW**
1A		230T	1.1	234T	2.6	268T	3.8	288T	2.0	311T	1.7	265T	1.5	1A
2A		226T	1.2	234T	2.3	269T	3.0	294T	2.0	313T	1.0	252T	1.8	2A
3A		205T	1.4	230T	1.8	269T	1.8	306T	1.1	168T	0.2	236T	1.2	3A
4A		180T	2.4	223T	1.0	275T	0.5	Slack		149T	0.9	218T	0.9	4A
5A		070T	0.2	072T	0.4	083T	0.8	087T	0.7	141T	0.7	193T	0.4	5A
6A		525T	1.6	053T	1.7	084T	2.0	101T	1.1	111T	0.4	095T	0.4	6A

Comments:

Pilot's Name		Master's Name	
Signature		Signature	
First Pilot		Assistant Pilot	

White: VTS Copy Yellow: Pilot's Copy Pink: Master's Copy

ABP Southampton Port Passage Plan (left) and Pilotage Document (right)



PILOT CARD PORT: HAMBLE

SHIP'S PARTICULARS

Name: VALLERMOSA — Call sign: IBZT

Displacement: 47914 (tonnes) — Deadweight: 39148 (tonnes) — Year built: 2003

Length OA: 176,0 (m) — Breadth: 31,0 (m) — Bulbous bow: YES

Draught fwd: 10,80 (m) — Draught aft: 10,80 (m) — Draught amidships: 10,80 (m)

Port anchor: 12 (shackles) — Stbd anchor: 11 (shackles) (1 shackle= 27.4 ı 15 fathoms)

ENGINE

Type of engine: Motor/Hyundai B&W — Maximum power: 8580 (kw) 11640 (HP)

		loaded speed	ballast speed
Full ahead	105 rpm	13,0 (kts)	13,5 (kts)
Half ahead	76	9,0 (kts)	9,5 (kts)
Slow ahead	55	6,0 (kts)	6,5 (kts)
Dead slow ahead	45	4,0 (kts)	4,5 (kts)
Dead slow astern	45		
Slow astern	55		
Half astern	76		
Full astern	105	(% of full ahead power)	

Engine critcal rpm: 56-68 — Maximun number of consecutive starts: 16

Time full ahead to full astern: 500 (sec) — Time limit astern: NONE (min)

STEERING

Rudders: 1 (number) — BECKER (type) — 65 (maximum angle)

Time hard-over to hard-over: 21 (sec) — Rudder angle for neutral effect: 0,5 STBD

Propellers: 1 (number) — Direction of turn: RIGHT — Controllable pitch: NO

Thrusters: 1 (number) — Bow power: 800/1080 (kw/HP) — Stern power: NIL (kw/HP)

Steering idiosyncrasies: y

EQUIPMENT CHECKED AND READY FOR USE

Anchors	y	Cleared away	y
Whistle	y		
Flags	y		
X-Band radar	y	ARPA	YES
S-Band radar	y	ARPA	YES
Speed log	y	Water/Ground	single axis
Echo sounder	y		
Electronic position-fixing	y	Type	GPS
Compass system	y	Gyro compass error	0°5
Steering gear	y	Number of power units in use	2
Rudder/RPM/ROT indicators	y	Engine telegraphs	YES
VHF	y		
Mooring winches and lines	y		

EQUIPMENT OPERATIONAL DEFECTS:

- NO DEFECTS

OTHER IMPORTANT DETAILS

SQUAT EFFECT:	SEE SQUAT CALCULATION FORM ATTACHED	
MINIMUM UNDER KEEL CLEARANCE:	1.09	10% MAX DRAFT

BECKER RUDDER : 65° RUDDER ANGLE MAY BE USED UP TO MAX 6 KNOTS SPEED
FOR SAILING CONDITIONS WITH MINIMUM MANOEUVRING SPEED, E.G. WHEN APPROACHING A LOCK OR PIER, IT IS VERY IMPORTANT TO USE A MINIMUM AHEAD PROPELLER TO GUARANTEE THE WATER FLOW TO THE RUDDER BLADE.
WHEN RUNNING ASTERN, THE HELM SHOULD NOT BE PUT TO MORE THAN 10° (FLAP 20°) IN ORDER NOT TO DESTROY TOO MUCH THE WATER FLOW TO THE PROPELLER. IF BIGGER RUDDER ANGLES ARE USED, IT WILL NOT BE DANGEROUS FOR THE SYSTEM, BUT WOULD ONLY HAVE A NEGATIVE EFFECT AT THE ASTERN RUNNING PROPELLER AND THE DESIRED MOVEMENT OF THE SHIP IS LESS AT CONSIDERABLY HIGHER VIBRATIONS.

Master's name: [redacted] — Date: 25/02/2009

Pilot signature: [redacted]

Pilot Card from *Vallermosa*

As *Vallermosa* proceeded inbound, the bridge was manned by the master, the 3/O, a cadet and a helmsman. The cadet was plotting the vessel's position on the paper chart, the 3/O was responding to the pilot's engine instructions, and the helmsman steered the vessel to the pilot's orders. The pilot was standing by the starboard radar display **(Figure 4)**. The master remained on the bridge throughout and allowed the pilot to con the ship.

Figure 4

Pilot's position next to the starboard radar display

Although *Vallermosa* was fitted with an Electronic Chart System (ECS), the paper chart remained the primary means of navigation. The vessel's position was monitored by visual and radar navigation and plotted on the paper chart. The ECS was not monitored during the passage, and the display did not show *Vallermosa*'s position from the time the vessel turned into the Thorn Channel.

At 0828 the pilot ordered full manoeuvring speed of 13.5 kts for the initial passage in the Solent.

At 0845 the pilot conducted the first turn in the Solent; the ship turned as expected, and neither pilot nor master commented on the manoeuvre. At 0908, with the speed through the water (STW) of 13 kts[2], the pilot ordered the

2 *Vallermosa*'s speed through the water is used throughout the narrative . Ground speed, shown in the figures and taken from AIS, is greater than water speed by around 1 knot, reducing to 0.5 knot as the flood tidal stream diminished during the passage.

main engine to *half ahead*. As the vessel passed the entrance to Portsmouth Harbour, the pilot and master discussed in more detail the berthing plan and the mooring lines required to secure the vessel. The pilot also observed that he expected to hear from the BPJ personnel shortly to confirm the berthing plan.

At 0926 a customs agent queried the origin of *Vallermosa*'s cargo and the customs paperwork provided. The origin of the cargo had been declared as "Rotterdam" on a customs form that was designed to be used for cargoes originating from outside the European Union.

At around 0940, as *Vallermosa* passed the Mother Bank buoy, the BP Hamble Terminal marine superintendent telephoned the Southampton Vessel Traffic Services (VTS) watch manager, and informed him that *Vallermosa*'s berthing might be aborted as the correct paperwork for the cargo had not been received. The watch manager informed the marine superintendent that any decision to abort would need to be taken within the next 15 minutes to enable *Vallermosa* to be diverted to an anchorage north of the Ryde Middle Buoy before she entered the Thorn Channel.

At around 0950, the Svitzer tugs booked to assist *Vallermosa*'s arrival, *Svitzer Sarah* and *Lyndhurst*, departed Dock Head in order to meet the vessel west of the Hook buoy.

At 0954 an email was sent from BP's London office to the BP Hamble Terminal marine superintendent, which stated that the required certificate of origin for *Vallermosa*'s cargo would be sent *"in the next 10 minutes"*.

At 1010, as *Vallermosa* approached the West Bramble Buoy, her speed was 9.4 kts, and the pilot ordered the main engine to *full ahead* to increase the water flow over the rudder and execute a broad turn to starboard into the Thorn Channel. During the turn no discussions were held between master and pilot regarding either the turn or the handling characteristics of the vessel.

At 1016, the marine superintendent sent an email to the BP Jet desk[3] in London stating that *Vallermosa*'s berthing had been aborted due to improper documentation, and then told the loading master to advise *Vallermosa* by VHF radio of the decision to abort and that the vessel should return to anchor.

Vallermosa continued to turn into the Thorn Channel and, at 1018, the pilot ordered the main engine to *half ahead*. As the ship entered the Thorn Channel the BP Hamble Terminal loading master called *Vallermosa* and advised the pilot that, due to incorrect paperwork, *Vallermosa*'s berthing was aborted and that he should return the ship to the Nab anchorage. The pilot requested that the transmission be repeated as he had expected to hear the routine berthing information, and to allow the master, who had not heard the original message,

[3] The BP Jet desk coordinates the transportation and delivery of jet fuel bought and sold by BP jet fuel brokers.

to listen. The information was then repeated. The pilot requested that the ship's agent be contacted so that the decision to abort could be formally passed to the master.

At 1021, once *Vallermosa* had completed the turn and was steady on a course of 040^o **(Figure 5)**, the pilot called Southampton VTS to confirm that the vessel was required to return to anchor. The Vessel Traffic Services Officer (VTSO) confirmed the information and explained that the vessel should return to the Nab anchorage, rather than the closer Ryde Middle anchorages, as the time required to rectify the paperwork problem was unknown.

The pilot then asked the VTS watch manager whether the tugs had been advised that they were no longer required, and was informed that they had not. The pilot checked with the master whether, as *Vallermosa* was fitted with a Becker rudder and bow thruster, he thought that tugs would be necessary to assist when turning the vessel to head seaward. The master replied that tugs were not necessary, and the pilot agreed with him. The pilot then confirmed to the VTSO that the tugs were not required, and that he would inform them of this.

The pilot, frustrated by the instruction to abort the berthing, remarked to the master that they should have been advised of the decision much earlier, or even before the pilot had embarked.

At 1023, with the vessel making 9.5 kts, the pilot ordered the main engine to *slow ahead*, for a speed of 6 kts. The pilot then called the harbour tug *Svitzer Sarah* on VHF radio and advised the skipper that the berthing had been aborted and that the tug was not required. *Svitzer Sarah*'s skipper offered to stand by until *Vallermosa* had been turned to face seaward. The pilot declined his offer, and then replied to a radio call from *Lyndhurst*'s skipper and confirmed that his tug was also not required.

Although the master had heard the various VHF exchanges concerning the change to the plan, the pilot again briefed him that he planned to turn *Vallermosa* off the Fawley Marine Terminal jetty and return to the Nab anchorage. The master then discussed the tug cancellation and the changed plan with the ship's agent by mobile phone.

At 1026, the vessel was approaching Calshot Spit at 8.8 kts. The pilot ordered the main engine to *half ahead* to assist the turn, and then ordered the rudder to *port 5^o*. At 1028, the pilot ordered the main engine speed to *full ahead* as *Vallermosa* started to turn into Calshot Reach.

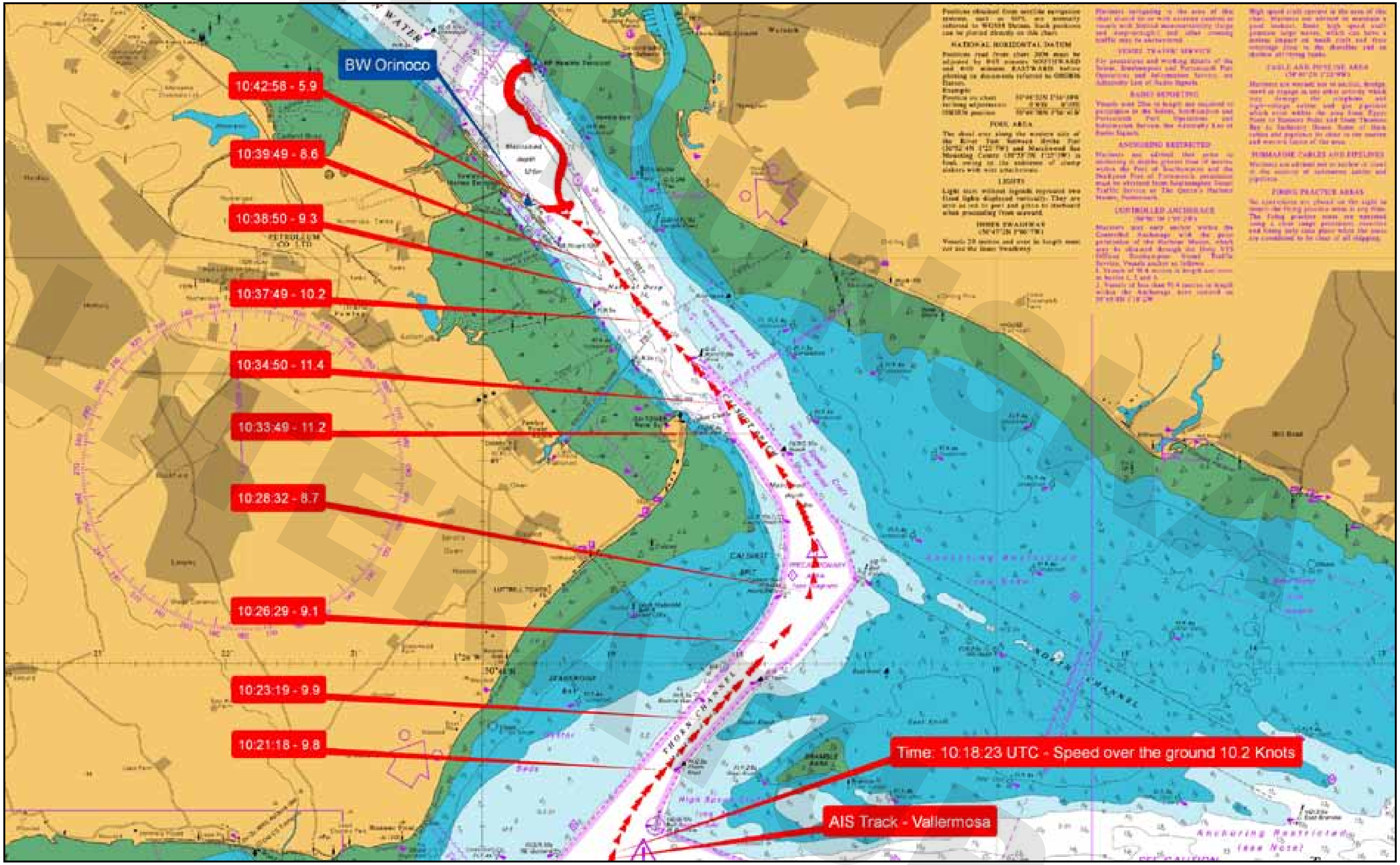
At 1029, the BP Hamble Terminal marine superintendent received another certificate of origin for *Vallermosa*'s cargo, which was forwarded to BP's customs agent. The customs agent subsequently replied that this certificate was acceptable.

As *Vallermosa* turned around Calshot Spit, her speed increased to 9.5 kts.

Figure 5

AIS data courtesy of MCA

Reproduced from Admiralty Chart BA 2036 by permission of the Controller of HMSO and the UK Hydrographic Office



Route taken by *Vallermosa*

At 1033, as the pilot ordered the helmsman to steady on a course of 318º into Southampton Water, he realised that the ship's speed was 10.5 kts, contrary to his plan, which called for the vessel to be proceeding at 4-5 kts at this point.

At 1034 the pilot reduced the main engine speed to *half ahead* as *Vallermosa* approached the VTS reporting point at the Hook buoy, 1nm from the southern end of the Fawley Marine Terminal. At 1035, the pilot reported to VTS as the vessel passed the Hook buoy, and the VTSO acknowledged his call. The pilot ordered the main engine to *slow ahead* at 1036, followed 30 seconds later by *dead slow ahead*. At 1037, the engine was ordered to *stop*, with the vessel travelling at 10.0 kts, and steady on a course of 320º.

Neither the master nor the bridge officers voiced any concern over *Vallermosa*'s speed, and the pilot did not bring the vessel's unexpectedly high speed to their attention.

At 1038, the VTSO called *Vallermosa* and advised the pilot that Bravo anchorage, which was closer than the previously agreed Nab anchorage, was available. Initially the pilot asked the master to wait to be shown the new anchorage until after the turn off Fawley Marine Terminal had been completed. The pilot then changed his mind, and requested the master's chart so that he could show him the position of the new anchorage. During this conversation *Vallermosa* started to swing to starboard, and the helmsman increased the port helm in an attempt to return the vessel to the required heading. When the rudder was at 35º to port the helmsman advised the pilot that the wheel was hard over and the ship was not responding to the helm. The pilot ordered the main engine to *dead slow ahead*, and the wheel held *hard to port*.

At 1039, 3 cables from Fawley Marine Terminal, and at a speed of 8.0 kts, *Vallermosa* started to swing to port. The pilot ordered the main engine to *stop* and the wheel to *amidships*, and 30 seconds later the main engine to *dead slow astern*. The pilot then asked the master to confirm that the bow would swing to starboard if the engine was operated astern. The master confirmed this, and the pilot ordered the main engine to *slow astern* as the rate of turn to port increased to 18º per minute.

At 1040, as the rate of turn did not decrease as expected, the pilot realised that the expected transverse thrust was not developing. The pilot then ordered the main engine to *stop*, the wheel *hard to starboard*, and then the main engine to *dead slow ahead*. At 1041, with *Vallermosa* 1 cable from the southern end of Fawley Marine Terminal, at a speed of 7 kts, the pilot ordered the bow thrust *full to starboard*. As the ship continued to swing to port, now at 20º per minute, the pilot ordered the main engine to *dead slow ahead*, and instructed that the Becker rudder should be used at 50º to starboard and then full over to 65º, which was repeated by the master. The pilot then ordered the main engine to *slow ahead*.

The Fawley Marine Terminal jetty supervisor saw *Vallermosa* approaching and called *Navion Fennia*'s OOW by VHF radio to advise him to stop pumping cargo immediately. He then repeated this message to the OOW of *BW Orinoco*.

The VTSO, aware that *Vallermosa* was close to Fawley Marine Terminal, contacted the Fawley Marine Terminal marine controller by telephone and alerted him to the vessel's presence.

At 1042, the pilot asked the master whether the anchors were ready to let go, and the master instructed the anchor party to stand by. The pilot ordered both anchors *let go*, the main engine to *stop* and, immediately after, the main engine to *full astern*. The rudder was held at 65º to starboard as both anchors were let go. The pilot then confirmed the *full astern* engine order and instructed the master to ensure that the anchors were held. He then ordered the rudder to *amidships*.

At 1043, *Vallermosa*'s speed had reduced to 5.5 kts as the vessel made contact with *Navion Fennia,* berthed at Fawley Marine Terminal berth 5, causing a large flash as the two ships touched. *Navion Fennia*'s OOW stopped discharging cargo by activating the cargo pump emergency stops following the contact. *BW Orinoco*'s OOW predicted that contact was imminent, and stopped discharging cargo before *Vallermosa* struck the vessel's stern. *BW Orinoco*, berthed at Fawley Marine Terminal berth 4, was pushed forward by the force of the contact, which parted two forward spring mooring lines and caused the shore gangway to collapse on to the vessel's deck.

As *Vallermosa*'s speed reduced, the pilot ordered the main engine to *slow astern* and the bow thrust stopped. The Solent Towage operated tugs *Tenax*, *Phenix, Apex* and *Thrax*, stationed at Fawley Marine Terminal, left their berth to assist. As *Vallermosa*'s stern lifted from the jetty, two of *BW Orinoco*'s four cargo hoses split and an estimated 600L of jet fuel leaked onto the jetty and then down and into the Solent. *BW Orinoco*'s master sounded the vessel's general alarm and contacted VTS for assistance.

1.2.4 Post accident

The tug *Tenax* assisted and then stood by as *Vallermosa* moved astern from Fawley Marine Terminal and clear of the berthed vessels. The tugs *Phenix, Apex* and *Thrax* pushed *BW Orinoco* alongside the jetty and held her in position while the cargo hoses and mooring lines were re-secured. During this movement, Svitzer tug *Lyndhurst* advised *Vallermosa* that VTS had given permission for the vessel to berth alongside BPJ.

The spilt jet fuel was quickly dispersed by the propeller wash from the tugs. The VTS watch manager contacted Solent Coastguard and the Environment Agency to advise them of the situation.

At 1050, the pilot used his mobile phone to contact VTS, who confirmed that the intention was for *Vallermosa* to berth at BPJ and that the necessary authorisation for this had been received.

With the tugs *Svitzer Sarah* and *Lyndhurst* made fast, and tug *Tenax* in attendance, *Vallermosa* was manoeuvred alongside BPJ and was secured at 1312. Cargo discharge started at 1636.

1.3 DAMAGE

1.3.1 *Vallermosa*

Vallermosa sustained damage **(Figure 6)** to the port and starboard side forecastle bulwark and connecting brackets, the forecastle deck was heavily buckled over a 15m length. Two fairleads on the port side and two on the starboard side were damaged along with the ventilation trunking to the forward store. Following discharge of her cargo, the vessel proceeded to Portland, where temporary repairs were effected. Permanent repairs were subsequently carried out in Flushing **(Figure 7)**.

1.3.2 *Navion Fennia*

Navion Fennia, which was starboard side alongside Fawley Marine Terminal berth 5, sustained damage to her port quarter **(Figure 8)**. This consisted of torn and indented plating with buckling of associated stiffeners. Temporary repairs were effected before the vessel left the Solent, allowing permanent repairs to be deferred until her next docking period.

1.3.3 *B W Orinoco*

BW Orinoco, port side alongside Fawley Marine Terminal berth 4, sustained extensive damage to her port quarter, stern structure, poop deck and steering gear **(Figure 9)**. The vessel required steelwork replacement **(Figure 10)**, and repairs were also required to the freefall lifeboat davit before she could leave the Solent.

1.4 ABP SOUTHAMPTON

1.4.1 ABP Southampton

Associated British Ports (ABP) is controlled by Associated British Ports Holdings plc, a company formed by the Secretary of State under Part II of the Transport Act 1981.

ABP is the Statutory Harbour Authority (SHA) and Competent Harbour Authority (CHA) for several ports, including Southampton.

ABP Southampton is one of the UK's busiest ports. It handles in excess of 42 million tonnes of cargo annually, or around 7% of the UK's seaborne trade, and is the main gateway for Far East imports. Its natural deep-water harbour allows the port to accept some of the world's largest vessels.

Figure 6

Damage sustained by *Vallermosa*

Figure 7

Vallermosa undergoing repairs in Flushing

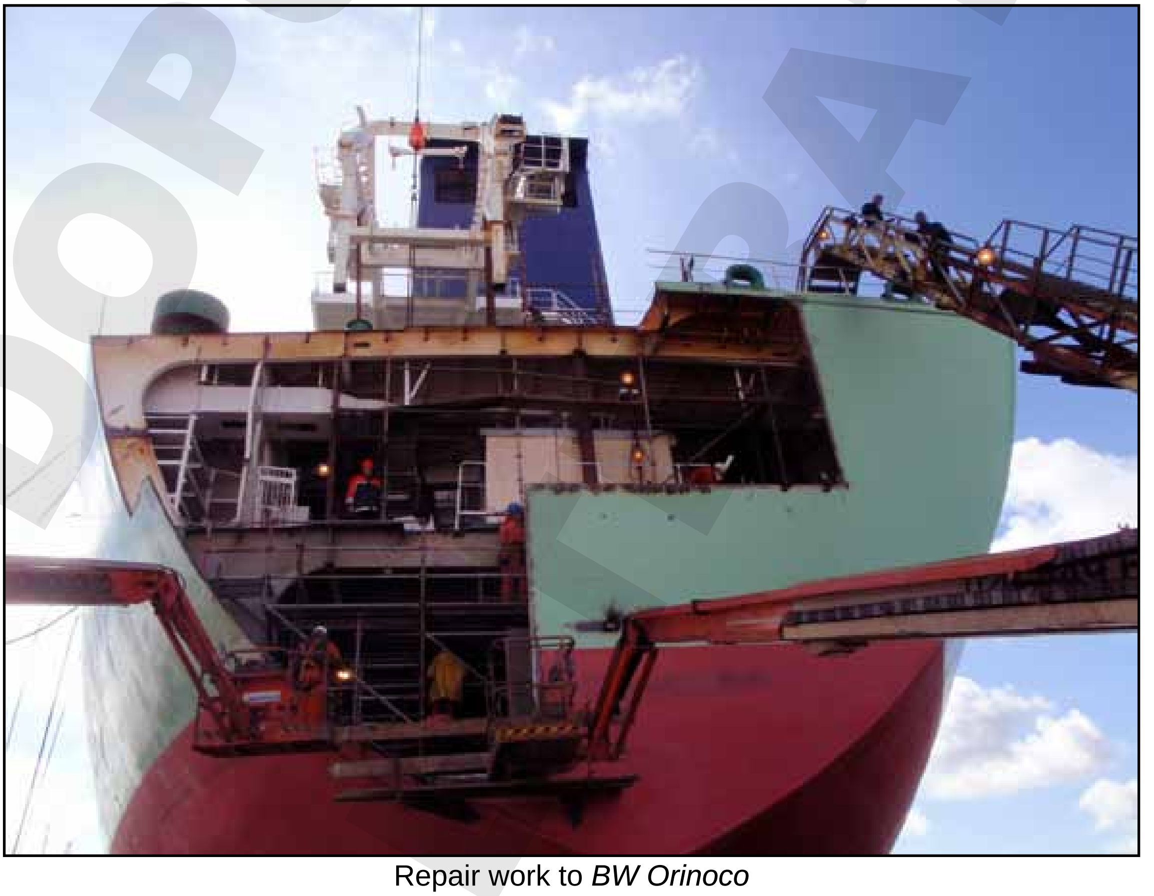
Figure 8

Damage sustained by *Navion Fennia*

Figure 9

Damage sustained by *BW Orinoco*

Figure 10



Repair work to *BW Orinoco*

Southampton's liquid-bulk traffic comprises mainly crude oil. The facilities at Esso Fawley and BP Hamble Terminal together handle over 28 million tonnes of oil and petroleum-related products each year.

1.4.2 Stakeholder meetings

ABP Southampton holds several stakeholder meetings each year, including the following:

- ABP Southampton, Esso and BP Liaison meetings are held biannually between the harbourmaster, deputy harbourmaster, assistant harbourmaster, pilots and terminal operators of both Esso Fawley and BP Hamble.
- Pilot Operational Meetings are held every 2 months between the deputy harbourmaster and Southampton pilot representatives.
- Risk assessment meetings are held at bi-monthly intervals with the deputy harbourmaster, assistant harbourmaster, Southampton pilots, marine officers, VTS staff and berthing operators.

1.4.3 Port users information and navigation guidelines

Guideline No 2 - The movement of inward bound large vessels, which considers a large vessel to be greater than 220m length overall (LOA), states that:

> *If any problems exist with the vessel or terminal, the vessel will not be permitted to enter the Thorn Channel and will be advised of a suitable anchorage by Southampton VTS any problem anticipated with the vessel or terminal berth before the vessel passes South Ryde Middle Buoy in order that appropriate action may be taken.* [sic]

Because *Vallermosa* had an LOA of 176m, there was no requirement for the availability of her berth at BP Hamble Terminal to be confirmed before she entered the Thorn Channel under the terms of this guideline.

1.4.4 Southampton harbour bylaws

Part II - Navigation of vessels – Speed of vessels, states that:

> *No person shall navigate a vessel or watercraft –*
>
> *Without the permission of the harbour master ….in the case of vessels with a draught of 6.0 metres or over, when approaching or passing the oil jetties at Fawley and Hamble in Southampton Water, at a speed in excess of 7 kts over the ground…and closer than 130m from the face of the jetties at Fawley and Hamble, unless engaged in berthing or un-berthing of vessels at those jetties.*
>
> *All vessels of a draught of less than 6.0 metres shall, so far as is consistent with safe navigation…., reduce speed when approaching or passing the oil jetties at Fawley and Hamble so as to have no adverse impact on vessels alongside the jetties.*

1.4.5 Southampton Vessel Traffic Services

Southampton VTS offers a Traffic Organisation Service, as defined by the MCA in Marine Guidance Note 238, viz:

> *'A service to prevent the development of dangerous maritime traffic situations and to provide for the safe and efficient movement of vessel traffic within the VTS Area'. The provision of a Traffic Organisation Service includes a comprehensive and dedicated service, throughout the declared service period, without which the long term planning of traffic movement and developing situation would not be possible. This service is, by its nature, more comprehensive than an Information Service, the capability of which it necessarily includes. A Traffic Organisation Service is concerned with, for example:*
>
> *(1) Forward planning of vessel movements;*
>
> *(2) Congestion and dangerous situations;*
>
> *(3) The movement of special transports;*
>
> *(4) Traffic clearance systems;*
>
> *(5) VTS sailing plans;*
>
> *(6) Routes to be followed;*
>
> *(7) Adherence to governing rules and regulations.*
>
> *Instructions given as part of a Traffic Organisation Service shall be result orientated, leaving the details of the execution to the vessel.*

The service applies to any craft of 20m or more in length.

1.5 PILOTAGE

1.5.1 Pilotage law

The law has traditionally considered a marine pilot on board a ship "conducting" its navigation as the employee of the ship owner. The International Maritime Organization (IMO) is clear in its assertion that the master remains in command of the ship throughout. IMO Resolution A.920(23), adopted on 5 December 2003, (Annex 2) – Recommendations on Operational Procedures for Maritime Pilots other than Deep Sea Pilots, states:

> *Duties of master, bridge officers and pilot.*
>
> *Despite the duties and obligations of a pilot, the pilot's presence onboard does not relieve the master or officer in charge of the navigational watch from their duties and obligations for the safety of the ship. It is important that, upon boarding the ship and before pilotage commences, the pilot, master and other bridge personnel are aware of their respective roles in the safe passage of the ship.*

The resolution also states:

> *Refusal of Pilotage services*:
>
> *The pilot should have the right to refuse pilotage when the ship to be piloted poses a danger to the safety of navigation or the environment. Any such refusal, together with the reason, should be immediately reported to the appropriate authority for action as appropriate.*

Over the years, the nature of the legal relationship between the ship owner and the pilot has been the subject of numerous court deliberations as to the liability of the ship owner and that of the pilot's general employer. In 1993 the ruling of the Admiralty Court in the case of *Cavendish*, in which the Pilotage Act 1987, rather than the 1913 Act, applied stated:

> *The fact that a ship is being navigated in an area and in circumstances in which pilotage is compulsory for it shall not affect any liability of the Owner or Master of the ship for any loss or damage caused by the ship or by the manner in which it is navigated.*

This decision made the ship owner the employer of the pilot. The judge went on to say that, once this was established, the principle that a servant cannot have two masters, precludes the pilot from being simultaneously considered the servant of his general employer[4].

1.5.2 Pilotage directions

Pilotage is compulsory in the ABP Southampton CHA for all vessels above 61m LOA bound to or from the port of Southampton, or transiting the Solent when navigating in CHA pilotage area. Pilotage is also compulsory for vessels greater than 20m in length carrying more than 12 passengers. However, military vessels may be exempt.

1.5.3 Pilot requirements

Vallermosa, with an LOA of 176m, a deadweight (DWT) of 39,148t, and a Summer DWT of 40,218t required an ABP Southampton Class 1 pilot for berthing. Upper 2nd Class pilots were permitted only to pilot vessels less than 170m LOA. A BP 'choice pilot' would have been required if *Vallermosa*'s DWT had exceeded 50,000t, or a Summer DWT of 60,000t.

1.5.4 Passage planning – pilot / master interface

The Port of Southampton Port Operations Manual states:

> Section 3: Pilotage-
>
> *The pilot does not assume the role of master, who remains at all times in charge of the safety of the vessel, including navigation. The essence of pilotage is the provision to a master of expert navigational advice, and subject to the master's overall responsibility for his ship, a pilot must have sole conduct of its navigation.*

---

4 Ambrose Rajadurai – Vicarious liability for negligent pilotage in Victoria

Section 3.8: Passage planning – Pilot / master interface **(Annex A)** states:

The careful planning of the movements of every ship in the confines of the port is an essential element of the Port's Safety Management System. The pilot / master exchange of information needs to be both detailed and structured, if the pilot's advice and the master's intentions are to be integrated to best effect.

1.6 PILOT TRAINING AND EXPERIENCE

1.6.1 Pilot training schedule

It takes a minimum of 5 years for an ABP Southampton pilot to progress from trainee to 1st Class (unrestricted) pilot status. To achieve this requires a number of specified pilotage acts, training and examination (**Figure 11)**.

After 12 months as a 1st Class (unrestricted) pilot, a pilot may be considered for appointment as a specialist 'choice pilot', for one of the Southampton's specialist pilot groups of either container, oil terminal or cruise ships. Additional trips on large vessels of the relevant type are required, along with additional simulator training and operations with tugs, prior to interview and appointment.

1.6.2 Simulator training

ABP Southampton holds three simulator courses each year at Lairdside College in Merseyside, aiming to provide each pilot with training within every 4-year period.

Groups of four pilots, including one facilitator, attend each course and carry out exercises in the 360º full mission simulator, assisted by tugs where necessary. The exercises are initially set by the facilitator, and include high winds, restricted visibility and mechanical failures. As the training progresses, input from the pilots is encouraged to focus the benefit they can gain through this training.

'Choice pilot' simulator training includes specific training for the ship type, including the largest vessels, and working with tug skippers from the Solent.

1.7 *VALLERMOSA*'S PILOT

Vallermosa's pilot joined ABP Southampton in 1996, having previously been employed as a deputy harbourmaster and pilot in another port. He was qualified as a first class, unrestricted, pilot in 2001. He had been a 'choice tanker pilot' since 2006, had recently been approved to pilot the largest tankers calling in the Solent, and had an unblemished ship handling record. The pilot had attended bridge simulator training in 2006, and had attended company-specific simulator training prior to being accepted as a company 'choice pilot'.

Figure 11

Pilot Training Schedule

Trainee	Lower 2nd Class		Upper 2nd Class	1st Class Restricted Yr 1	1st Class Restricted Yr 2	1st Class (Unrestricted)
EXAMINATION				EXAMINATION		
13 weeks min 100 Acts	V/Ls not exceeding 110m (6 months min 100 Acts)	V/Ls not exceeding 140m (6 months min 100 Acts)	V/Ls not exceeding 170m (24 months min 400 Acts)	Vessels not exceeding 220m (12 months)	Vessels not exceeding 280m (12 months) *Able to act as Liason Pilot*	Not restricted by way of vessel size but will require to keep 'in class' for piloting vessels >300m.
2 Formal Practical Assessments *(Inward & Outward)*		Interview with DHM and Training Pilot 2 Formal Practical Assessments *(Inward & Outward)*	Interview with DHM and Training Pilot 2 Formal Practical Assessments *(Inward & Outward)*	Interview with DHM and Training Pilot 2 Formal Practical Assessments *(Inward & Outward)*		Specialist (Unrestricted) Container or Tanker or Cruise
12 tug trips 4 Watches in VTS Familiarisation: hydro / Patrol Visit QHM / ESSO Radar / Ship Simulator Round trip on Dredger	6 tug trips Handling V/Ls >140m Manned Model Course		6 tug trips Handling V/Ls >170m, including one inward ESSO escort Min 6 turns on V/Ls > 170m Not less than 2 Car Carriers	8 turns on large ships >250m (4 inwards 4 outwards) Consisting of at least: 2 containers >250m 2 cruise ships >250m 2 Ro-Ros >250m		Eligible for appointment to a specialist 'Choice' group after 12 months. **Training module:** Minimum 6 appropriate turns on - Container ships 290m or Tankers > 60,000 DWT or Cruise Ships >290m (3 inwards 3 outwards) An appropriate ship / tug simulator course.

3 Months → 1 year 3 Months → 3 years 3 months → 4 years 3 months → 5 years 3 months (2006)

Pilot training schedule

1.8 BP HAMBLE TERMINAL

1.8.1 Overview

BP Hamble Terminal is located on the north of Southampton Water near the entrance to the River Hamble. The terminal imports jet fuel for distribution to the UK aviation fuel grid, and exports crude oil from the Wytch Farm oil field in Dorset. In the 12 months prior to the accident, 64 tankers have called at the jetty to either load crude oil or discharge jet fuel.

1.8.2 Berthing requirements

For vessels of *Vallermosa*'s size (18,000-49,000 DWT), two tugs were required to berth and un-berth at BPJ.

BP Hamble Terminal stipulated that a BP 'choice pilot' was required only for vessels over 60,000t Summer DWT, with a berthing displacement over 50,000t. Therefore *Vallermosa* required a first class pilot, but not a 'choice pilot' for her passage to the terminal.

1.8.3 Personnel

The terminal manager had overall responsibility for the operation of the terminal and had a shore based oil terminal background, with no practical marine experience.

The marine superintendent was a master mariner with command experience on tankers, and was responsible for the marine aspects of the jetty operation. The marine superintendent was assisted by a marine supervisor, on leave at the time of the accident, and two loading masters, all of whom had previous professional marine experience.

1.8.4 Risk Assessment

The BP Hamble Terminal managers had carried out several risk assessments, and these had been regularly reviewed. The risk assessment had included: the import and export of oil product by ship; the use of escort towage on laden vessels and vessels in ballast, entry into ship's pump rooms and pollution from ship's sea valves.

The risk assessment for importing oil product into BP Hamble was carried out in 2006 and reviewed in January 2009. This Risk Assessment considered the risks to the jetty, jetty personnel and pollution, from a vessel berthing, discharging oil product and departing the berth.

The risks to a vessel remaining alongside BPJ versus the risk of aborting the vessel to return to anchor and a subsequent inbound passage, with the inherent risks of collision and grounding, had not been assessed and were not considered to be the responsibility of BP Hamble Terminal's managers.

1.9 FAWLEY MARINE TERMINAL

The Esso refinery at Fawley, on the southern edge of Southampton Water, is the largest in the UK and one of the most complex in Europe. The refinery processes around 300,000 barrels of crude oil a day and supplies around 13% of all petroleum products in the UK. In support of this activity, Fawley Marine Terminal handles around 2,000 ship movements and 22 million tonnes of crude oil and other products every year.

1.10 IMPORTATION OF OIL - HM REVENUE AND CUSTOMS

HM Revenue and Customs (HMRC) considers oil to have been imported into the UK once the oil is pumped into the relevant shore reception facilities or the pipeline. Had *Vallermosa* berthed alongside BPJ without connecting the cargo lines, HMRC would not have considered the vessel to be importing cargo.

1.11 NAVIGAZIONE MONTANARI

1.11.1 History

At the time of the accident, Navigazione Montanari operated a fleet of 24 tankers, 19 of which were oil product carriers. A further five oil tankers were scheduled for delivery in 2009.

1.11.2 ISM Procedures - navigation with pilot on board

The Company's Safety Management Manual – Procedures and Instructions – Safety during Navigation at Anchor and Manoeuvres **(Annex B)** stated:

(*viii) Navigation with pilot on board – Captain / Pilot Relationship*

- *The presence of the Pilot on board does not alter the responsibility of the Captain who remains solely responsible for navigation safety and / or for the mooring operations of his vessel.*
- *The Captain and his officers must observe the handling of the vessel by the pilot and must not hesitate to countermand his orders if they think that the safety of the vessel is at risk.*
- *If the Captain thinks that the Pilot's incompetence can put the safety of the vessel at risk, he should take those steps that ensure safety and request that the Pilot be replaced……*[sic]

1.11.3 Audit results

The last internal audit before the accident had been carried out on 23 October 2008 by one of the marine superintendents of the SMS quality vetting department, during which no navigational non conformities were identified. A company technical inspection was completed successfully on 7 October 2008 by the technical superintendent.

Most audits are carried out while vessels are alongside in port. The company SMS did not require that the audit of navigational practices was carried out while the vessel was on passage, nor with a pilot on board.

1.12 *VALLERMOSA*

1.12.1 Construction

Vallermosa is one of a 'class' of at least 14 sister ships built in the last 8 years at the Hyundai Mipo Dockyard. All the vessels were designed and fitted with Becker high performance rudders, and the same engine and bow thruster arrangements.

1.12.2 Trade

Navigazione Montanari operated its vessels worldwide, and *Vallermosa* traded mainly on the worldwide spot markets. The ship had been chartered to BP Oil UK Limited, had been successfully vetted by BP Shipping and routinely vetted by other oil majors to carry their cargo.

1.12.3 Manning

Vallermosa's safe manning certificate required 20 crew. At the time of the accident the vessel was manned with 23 crew, comprising three Italians and 20 Indians.

- Master

  The Italian captain held an STCW Class II / 2 certificate of competency and had 14 years experience on tankers, with 4 years in command. He had been employed by Navigazione Montanari for the last 2 years, working on board several tankers, including *Vallermosa*'s sister vessels, and he had been on board *Vallermosa* for 2 months. He had called at Southampton, as master, once before.

- OOW

  The Italian third officer (3/O) was on his first voyage as OOW, previously having been a company cadet. He held an STCW Class II/ 1 certificate of competency. He kept the 0800 to 1200 watch.

- Cadet

  The Italian cadet was nearing the completion of his training. He was satisfactorily monitoring and plotting the vessel's position on the paper chart.

- Helmsman

  The Indian AB had been on board for 3 months. He was a competent helmsman, had a good standard of spoken English language, and had been steering *Vallermosa* from 0800 up until the accident occurred.

- Chief Officer

  The Indian chief officer held an STCW Class II /1 certificate of competency. He held the 0400 to 0800 watch and had been on the bridge until relieved by the 3/O. He was in charge of the anchor party on the forecastle at the time of the accident.

1.13 MANOEUVRING CHARACTERISTICS

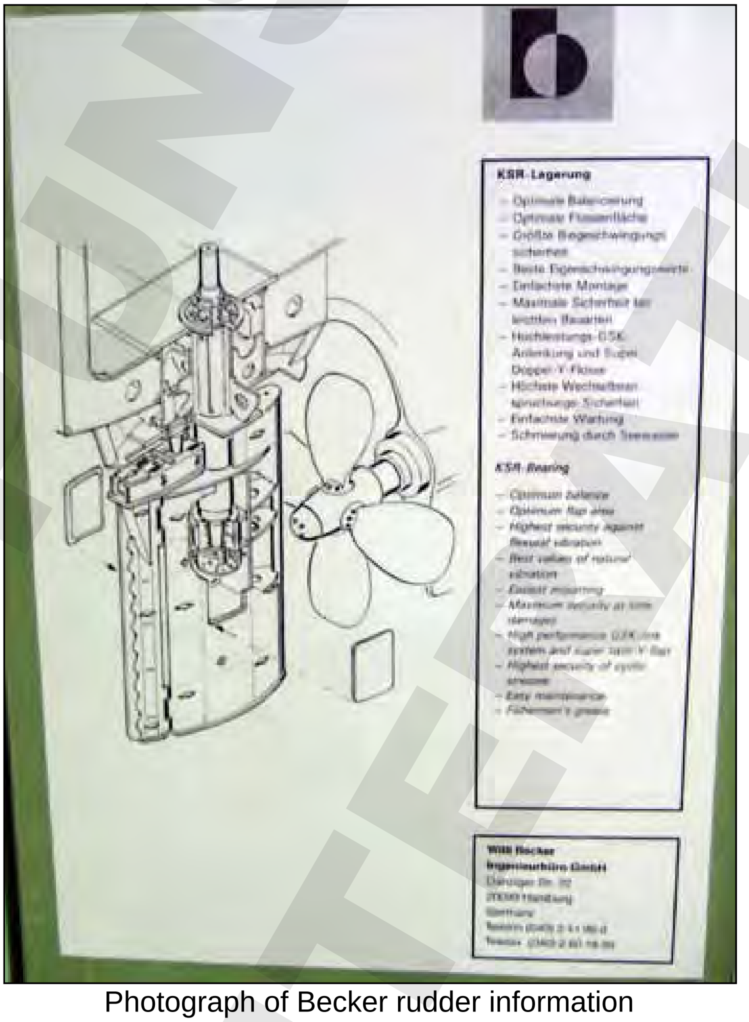
1.13.1 Propulsion

Vallermosa was fitted with a fixed pitch right hand propeller powered by a single 8,580kW Hyundai B&W marine diesel engine.

1.13.2 Becker rudder

Vallermosa was designed and fitted with a Becker rudder. The main advantage of the Becker rudder **(Figure 12)** is that it generates greater lateral forces than conventional rudders at small rudder angles. The flap at the trailing edge of the rudder turns to almost twice the angle of the main rudder blade. The maximum lateral force was achieved at a main rudder angle of about 35º with the flap at an angle of around 70º from amidships.

Figure 12



Photograph of Becker rudder information

The manufacturer estimated that the Becker rudder was three times as effective as a conventional rudder. The advice posted at *Vallermosa*'s steering position **(Figure 13)**, located beneath the helm and obscured from the pilot's view warned:

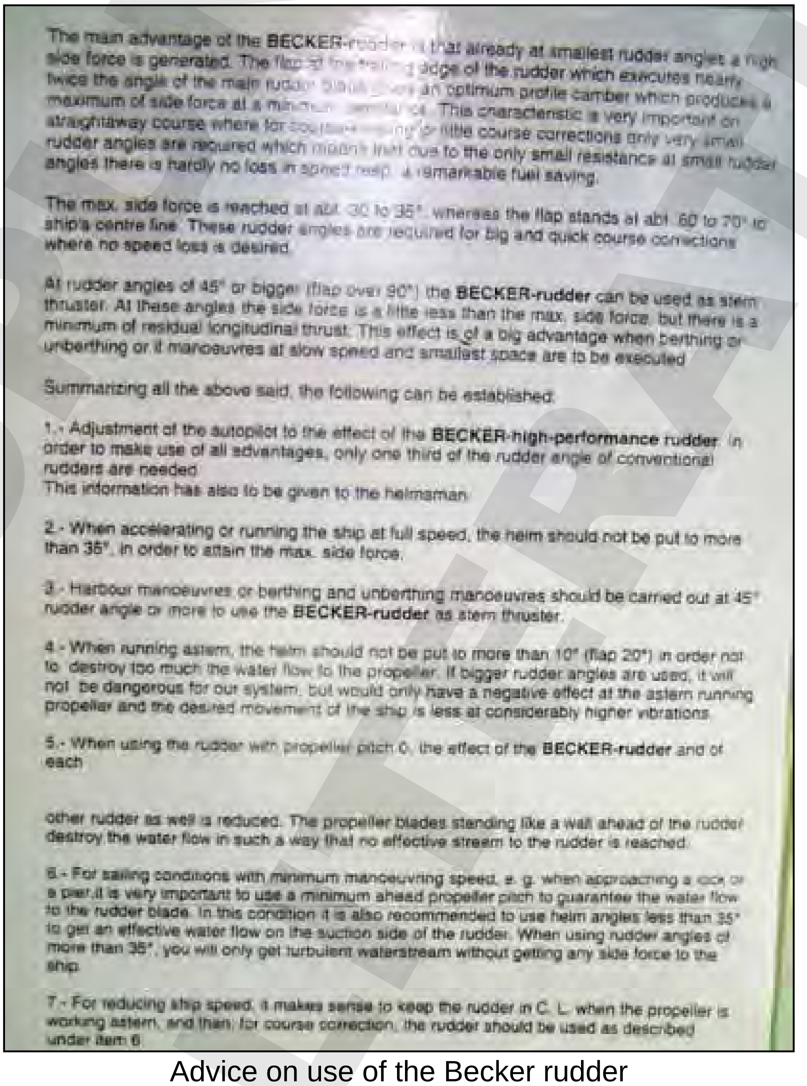
"*It is very important to use a minimum ahead propeller pitch to guarantee the water flow to the rudder blade. In this condition it is also recommended to use helm angles less than 35º to get an effective water flow on the suction side of the rudder. When using rudder angles of more than 35º, you will get turbulent water stream without getting any side force to the ship.*"

"When using the rudder with pitch 0, the effect of the Becker rudder…. is well reduced. The propeller blades standing like a wall ahead of the rudder destroy the water flow in such a way that no effective stream to the rudder is achieved."

A précis of this information was provided on the Pilot Card **(Figure 3)**.

At rudder angles of 45º or larger, with the flap at an angle greater than 90º, the rudder acts as a stern thruster at slow speeds.

Figure 13



The main advantage of the **BECKER**-rudder is that already at smallest rudder angles a high side force is generated. The flap at the trailing edge of the rudder which executes nearly twice the angle of the main rudder blade gives an optimum profile camber which produces a maximum of side force at a minimum resistance. This characteristic is very important on straightaway course where for course keeping or little course corrections only very small rudder angles are required which means that due to the only small resistance at small rudder angles there is hardly no loss in speed resp. a remarkable fuel saving.

The max. side force is reached at abt. 30 to 35°, whereas the flap stands at abt. 60 to 70° to ship's centre line. These rudder angles are required for big and quick course corrections where no speed loss is desired.

At rudder angles of 45° or bigger (flap over 90°) the **BECKER-rudder** can be used as stern thruster. At these angles the side force is a little less than the max. side force, but there is a minimum of residual longitudinal thrust. This effect is of a big advantage when berthing or unberthing or if manoeuvres at slow speed and smallest space are to be executed.

Summarizing all the above said, the following can be established:

1.- Adjustment of the autopilot to the effect of the **BECKER-high-performance rudder**. In order to make use of all advantages, only one third of the rudder angle of conventional rudders are needed.
This information has also to be given to the helmsman.

2.- When accelerating or running the ship at full speed, the helm should not be put to more than 35°, in order to attain the max. side force.

3.- Harbour manoeuvres or berthing and unberthing manoeuvres should be carried out at 45° rudder angle or more to use the **BECKER-rudder** as stern thruster.

4.- When running astern, the helm should not be put to more than 10° (flap 20°) in order not to destroy too much the water flow to the propeller. If bigger rudder angles are used, it will not be dangerous for our system, but would only have a negative effect at the astern running propeller and the desired movement of the ship is less at considerably higher vibrations.

5.- When using the rudder with propeller pitch 0, the effect of the **BECKER-rudder** and of each

other rudder as well is reduced. The propeller blades standing like a wall ahead of the rudder destroy the water flow in such a way that no effective stream to the rudder is reached.

6.- For sailing conditions with minimum manoeuvring speed, e. g. when approaching a lock or a pier, it is very important to use a minimum ahead propeller pitch to guarantee the water flow to the rudder blade. In this condition it is also recommended to use helm angles less than 35° to get an effective water flow on the suction side of the rudder. When using rudder angles of more than 35°, you will only get turbulent waterstream without getting any side force to the ship.

7.- For reducing ship speed, it makes sense to keep the rudder in C. L. when the propeller is working astern, and than, for course correction, the rudder should be used as described under item 6.

Advice on use of the Becker rudder

1.13.3 Bow thruster

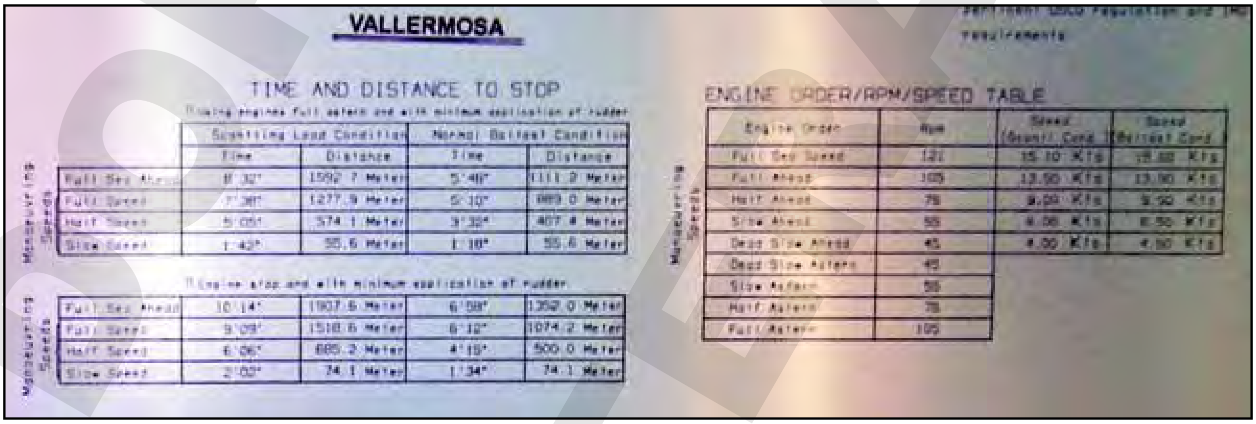
Vallermosa was fitted with an 800kW bow thruster unit. In general, bow thrusters are affected by the turbulence caused by water flow across the bow thruster tunnel entrance. Bow thruster performance will reduce when the vessel's speed increases over 2 kts, and will become ineffective at speeds over 5 kts.

Another factor limiting the effectiveness of a bow thruster is that a vessel's pivot point moves forward while making headway, usually to between ⅓ and ¼ of the ship's length from the bow. As a vessel increases headway, the distance between the bow thruster and the pivot point reduces, resulting in a shorter turning lever and reduced effectiveness. This effect is exacerbated when the rudder is applied, and the pivot point moves further forward still, when virtually no turning moment may be produced.

1.13.4 Manoeuvring information

Vallermosa's manoeuvring data was provided to the pilot during the pilot / master exchange discussion held when he arrived on board, and on the pilot card **(Figure 3)**. Additional data was available on the bridge, located below the forward bridge window, but the pilot was unaware of it. The stopping data **(Figure 14)** indicates that, for example, with an ahead speed of 9 knots in the loaded condition, had the main engine operated full astern, *Vallermosa* would have stopped in 574.1m (3.1 cables). The effect on the heading, on a vessel which is directionally unstable, is not shown.

Figure 14


VALLERMOSA

TIME AND DISTANCE TO STOP

	Scantling Load Condition		Normal Ballast Condition	
	Time	Distance	Time	Distance
Full Sea Ahead	8'32"	1592.7 Meter	5'48"	1111.2 Meter
Full Speed	7'38"	1277.9 Meter	5'10"	889.0 Meter
Half Speed	5'05"	574.1 Meter	3'32"	407.4 Meter
Slow Speed	1'42"	55.6 Meter	1'18"	55.6 Meter

Full Sea Ahead	10'14"	1907.6 Meter	6'58"	1352.0 Meter
Full Speed	9'09"	1518.6 Meter	6'12"	1074.2 Meter
Half Speed	6'06"	685.2 Meter	4'15"	500.0 Meter
Slow Speed	2'02"	74.1 Meter	1'34"	74.1 Meter

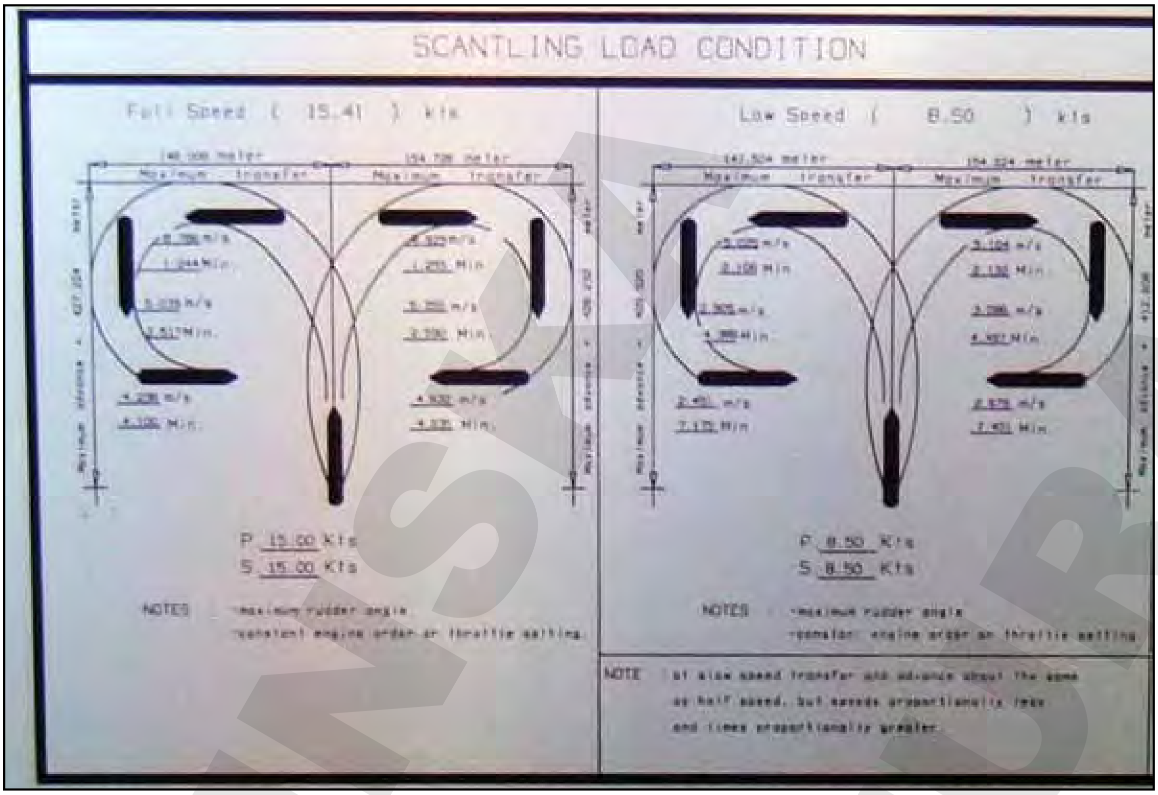
ENGINE ORDER/RPM/SPEED TABLE

Engine Order	Rpm	Speed (Scantl. Cond.)	Speed (Ballast Cond.)
Full Sea Speed	121	15.10 Kts	[illegible] Kts
Full Ahead	105	13.50 Kts	13.90 Kts
Half Ahead	75	9.00 Kts	9.50 Kts
Slow Ahead	55	6.00 Kts	6.50 Kts
Dead Slow Ahead	45	4.00 Kts	4.50 Kts
Dead Slow Astern	45		
Slow Astern	55		
Half Astern	75		
Full Astern	105		

Stopping data from *Vallermosa*

The turning data **(Figure 15)** indicates that in the loaded condition at 8.5 kts with maximum rudder angle and constant engine speed, *Vallermosa* would advance by a maximum of 410m (2.2 cables) and transfer 150m (0.8 cables) during a full round turn. This distance would be affected by the environmental conditions; notably, the advance and transfer could have increased due to the depth of water.

Figure 15



Turning data from *Vallermosa*

1.13.5 External report

BMT Seatech[5] was commissioned to conduct an assessment of *Vallermosa*'s handling characteristics and, from VDR data, the impact of ship handling on the vessel's movement during the voyage through the Solent, and the ship handling actions prior to the contact damage **(Annex C)**.

On the issue of manoeuvring characteristics, BMT Seatech's report confirmed that *Vallermosa* handled as would be expected of a vessel of her size, block coefficient, propulsion and rudder arrangement, and the vessel exhibited no manoeuvring anomalies that could have contributed to the accident.

Vallermosa, as with other vessels of this design, was partially directionally unstable. While this was not excessive, vigilance was required to ensure that the desired course was maintained. This characteristic was evident to the pilot during the transit, and the large West Bramble turn, when the hesitancy of the turn, counter helm required, and the changes of rate of turn indicated to the pilot, who applied numerous incremental heading changes, that the ship was difficult to steady up on course in benign conditions.

Course instability is not necessarily detrimental, provided that the ship remains under control, and that these characteristics are fully understood by the ship handler.

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5 BMT Seatech Ltd is an independent marine consultancy providing specialist services and products in the fields of vessel performance and marine safety and compliance.

The report concluded inter alia that:

- *The ship entered Southampton Water at too high a speed, resulting from prolonged use of full ahead power in the bend round Calshot Spit. This lay at the heart of all that went wrong subsequently.*

- *There was no allowance for the possibility of a sheer to starboard, once the engine was stopped, due to the cessation of screw bias effects.*

- *The Becker rudder was used inappropriately and in contravention of the recommendations for use of such rudders posted on the bridge.*

1.14 BRIDGE RESOURCE MANAGEMENT

1.14.1 Origins of Bridge Resource Management

Bridge Resource Management (BRM) can trace its roots back to Bridge Team Management, which was first applied on a few large Baltic ferries in the 1980s. The core function of Bridge Team Management was to provide an organisation that ensured an error or omission by one person did not go unnoticed, and that this error would always be brought to the attention of the 'team leader'. Bridge Team Management – a practical guide, by Captain A J Swift, was first published by The Nautical Institute in 1993. Since then, Bridge Team Management has been developed in to BRM, to reflect the wider circle of resources which are informed and affected by human factors. BRM training is now offered by many nautical colleges, though many shipping companies elect to run bespoke in-house training for their crews.

1.14.2 Guidance on Bridge Resource Management

No specific advice is provided by the MCA on BRM, however guidance on 'Performing the Navigational Watch' is contained in MGN 315(M). This instructs the officer of the navigational watch to inter alia:

- *Continue to be responsible for the safe navigation of the vessel despite the presence of a pilot on board*

- *If in any doubt as to the pilot's actions or intentions, seek clarification from the pilot; if doubt still exists, they should notify the master immediately and take whatever action is necessary until the master arrives* [sic]

More comprehensive advice on BRM has been provided by the Australian Maritime Safety Authority in its Marine Notices 9/2006 and 7/2009. For example, Marine Notice 7/2009 states:

> "*The master and the bridge team should remember that they are always responsible for, and are in charge of the safe navigation of the ship, even when navigating with a pilot …*"

also:

> *"…pilots expect masters and watchkeepers to participate fully in the navigation of their ship during pilotage. The master and the deck officers must continue to monitor the safe passage of the ship, critically appraise the pilot's advice and incorporate the pilot fully into the bridge team in a mutually supportive manner to ensure efficient and safe navigation. All BRM procedures still apply when a pilot boards the ship, and the bridge team should conduct a pre-passage briefing, together with the pilot to ensure a shared view of the intended passage prior to its execution".*

1.14.3 Navigazione Montanari BRM training

Navigazione Montanari required that masters and deck officers attend IMO approved BRM courses[6], and the company's 3 day "Ship Handling Course" included BRM training in confined and pilotage waters. The master had previously attended the approved STCW BRM training in September 2007 during his time with Navigazione Montanari; the 3/0 officer was trained in BRM during his cadetship; the cadet had not been trained in BRM.

1.15 PREVIOUS ACIDENTS

The following recent MAIB investigations have relevance to this investigation:

- *Skagern / Samskip Courier* –

  On 7 June 2006, the general cargo ship *Skagern* and the container ship *Samskip Courier* collided in the Humber estuary in dense fog. Both vessels had experienced pilots on board at the time of the accident. The report highlighted the: failure to apply long established collision avoidance methods by the masters and pilots; poor pilot / master relationships; the masters' over reliance on the pilots and poor interaction and communications among the bridge teams.

- *Sea Express 1 / Alaska Rainbow*

  On 3 February 2007, the high speed ferry *Sea Express 1* and the general cargo vessel *Alaska Rainbow* collided on the River Mersey in thick fog. The collision holed the starboard hull of the ferry, causing her to list and trim significantly.

  One of the report's conclusions was that: the *Alaska Rainbow* pilot was not proactive in requiring support, and neither the master nor the OOW was proactive in providing support to the pilot, thereby unnecessarily increasing the pilot's workload.

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[6] In accordance with Standards, Training and Certification of Watchkeepers (STCW) Section b–viii/2 part 3-1.

- *Audacity / Leonis*

  On 14 April 2007, the product tanker *Audacity* was involved in a collision with the general cargo ship *Leonis*, in very poor visibility, in the precautionary area at the entrance to the River Humber. Both vessels sustained damage to their bows. The report's conclusions included that: the pilots and bridge teams, on both vessels, did not make a full assessment of the risk of collision and that communications were poor.

- *Sea Mithril*

  On 18 February 2008, the UK registered cargo vessel *Sea Mithril* grounded in the River Trent on three occasions. A river pilot was embarked and dense fog had reduced visibility to about 20m. The report highlighted that:

  - The master was unable to maintain a command overview of the vessel's passage.
  - The master relied totally on the pilot for the safe navigation of his vessel.
  - Communication and co-ordination between the master and pilot prior to the groundings were poor.
  - The pilot was not supported by the bridge organisation, which became dysfunctional after restricted visibility was encountered.
  - Flaws in the bridge organisation and available support were not identified by the master or the pilot.

- *Sichem Melbourne*

  On 25 February 2008 the product carrier, *Sichem Melbourne,* sustained damage and damaged mooring structures as she departed her berth at Coryton Oil Refinery on the River Thames estuary. The report found that there was an inadequate exchange of information between the master and pilot before commencing unmooring operations and that the interaction and communications between members of the bridge team were poor.

1.16 PREVIOUS MAIB RECOMMENDATIONS

A number of MAIB recommendations were made following the investigations referred to in Section 1.15. Of these, only the recommendations relevant to this accident are listed below. These recommendations were accepted by their recipients and reported as implemented, however, see separate comments with respect to M2008/157.

1.16.1 Following the *Skagern* and *Samskip Courier* investigation, the MAIB made recommendations to:

The **Port Marine Safety Code Steering Group**, to:

2007/122 Promulgate to Port Authorities the need for pilots to maintain dialogue with the bridge team regarding the conduct and execution of the passage plan, thus ensuring the team is kept fully involved, and informed, at all times.

The **International Chamber of Shipping**, to:

2007/125 Through its member organisations, emphasise the need for shipowners to ensure masters are given clear guidelines which detail the importance of effective dialogue with pilots, and identifies the need for masters to challenge or question decisions or actions taken by pilots at an early stage so that, when required, effective corrective action can be taken to prevent accidents.

1.16.2 Following the *Sichem Melborne* investigation, the MAIB made recommendations to:

All United Kingdom **Competent Harbour Authorities**, to:

M2008/166 Whilst ensuring the ability of vessels to navigate in harbour limits (MAIB Recommendation M2008/157 refers), take the following additional factors into consideration:

- The time required for full exchange of information, using diagrammatic explanation where appropriate, between the pilot and the full ship's team, including mooring parties.
- Only one person to be responsible for all manoeuvring instructions, including bow/stern thrusters, with instructions given orally to allow the whole bridge team to monitor the orders and responses.

1.16.3 Following the *Sea Mithril* investigation, the MAIB made recommendations to:

All United Kingdom **Competent Harbour Authorities**, to:

M2008/157 Ensure sufficient controls and/or procedures are established to enable embarked pilots to assess the ability of vessels to navigate within harbour limits. Factors to be taken into account when making this assessment include:

- The support that can be provided to the pilot by the ship's crew.
- The prevailing weather conditions and, when applicable, the likely effectiveness of the bridge organisation in restricted visibility.

- The availability and use of large scale charts for passage planning.
- The time and sea room required for a meaningful and effective master and pilot interchange.

While most harbour authorities accepted this recommendation, a few expressed concern that they did not have the powers necessary to inspect vessels on arrival, and that the pilots' obligation to the ship owners and masters might prevent them from fulfilling this task.

The **United Kingdom Major Ports Group (UKMPG)** and **British Ports Authorities (BPA)**, to:

2008/158 Encourage their members to:

- Develop and share guidance on the minimum levels of support pilots should expect from ships' bridge teams.
- Promulgate the availability of locally produced large scale charts for their area of responsibility.
- Conduct surveys of all ships using pilotage services, similar to the survey conducted by ABP Humber, to identify vessels which are unable to provide the necessary support required by a pilot.

The **United Kingdom Maritime Pilots' Association (UKMPA)**, to:

2008/159 Urge its members to work with ports and harbour authorities to:

- Identify the minimum acceptable levels of support required from bridge teams to support pilots and which are necessary to ensure the safety of navigation in varying conditions.
- Conduct the surveys identified above in 2008/158.

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 FATIGUE

There is no evidence that any of the crew, or the pilot, were suffering from fatigue and, therefore, it is not considered a contributory factor to this accident.

2.3 OVERVIEW

Vallermosa's pilot was informed that he should abort the berthing at BPJ and return to anchor just as the vessel was completing the challenging turn to starboard around the Bramble Bank. He had a few minutes while transiting the Thorn Channel to clarify this instruction, and to make plans to turn the vessel and return to the anchorage, before focussing on the equally challenging turn to port around Calshot Spit. *Vallermosa*'s speed was not reduced sufficiently in the Thorn Channel, nor during the turn around Calshot Spit during which she increased speed, and the vessel entered Southampton Water at 10.5 kts, when the appropriate speed would have been around 5.0 kts.

In attempting to reduce the vessel's speed, in order to turn *Vallermosa* around, as intended, off Fawley Marine Terminal, the pilot lost control of the vessel which started to sheer to port. His attempts to regain control were unsuccessful, and *Vallermosa*'s rate of turn increased to the point that contact with the vessels discharging alongside at Fawley Marine Terminal was inevitable.

The keys to this accident are: the triggers that caused a suitably qualified and very experienced pilot to become distracted and then increasingly stressed to a degree that led him to make these errors; and the lack of effective barriers to detect and correct the erroneous actions of the pilot.

2.4 PRECURSOR TO THE ACCIDENT

2.4.1 BP Hamble Terminal - Administration

Vallermosa had anchored at Nab No 10 anchorage at 2212 on 24 February after the BP Hamble Terminal's offices had closed for the night. The vessel was underway inbound to Southampton at 0658, and the pilot embarked at 0824 as she was approaching the Nab Tower. While the vessel was inbound, the BP Hamble Terminal loading master discovered that the customs declaration for the cargo was incorrect, and notified the BP marine superintendent accordingly.

It was the marine superintendent's belief that the customs declaration should be correct before the vessel was allowed to berth, and that if the correct document could not be provided in time then the vessel should be turned away. At 0940 the marine superintendent notified the VTS watch manager that this was a possibility. During the following 36 minutes, in which *Vallermosa* passed her final abort point before committing to the turn around Bramble Bank, BP Hamble Terminal staff exchanged emails with BP's Jet desk operator in an attempt to obtain the correct document. At 1016, the marine superintendent made the decision to abort *Vallermosa*'s call, and commenced notifying all concerned.

Had a check been carried out to ensure that all essential pre-arrival documentation was in order before *Vallermosa* commenced her passage from the anchorage at 0830, the risks associated with aborting her inbound passage for administrative reasons could have been avoided.

2.4.2 BP Hamble Terminal - decision to abort

The marine superintendent, with the marine supervisor on leave and his expertise unavailable, felt that incorrect customs documentation constituted a compelling reason to abort *Vallermosa*'s berthing. Some years previously there had been problems with inbound cargo documentation at the terminal, but these had been resolved. In any event, HMRC officials were clear that provided a vessel did not start to discharge cargo, then they would not object to it lying alongside until the correct documentation arrived. The marine superintendent did not have a complete understanding of HMRC's requirements, and the decision to turn *Vallermosa* away was primarily to avoid potentially risking BP Hamble Terminal's licence to import by allowing a vessel, whose customs paperwork was incorrect, to berth alongside.

The marine superintendent was also concerned that there was a risk to the terminal of having a vessel, which was not working cargo, lying alongside for any period of time. However, this risk had not been articulated or quantified in the terminal's risk assessments and, as many of the vessels using the terminal were tidally constrained and so could not arrive and depart at will, the risk was a common part of normal operations.

Importantly, although the marine superintendent considered it unacceptable to allow the vessel to lie alongside until the paperwork was corrected, this was not balanced against the potential risks to the vessel of having to abort her passage inbound, turn around, and return to anchor. Had the marine superintendent considered these respective risks, it might have been concluded that it was preferable, at that late stage of *Vallermosa*'s approach, to accept the vessel alongside. Consultation with HMRC staff would then have established that they had no objection to this course of action.

Although the marine superintendent's decision had to be ratified by the terminal manager, the former was the senior marine professional at the site, and the terminal manager had no other adviser with whom he could calibrate the recommendation.

There is a need for BP Hamble Terminal to assess the risks to the terminal and jetty from vessels lying alongside, and to ensure that the potential risks to vessels are considered when the control measures include directing or instructing those vessels to take unanticipated actions.

2.4.3 VTS

ABP Southampton's operating procedures provide guidance on abort procedures for vessels over 220m LOA. The procedures do not differentiate between aborting for safety reasons and administrative reasons, but they do require the decision to be made before the vessel passes South Ryde Middle Buoy so that appropriate action may be taken and so that the vessel does not enter the Thorn Channel.

At 176m LOA, *Vallermosa* fell below the threshold at which the port's rules for aborting an inbound passage applied. When the BP marine superintendent called the VTS watch manager to advise him that aborting the vessel's approach was being considered, he asked that a decision on this be taken within 15 minutes, which would have been as *Vallermosa* was passing South Ryde Middle Buoy. However, as the vessel passed this decision point, he did not put any pressure on the BP marine superintendent to make a decision, nor did he query that the abort decision was being made for administrative reasons. It is accepted that the option to abort any passage for safety reasons should always be available. However, it is MAIB's opinion that, once committed to transiting the Thorn Channel, vessels should not be permitted to abort for the sake of administrative convenience.

This accident indicates that ABP's abort procedures were not sufficiently robust, and that there is a case to review further the minimum size of vessel to which abort restrictions apply.

Southampton VTS was notified that there was a possibility that *Vallermosa* would not be allowed to berth as the vessel was passing Mother Bank buoy. The VTSO asked the VTS watch manager if this information should be passed on to the pilot, and the watch manager made the decision to wait until the BP marine superintendent had made a final decision before troubling the pilot with something that might not occur.

There was some benefit in not causing the pilot unnecessary uncertainty. However, by withholding the information, VTS denied the pilot the opportunity to contribute to the decision making process and of taking steps to delay the vessel's arrival to allow more time for the necessary documents to arrive. Had the pilot been informed, at the earliest opportunity, of the potential for a change of plan, he could have reduced *Vallermosa*'s speed or adjusted track to delay her arrival, or anchored clear of the approach channel pending a decision. In the event, the pilot received the information at a challenging part of the inward passage and when his potential courses of action had become limited.

2.5 THE PILOT

The largely passive role adopted by *Vallermosa*'s bridge team meant that the pilot bore an unnecessarily disproportionate responsibility for the safe navigation of the vessel. Without proper support, the pilot would have found the voyage to the berth challenging even if it had been accomplished without incident. Once the plan began to change, the pilot's exposure to stress increased substantially. This is examined more closely below:

2.5.1 Stress

The effects of stress can be described[7] as:

> "*Stress has a restrictive effect on analytical thinking, thereby making a person more rigid. Consequently, flexibility decreases and so does the capacity for evaluating or considering alternative actions …… Decision making runs the risk of being restricted to short term solutions to imminent problems only, and tends to be linear, addressing partial problems as they occur ….*"

2.5.2 Decision to abort

As *Vallermosa* was completing the turn around Bramble Bank into the Thorn Channel, the pilot was informed of the decision to abort the berthing. It is probably significant that the reason for this was for administrative, rather than safety reasons. Had the berthing operation been aborted because of, for example, a fuel leak on the BP Hamble jetty, this might have stimulated both the pilot and the bridge team and resulted in heightened awareness, raised activity levels, and increased information flow and cooperation between all the parties.

As well as considering the implications of the change of plan with respect to the safe navigation of *Vallermosa*, the pilot also had to deal with unanticipated demands: confirming the change of plan with BP Hamble Terminal loading master and with Southampton VTS and the master; making calls to the tugs; and advising the master to contact the ship's agent. All these activities constituted distractions from the immediate task of controlling the vessel and, as such, account in some measure for him not reducing speed in the Thorn Channel.

That the pilot allowed himself to be distracted from his key task of conning the vessel at an appropriate speed raises doubts about his bridge resource management skills, but this lapse could also be attributed to effects of the frustration and anxiety he experienced on being presented with the unanticipated and potentially difficult task of taking *Vallermosa* back to anchor.

2.5.3 The turn round Calshot Spit

Vallermosa's turn around Calshot Spit was made more challenging than usual by her high entry speed. Albeit that *Vallermosa* handled as would be expected for a vessel of her size and type, the difficulty of this manoeuvre

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would have demanded nearly all the pilot's attention and further exacerbated his anxiety. As a result of this stress, it is likely that his ability to anticipate and analyse problems, to consider alternative courses of action and to manage the resources available to him were all compromised during this critical period.

2.5.4 Decision to continue the approach

At 1036, just after passing the Hook buoy, the pilot gave a series of engine orders in an attempt to slow *Vallermosa*, which culminated in the order to *stop engine.* He then became engaged in briefing *Vallermosa*'s master about the revised anchorage instructions. He was still intent on turning the vessel as he had planned. However, to slow her sufficiently to turn off the oil jetties would have required large amounts of astern propulsion, but the result of this would have been unpredictable. The pilot's better course of action would have been to continue along Southampton Water, decelerating gradually, to turn off Dock Head. The tugs, which were returning to Dock Head, could have been used to assist this manoeuvre.

2.5.5 Loss of control

While the pilot was briefing *Vallermosa*'s master about the revised anchorage instructions, he did not notice the vessel beginning to sheer, and the helmsman applying 35º of helm in an attempt to stop the swing. It was not until the helmsman reported that the vessel was not responding to the helm, that he recognised the problem.

Using a small amount of ahead power, the pilot stopped the starboard swing. However his subsequent actions were ineffective in preventing *Vallermosa* from developing a counter sheer to port because he was still focussed on reducing speed so that the vessel could be turned off the oil jetties. In these circumstances, a bold application of power was required to regain control of the vessel to avoid making contact with the vessels berthed at Fawley Marine Terminal. The fact that the pilot continued to be fixated with his plan and did not take the more logical alternative action is indicative that stress was affecting his cognitive function.

2.5.6 Summary

The late notice to abort the berthing irritated the pilot and might have provoked some anxiety as it confronted him with an unanticipated and challenging return passage to the anchorage. As a result of this anxiety and the distraction of activities resulting from the decision to abort, he did not reduce *Vallermosa*'s speed significantly in the Thorn Channel. This made negotiating the turn around Calshot Spit especially demanding and he was unable to reduce the vessel's speed during this turn. Increased stress levels which resulted from the sequence of events probably compromised the pilot's ability to anticipate and analyse problems or formulate alternative courses of action. As a result, he persisted in trying to slow the vessel sufficiently to turn her off the oil jetties in accordance with his plan, and lost control of the vessel.

2.6 DEFENCES

2.6.1 Bridge Resource Management

When the pilot arrived on *Vallermosa*'s bridge, he found an appropriately manned bridge, including: the master, the 3/O as the watch keeper, a dedicated helmsman, and a cadet who was plotting the vessel's position on a paper chart.

The pilot handed over the port passage plan, and the pilot/master exchange took place. During the exchange, the pilot outlined the passage and explained how and where the vessel would berth; and the master briefed the vessel's propulsion, steering and manoeuvring characteristics. The pilot did not explain the detail of the passage plan, how he intended to conduct it, or the speed profile. For his part, the master did not ask for any of this detail. As the passage up harbour commenced, the master left his team to respond to the pilot's instructions while he occupied himself with other activities and made a series of mobile phone calls.

Neither the pilot nor the master identified that they had established the conditions which would allow the subsequent accident to happen. The master had not gained sufficient information about the pilot's intentions for him to check progress against the plan, or to ensure the safety of his vessel by monitoring the pilot's actions. However, the pilot had not given the bridge team the information they needed to be able to monitor his execution of the plan. Both parties were content that their interaction would be minimal, and as a result the principles of BRM could not be applied during the pilotage.

Vessels routinely take a number of actions in preparation for entering or leaving port. These include: changing over from heavy fuel oil to gasoil; configuring power generation to minimise the risk of blackouts; starting additional equipment including steering motors, bow thrusters, secondary radars etc; and closing up additional personnel. All these actions are aimed at increasing redundancy, mitigating failure, reducing response times, validating actions and decisions and, thereby, reducing risks. It is, therefore, illogical that BRM should be allowed to fall into abeyance when, arguably, it is most necessary.

In certain ports, the pilots are seen as the marine experts with the local knowledge necessary to ensure the vessel's safe arrival. Masters rely heavily on them, defer to them and, in many cases, leave them to pilot the vessel without interference or supervision. This, in turn, leads to pilots failing to fully brief the master and bridge team either at the start of the passage or as situations develop. *Vallermosa*'s master could have queried the pilot's unusual suggestion of turning the vessel without tugs; he should have been concerned at the vessel's speed on exiting the Calshot turn; and, he was required to become directly involved once it was clear that *Vallermosa* was starting to sheer towards the vessels berthed at Fawley Marine Terminal. That the master did none of these things implies he had placed total reliance and trust on the pilot's ability to con the vessel, despite his obligation to ensure his vessel's safety.

Evidence from this and previous accidents (see 1.15) demonstrates the potential for serious accidents to occur once bridge teams abdicate their responsibility for monitoring and providing support to pilots. Further, during this investigation, anecdotal evidence was received indicating that around 75% of bridge teams have a neutral or negative effect on the pilots' ability to carry out their duties, and only 25% actually assist them. This suggests that, routinely, bridge teams are leaving pilots to get on with bringing their vessels into harbour, and pilots are expecting to carry out this task unassisted. While this situation persists, pilots will continue to have the potential to be the weak link in the safety chain.

There is, consequently, a need for CHAs to make clear their expectations that bridge teams will properly assist the pilots and monitor their actions. Ideally, this should be a common expectation which could be published by the maritime administration, along the lines of the Australian Maritime Safety Authority's Marine Notices 9/2006 and 7/2009. To further improve this common purpose, both shipping companies' and pilot authorities' BRM training should focus more on the integration of the port pilot into the bridge team during pilotage.

2.6.2 VTS

In practice the role of VTS authorities in monitoring the safe passage of vessels varies depending on the characteristics of the VTS area. In most areas, it would be expected that a VTS Traffic Organisation Service (TOS) would notify vessels of other traffic that had the potential to affect their passage, and check they were aware of an approaching vessel's presence. Some TOS' will monitor a vessel's progress against a radar reference line or similar track mark in order to provide the master or pilot with details of the vessel's distance from the centre of the channel or fairway. Other TOS' monitor the speed of vessels passing locations that are vulnerable to high wash or the effects of interaction.

The port of Southampton has a speed limit of 7 kts and minimum passing distance of 130m for vessels with a draught of 6m and over, to avoid interaction with the vessels berthed at the oil jetties. This speed limit was not proactively monitored by the VTSO on watch at the time of the accident. However, data from the VTS recording system was used to identify, after the event, those vessels that have caused damage by passing the oil jetties at too high a speed.

While the VTS watch manager would not necessarily have been able to judge whether *Vallermosa* had departed the turn around Calshot Spit at too high a speed for her to turn off the oil jetties, it should have been evident to him that the vessel was likely to infringe the speed and passing requirements for that area. The VTSO noted *Vallermosa*'s speed and proximity to the jetty at Fawley Marine Terminal, and contacted the marine controller to alert him. However, no calls were made to the pilot.

Although the primary responsibility for monitoring the actions of a pilot falls to a vessel's master and bridge team, the VTS organisation offers another potential barrier to erroneous behaviour, and is one that should be explored.

2.7 SIMILAR ACCIDENTS

Despite extensive industry guidance and the numerous recommendations following MAIB's investigations into recent accidents with a pilot embarked, this and other accidents indicate that there has been little change in the culture of masters not involving themselves in the pilotage of their vessel, and pilots not expecting or demanding support from bridge teams. Until the expectation of an appropriate level of BRM performance from vessels visiting UK ports is articulated, and pilots are better trained to integrate proactively with bridge teams, this unsafe situation will persist.

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT WHICH HAVE RESULTED IN RECOMMENDATIONS

1. The late notice to abort *Vallermosa*'s berthing irritated the pilot and might have provoked some anxiety as it confronted him with an unanticipated and challenging return passage to the anchorage. As a result of this anxiety and the distraction of activities resulting from the decision to abort, he did not reduce *Vallermosa*'s speed significantly in the Thorn Channel. This made negotiating the turn around Calshot Spit especially demanding and he was unable to reduce the vessel's speed during this turn. Increased stress levels which resulted from the sequence of events probably compromised the pilot's ability to anticipate and analyse problems or formulate alternative courses of action. As a result, he persisted in trying to slow the vessel sufficiently to turn her off the oil jetties in accordance with his plan, and lost control of the vessel. [2.5]

2. The master had not gained sufficient information about the pilot's intentions for him to check progress against the plan or to ensure the safety of his vessel by monitoring the pilot's actions. However, the pilot had not given the bridge team the information they needed to be able to monitor his execution of the plan. Both parties were content that their interaction would be minimal, and that the principles of BRM would not be applied during the pilotage. [2.6.1]

3. *Vallermosa*'s master could have queried the unusual suggestion by the pilot that the vessel should be turned without tugs; he should have been concerned at the vessel's speed on exiting the Calshot turn; and, he should certainly have become directly involved once it was clear that *Vallermosa* was starting to sheer towards the vessels berthed at Fawley Marine Terminal. That the master did none of these things suggests he had placed total reliance and trust on the pilot's ability to con the vessel, despite his obligation to ensure the vessel's safety. [2.6.1]

4. Evidence from this, and previous accidents, demonstrates the potential for serious accidents to occur once pilots become the weak link in the safety chain. [2.6.1]

5. There is a need for SHAs to make clear to vessels transiting their waters their expectations that bridge teams will properly assist the pilots and monitor their actions. This expectation should also be promulgated by the maritime administration. [2.6.1]

6. Although the primary responsibility for monitoring the actions of the pilot falls to a vessel's master and bridge team, the VTS organisation offers another potential barrier to erroneous behaviour that should be explored. [2.6.2]

3.2 SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION WHICH HAVE NOT RESULTED IN RECOMMENDATIONS BUT HAVE BEEN ADDRESSED (I.E. PER SECTION 4)

1. Had a check been carried out to ensure that all essential pre-arrival documentation was in order before *Vallermosa* commenced her passage up harbour at 0830, the risks associated with aborting her inbound passage for administrative reasons could have been avoided. [2.4.1]

2. The marine superintendent did not have a complete understanding of HMRC's requirements, and the decision to turn *Vallermosa* away was made primarily to avoid potentially risking BP Hamble Terminal's licence to import by accepting alongside a vessel whose custom's paperwork was incorrect. [2.4.2]

3. The risk to BP Hamble Terminal of a vessel lying alongside, when not engaged in cargo operations, had not been articulated or quantified in the terminal's risk assessments. [2.4.2]

4. Had the marine superintendent balanced the risks of *Vallermosa* lying alongside against the risk to the vessel of having to turn around and return to anchor, it might have been concluded that it was preferable, at that late stage of the vessel's approach, to accept it alongside. [2.4.2]

5. ABP Southampton's procedures for vessels aborting an approach did not apply to vessels of *Vallermosa*'s size. [2.4.3]

6. The VTS watch manager did not put any pressure on the BP marine superintendent to decide whether or not to abort *Vallermosa* before the vessel passed South Ryde Middle, nor did he question that the abort decision had been made for administrative, rather than safety reasons. [2.4.3]

7. The VTS watch manager did not tell the pilot of the possibility of aborting the berthing at the earliest opportunity. Consequently, the pilot was denied the chance to be part of the decision making process, and he received the information at a challenging part of the inward passage when his courses of action had become limited. [2.4.3]

SECTION 4 - ACTION TAKEN

BP OIL UK Limited has:

- Amended its procedures to ensure that vessels have the required paperwork in place prior to commencing the inbound passage into the Solent.
- Ensured that vessels are not aborted during the inbound passage for administrative errors, however caused.

Navigazione Montanari has:

- Issued a letter to its masters reminding them of their responsibilities, as stated in the SMS for masters and bridge teams to monitor the pilot's actions and their ultimate responsibility for the safety of the ship.
- Required the master to attend a refresher bridge resource management training course and to review the accident with company managers.
- Introduced a requirement that all deck officers attend Bridge Resource Management training prior to employment.

ABP Southampton has amended its procedures to ensure that:

- Any vessel bound for Fawley or BP Oil Terminals will not be permitted to enter the Thorn Channel if any problem exists which may prevent the vessel berthing.
- All vessels manoeuvring in the area of the oil terminals, other than those transiting the area, are required to observe the minimum towage criteria for Fawley Terminal.

The **MAIB** has:

- Written to ABP Southampton to strongly express its view that, once committed to transiting the Thorn Channel, vessels should not be permitted to abort for administrative reasons.

SECTION 5 - RECOMMENDATIONS

The **UK Major Ports Group, British Ports Association** and **UKMPA**, are recommended to:

2009/172 Task the UKMPG/BPA Marine Pilotage Working Group in consultation with the UKMPA to define their expectations of bridge team / pilot performance, and from this:

- Determine the training requirements necessary to ensure pilots can integrate effectively into bridge teams during the performance of their duties. To reinforce the benefits and rationale of integration with bridge teams, such training should make clear the negative impact stress / overload will have on individuals' cognitive functions.

- Determine the required level of support provided by bridge teams during acts of pilotage and ensure this expectation is disseminated to vessels arriving at their ports.

2009/173 Encourage their members to develop feedback mechanisms for pilots to report on substandard bridge team performance, and take appropriate action as necessary.

The **Maritime and Coastguard Agency** is recommended to:

2009/174 Disseminate to the shipping industry specific detailed information on the expected levels of support which should be provided by bridge teams when a pilot is embarked.

The **International Association of Marine Institutions** is recommended to advise its members to:

2009/175 Tailor Bridge Resource Management training courses, as guided by the output of the UKMPG, BPA and MPA Marine Working Group, to include integration of pilots into the bridge team during pilotage.

Marine Accident Investigation Branch
November 2009

Safety recommendations shall in no case create a presumption of blame or liability

Annex A

Extract from The Port of Southampton Port Operations Manual

Tidal information

Tug availability.

(iii) Delayed Sailing

If, for any reason, the vessel is delayed after the pilot has boarded, he shall remain on the ship for a period of at least one hour, subject to the discretion of the Duty VTSO, after which he shall leave the vessel and it will then be necessary to re-order the pilot when a confirmed departure is known.

8 Passage Planning – Pilot / Master Interface

The Pilotage Act 1987 requires the exchange of certain information between the master of a ship and the pilot. In addition SI 1995 No. 3128 requires a pilot to report to the Port State Control (MCA) through the harbour authority where appropriate, any ship deficiencies that may affect its safe navigation.

The careful planning of the movements of every ship in the confines of the port is an essential element of the Port's Safety Management System. The pilot / master exchange of information needs to be both detailed and structured, if the pilot's advice and the master's intentions are to be integrated to best effect. It should include as a minimum:

> The provision by the pilot of detailed local navigational information, including his recommended passage plan. Such details will assist the Master to update his own passage plan.
>
> The provision by the master of precise information, about the ship, its manoeuvring characteristics, its equipment, including details of any defects. Details on how the bridge is managed, and who fulfils what functions will also assist the pilot to integrate into the bridge team.
>
> The net effect of the above should be to ensure, firstly that the vessel has an agreed passage plan, and secondly that the vessel's position is monitored independently whilst the pilot has the conduct of the ship.
>
> In order to avoid misunderstanding, and to overcome any possible language problems, this verbal exchange between master and pilot should be complemented by written details. Such details will also facilitate the provision of a record of the exchange, should it ever be necessary to establish who said what.

Master to Pilot Pilot Card – this should provide, in clear, written / diagrammatic format all relevant information and details regarding the vessel and its equipment.

Pilot to Master Port Passage Plan – this will show on an appropriate form all information relevant to the passage from pilot station to berth, including any tidal constraints and abort plans.

Pilot to CHA/MCA Pilots have a statutory duty [MS (Port State Control) Regs] report ship deficiencies that may affect adversely its sa navigation. These should be reported to the Authority, whic will, in turn, inform the MCA. It should be noted that if any suc defects are of major concern, the pilot should not commit th vessel to a passage in confined waters and instead should tak the vessel to a safe area or anchorage.

Master to Pilot The master of any vessel carrying dangerous or pollutin goods must supply to the pilot an appropriate 'HAZMAT Chec List'. If the Check List is not satisfactorily completed, or it is no supplied, the pilot must report this fact to VTS immediatel VTS in turn will pass this information to the Harbour Maste who will pass this information to the MCA.

The Harbour Authority will ensure that pilots are allocated in adequate time t prepare passage plans (Appendix H) as well as ensuring the provision of relevar information to the pilots to ensure that they operate properly.

3.9 Reporting Procedures – Movement Reporting Points

These procedures are clearly set out in the current Local Notice to Mariners.

3.10 Watch Arrangements

Rostering and allocation of duties are as agreed by the pilots and approved by th Harbour Master. These are as laid down in the Pilotage Operational Orders.

3.11 Pilotage Training

(i) Introduction

The Southampton CHA maintains a body of fully trained Marine Pilots, providin pilotage services to all vessels compulsory in terms of the ABP Port of Southampto Pilotage Directions.

All pilots are initially authorised by the Southampton CHA having satisfied th Harbour Master or his designated representative by means of previous experience recorded training experience, formal assessment and successful oral examination.

The training schedule recognises the progression of authorised pilot to Class (Unrestricted) pilot, via a number of intermediate grades, is by means of structured training programme, which incorporates assessments, examination an specified training at all appropriate stages.

Monitoring of pilot training, and upgrading of pilots when the requisite standards o experience and training have been met, is the responsibility of the Harbour Master Each new entrant will be assigned a mentor who will monitor progress throughou initial training.

The Harbour Master regularly monitors the strength of the pilotage service in term of:

- The present and predicted demand for pilotage services.

Extract from Navigazione Montanari’s Safety Management Manual intervals. Whenever circumstances permit, the vessel's position must be taken using more than one method.

2. The Watch Officer must identify all the on-shore references with certainty.

(vii) Calling the Captain

1. The Officer of the Watch must immediately inform the Captain in the following circumstances:
   - if reduced visibility is encountered or forecast
   - if traffic conditions or movements of other vessels are causing concern
   - if there are difficulties in maintaining the course
   - in case land or an on-shore reference cannot be sighted, or it is impossible to take depth measurements using the echo sounder
   - if, unexpectedly, land or an on-shore reference is sighted or a change in the depth is observed
   - in case of failure of the propulsion engines, of the steering gear or of any equipment essential for navigation
   - in heavy sea conditions, if he fears possible damage due to bad weather.
   - if the vessel encounters navigation hazards like sea ice or flotsam
   - in any other emergency or situation in which he has some doubts
2. Regardless of the requirement to inform the Captain immediately in the above circumstances, the Officer of the Watch must not hesitate to take immediate steps for the safety of the vessel if circumstances so require.

(viii) Navigation with pilot on board - Captain/Pilot Relationship

1. If the Officer of the Watch has any doubt as to the Pilot's actions or intentions, he must ask the said Pilot for clarifications

If the doubts persist, he must immediately inform the Captain and take whatever step is necessary before the Captain arrives.

2. Captain/Pilot Relationship
   - The presence of the Pilot on board does not alter the responsibility of the Captain who remains solely responsible for navigation safety and/or for the mooring operations of his vessel.
   - The Captain and his Officers must observe the handling of the vessel by the Pilot and must not hesitate to countermand his orders if they think that the safety of the vessel is at risk.
   - If the Captain thinks that the Pilot's incompetence can put the safety of the vessel at risk, he should take those steps that ensure safety and request that the Pilot be replaced. Details of the incidents should be entered in the logbook.

(ix) Bad weather and reduction of speed

1. Time and space permitting, the course should be changed so as to avoid the bad weather area and the consequent risk of damage to the vessel and/or to the cargo.
2. The Captain must ensure that the vessel speed is adequate during bad weather so as to prevent damage or stress to the vessel and to the engines.

3. reduced visibility
4. high traffic density
5. other hazardous situations

the vessel speed must be adjusted so as to allow a safe manoeuvring margin even in case of failure of the main engine or of the radar; in particular, the following precautions must be taken:

a) if the automatic pilot is used, it must be possible to immediately transfer control to the manual steering equipment. The change-over from automatic pilot to manual steering and vice versa must be made by or under the supervision of the responsible Officer
b) a continuous radar and ARPA watch must be kept
c) a skilled helmsman must be ready at all times to assume manual control of the helm
d) if possible, both the helm pumps must be put into operation
e) the propulsion engines must be ready for operation immediately
f) an additional generator must be started up and connected to the main electrical panel

(ii) In conditions of reduced visibility, the first responsibility of the Officer of the Watch is to observe the rules for preventing collisions at sea. In particular, the rules related to the signals to be given in case of fog and the navigation lights to be turned on must be observed.

(iii) When ice on the course or in the immediate vicinity of the vessel is signalled, the Captain, at night, is required to reduce the speed of the vessel or to alter her course so as to keep well clear of the danger zone.

12.1.7 Information to the Pilot on the manoeuvreability of the vessel (Also see the ICS publication: "**Bridge Procedures Guide**")

The presence of the Pilot shall not relieve the Captain or the Officer of the Watch of their tasks or duties. The Captain must inform the Pilot about the vessel's characteristics using the "Pilot Card" form reproduced in Annex 1" of the "Bridge Procedure Guide".

This form must be completed as ordered by the Captain and delivered to the Pilot, who shall sign the relevant "Master/Pilot exchanging information" form at the time of coming on board.

The Captain must request the Pilot for information regarding local conditions and his navigation plans. This information must be in such a form as to allow the Captain or the Officer of the Watch to check the fixed course.

The Officer of the Watch must cooperate closely with the Pilot to assist him as much as possible and to maintain an accurate check of the position and movements of the vessel.

In addition to the "Pilot card", a placard containing the manoeuvreability features of the vessel must be permanently posted on bridge. It must be taken into account that the vessel's manoeuvreability performance may differ from that given in the placard because of different environmental, bottom cleaning and loading conditions.

12.1.8 Precautions when the vessel is at anchor

When the vessel is at anchor, the Captain must take all the precautions to avoid endangering the vessel and her crew. These precautions must take into account the following:

BMT SeaTech's report -
Vallermosa Collision on 25 February 2009: Some Comments

BMT SeaTech

A part of BMT in Maritime Transport

Vallermosa Collision on 25 February 2009: Some Comments

Reference: C13558.R01.V02
Date: 24 April 2009
Commercial in Confidence

Vallermosa Collision on
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Some Comments

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Issue date: 24 April 2009 Document No: C13558.R01

VALLERMOSA COLLISION ON 25 FEBRUARY 2009: SOME COMMENTS

1. Introduction

On 25 February 2009 the chemical/oil tanker Vallermosa came into contact with two tankers, Navion Fenna and BW Orinoco, at berths 5 and 4 respectively of the Fawley Terminal. The Vallermosa sustained damage to the starboard focsle bulwark and the BW Orinoco some damage to the port side of her transom stern above the waterline.

AIS records and other information exist for the arrival manoeuvres of the Vallermosa and BMT SeaTech (BMT) were commissioned by the Marine Accident Investigation Branch of the UK Department for Transport (MAIB) to explore this information with a view to determining any hydrodynamic or other dynamic features which could have led to the incident.

This report describes this investigation and provides an opinion as to contributory causes to the collision.

2. Aims and Scope

2.1 Aims

The main aims of the study were as follows:

- To provide answers to the following questions:
    - Was the Vallermosa likely to have had any unusual handling characteristics which could have led to her behaviour on 25 February last?
    - In the four stages of the accident:
        - Did the vessel's hull form, propulsion, or rudder arrangement contribute to the loss of control of the vessel?
        - Why was the rate of turn so difficult to kill particularly on the exit from the turn off Calshot Spit?
        - Why was slowing down a problem and did the propeller speed and ship's speed through the water allow the ship to decelerate as expected?
        - Did the pilot's actions make things worse while slowing down?
        - Was the pilot's use of the Becker rudder appropriate, particularly when operating the rudder at large angles with the propeller turning astern?
- To suggest any other work that might be needed to further investigate hydrodynamic and dynamic aspects of the incident.

2.2 Scope

The scope of the study was confined to:

- The four stages of the incident, defined as:
    - Passage from south east of the Isle of Wight to the Thorn Channel which gave no cause for concern, followed by passage round the turn at the Bramble Bank which was uneventful although the vessel's speed should be considered
    - Passage from the North Thorn buoy round the bend at Calshot Point to a position off Calshot Castle when the pilot was was possibly distracted.
    - Passage from Calshot Spit to a location roughly off Hamble Point buoy when the pilot was informed by VTS that he could not berth at the Hamble jetty and would have to turn and make out to anchor.
    - Passage from Hamble Point buoy to the collision when the pilot made a number of manoeuvring actions and the ship gradually sheered to port, ultimately to collide with ships on the Fawley jetties.
- Information provided by the client which included:
    - A summary of the Voyage Data Recorder (VDR) log and bridge voice recorder, including transcriptions of helm and course orders issued on the bridge, from 08:25 to 10:43 on the day
    - Engine data logger summary from 10:18 to 11:08
    - General arrangement drawing
    - Annotated track plots derived from the Vallermosa AIS
    - Vallermosa pilot card
    - Photos of drawings for the Vallermosa's Becker rudder
    - Photos of the wheelhouse poster and the vessel details poster
    - Photos of two notices on the bridge dealing with use of the Becker rudder.

3. The Incident

The Vallermosa was planning to berth at the BP Hamble Terminal and left her anchorage off the south east of the Isle of Wight with this intent at about 0700 UTC hours on 25 February, 2009 (see Figure 1). She then proceeded to take the a course along part of the Nab Channel into the Eastern Solent where she arrived making about 12 knots over ground, a speed which was reduced to around 9 knots off Ryde at which point she appears to have followed the radar reference line to the turn past Calshot Spit. She was still making 9 knots overground past Ryde Middle and on entry to the Thorn Channel.

The turn to starboard round the West Bramble buoy was accomplished successfully with a ground speed around 10 knots on exit. The pilot was then informed that the berth was unavailable and that the vessel should abort the berthing and return to anchor. In the next section of the Thorn Channel, as the turn to port around Calshot Spit was approached at a ground speed of about 9.8 knots and the turn was completed. However, by this time the speed had risen to 11.2 knots on exit after an application of full ahead when entering the turn to port.

Speed continued to build until the application of a sequence of engine orders of "half ahead", "slow ahead", "dead slow ahead" and "stop" in quick succession some minutes later, made in an attempt to reduce the overground speed from its peak of 11.5 knots.

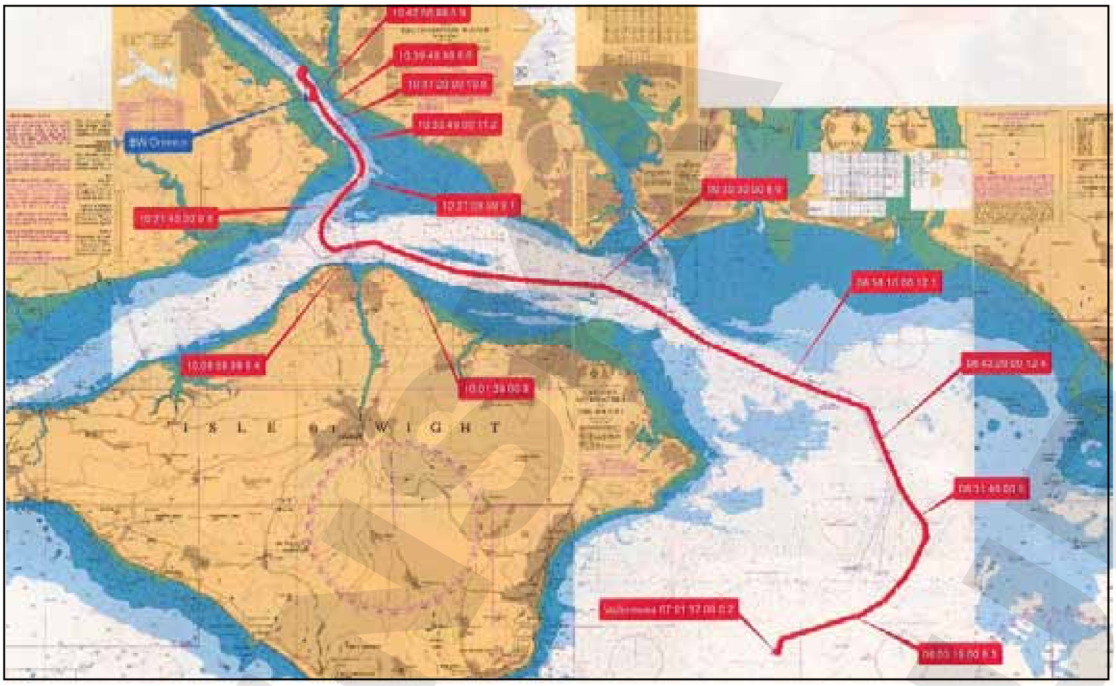

Figure 1: Route of the Vallermosa on 25 February 2009

After the engine was stopped, the Vallermosa began a slow turn to starboard which the helmsman was unable to correct until the engine was put to “dead slow ahead”, combined with hard a-port. This killed the starboard swing which was replaced with a swing to port which began to build as the engine was once again stopped and put astern. Still the port swing did not come off until hard a-starboard was applied, accompanied by “dead slow ahead”. This had little effect and the rate of swing was only reduced after rudder applications of 50^{o} and then full over to starboard.

These actions were too late to avoid collision, however, and the Vallermosa struck the port side of the stern of the BW Orinoco at about 10:44 UTC.

4. Background Information

In this section the relevant data on the Vallermosa and the metocean conditions at the time of the incident are introduced.

4.1 The Vallermosa

The Vallermosa is a single-screw chemical/oil tanker. The fixed pitch single propeller is driven by a diesel engine and the ship is controlled by a single Becker rudder. Her principal particulars are shown in Table 1.

It may be noted that in this table the design draught is highlighted thus * to draw attention to the fact that the value given in the Table is not that given in the General Arrangement Drawing. On this, the design draught is stated as 9.0 metres and the scantling draught 10.0 metres. The drawing also shows the design water line at 9.0 metres and the bulb and transom stern appear to have been designed for this draught. The rudder profile shown in the drawing has an area of 26.9 m^2 which gives a rudder area ratio ($a_R/(L_{PP}.T_D)$) of about 1.8% at a draught of 9.0 metres, a reasonable value for a ship of this type. Increasing the design draught to 11.1 metres drops the rudder area ratio to about 1.4%, with the rudder as drawn, which is rather low and may explain why the Becker rudder area was increased to give a rudder area ratio of 1.8% at the new design draught.

Particular	Value
Length Overall, L_{OA}	176.0m
Length between Perpendiculars, L_{PP}	168.0m
Beam, B	31.0m
Design Draught*, T_D	11.1m
Incident Draught, T_I	10.8m
Incident Trim, τ	level
Number of Rudders	1
Rudder Type	Becker
Rudder area, a_R	33.7m^2
Maximum rudder angle	65^o
Number of Propellers	1
Propeller diameter, D	5.88m
Engine revolutions at mcr, N_{mcr}	127
Power at mcr	8683kW
Bow thruster?	yes
Bow thruster – diameter - power - location	2.0m 1066kW 0.464L_{PP}
Design speed	15 kts
Time full ahead to full astern	500s
Time to hard-over	21s
Angle for zero bias	0.5^o stbd

Table 1

The non-dimensional ratios for the ship are given in Table 2.

Coefficient	Value		
	Implied by GA	Present condition	Incident
Block Coefficient	0.795	0.827	0.831
Prismatic Coefficient	0.800	0.831	0.835
Midship Section Coeff	0.994	0.995	0.995
L_{PP}/B	5.419	5.419	5.419
B/T	3.444	2.793	2.870
$a_R/(L_{PP}.T)$	1.78%	1.81%	1.86%

Table 2

4.2 Metocean Conditions

The measured metocean conditions on the day were obtained from weather station data at Southampton VTS and Bramble Bank. They are summarised in Table 3.

The value marked * in Table 3 was obtained from the client because no measurements were logged at the weather station for that time.

It is seen that the wind was about BF3 from the south west during the period of the incident with the tide flooding to a time of high water just after the Valermosa struck BW Orinoco. A following current may therefore be assumed and, from chart BA394, would appear to have had a magnitude of about 1.0 knot on exit from the Thorn Channel.

Location	Time (UTC)	Wind speed (kts)	Wind dirn (°)	Tide Ht (m)	Atm. Press (mb)
Bramble Bank	08:00	6.8	231	2.01	1029.3
Bramble Bank	09:00	7.9	238	2.46	1029.7
Bramble Bank	10:00	5.7	254	3.38	1029.7
Bramble Bank	11:00	8.2	241	3.98	1029.7
Soton VTS	08:00	7.3	250	2.37	-
Soton VTS	09:00	8.8	250	2.60	-
Soton VTS	10:00	7.6	250	3.62	-
Soton VTS	11:00	-	-	4.40*	-

Table 3

5. Manoeuvring Performance of Vallermosa

In this Section an attempt is made to assess the inherent manoeuvrability of the Vallermosa in order to see if it would have been likely to show any unusual handling characteristics. This is done by checking its performance (as indicated on the wheelhouse poster) against IMO requirements, comparing its hull characteristics against some design criteria and assessing its course stability behaviour, as measured by the VDR.

First, however, it is not clear from the “Manoeuvring Characteristics” poster whether the information it contains is for the ship in its original or present configuration. The Z-manoeuvre section of the poster implies that the trials were carried out at an approach speed of 14.75 knots and a “scantling draught of 10 metres” (which is the value given on the General Arrangement drawing corresponding to the 9.0 metre design draught shown on the drawing). It also states that a 20/20 Z-manoeuvre is shown, but the plotted results clearly show a 10/10 Z-manoeuvre. It is admitted that the plot may be simply a diagram to illustrate the Z-manoeuvre, but the first and second overshoot angles given thereon rather suggest a 10/10 manoeuvre. It is assumed to be so in what follows, but it is not clear if any of the data on the poster is in fact for the ship at the “new” design draught of 11.1 metres with a Becker rudder.

5.1 Compliance with IMO

Compliance with the IMO deep water Manoeuvring Criteria is checked in this section, bearing in mind the caveats mentioned above. There are four main, plus one optional, criteria. However, data is available for only three of the main four and they will be dealt with in turn. Only load draught trials results are considered.

5.1.1 Turning Ability

The requirement states that the advance must be less than or equal to 4.5L while the tactical diameter must be less than or equal to 5L where L is the ship length in metres. It appears from the slightly indistinct photos of the wheelhouse poster that the advance is 420 metres and the tactical diameter 455 metres. Taking the "ship length" as the length between perpendiculars, these give values of $2.5L_{PP}$ for the advance and $2.71L_{PP}$ for the tactical diameter, comfortably below the required maxima.

5.1.2 Initial Turning Ability

For this criterion the ship should not have travelled more than 2.5L, with 10^o rudder, by the time the heading has changed by 10^o from its initial value.

Unfortunately it has not been possible to find data to check this criterion.

5.1.3 Yaw Checking and Course Keeping Qualities

The requirement states firstly that the value of the first overshoot angle in a 10/10 Z-manoeuvre should not exceed:

10^o if $L/V < 10$ seconds
20^o if $L/V \geq 30$ seconds
$(5+½(L/V))^o$ for $10 \leq L/V < 30$ seconds

where V is the test speed in metres/second.

Making the assumption mentioned above, the L_{PP}/V is 22.16 seconds for an approach speed of 14.75 knots, giving a requirement that the first overshoot angle shall not exceed 16.1^o; it is 11.98^o from the "Manoeuvring Characteristics" poster and the vessel therefore complies.

The second IMO requirement in this segment is that the second overshoot angle in a 10/10 Z-manoeuvre should not exceed:

25^o if $L/V < 10$ seconds
40^o if $L/V \geq 30$ seconds
$(17.5+0.75(L/V))^o$ for $10 \leq L/V < 30$ seconds

This gives a required angle of 34.1^o and the actual angle on the "Manoeuvring Characteristics" poster was 23.21^o, so the vessel complies.

The final requirement in this segment requires that the first overshoot angle in a 20/20 Z-manoeuvre should not exceed 25^o. There is no data for a 20/20 manoeuvre, so this criterion cannot be checked.

5.1.4 Stopping Ability

The requirement states that the track reach in a "full astern" stopping test from the design speed should not exceed 15L. It appears from the wheelhouse poster that the track reach is 15 cables or $16.5L_{PP}$, so the ship does not quite comply.

5.1.5 Summary

In summary it would appear that the ship complied with the IMO manoeuvring criteria in all but stopping ability, although the last failed by only a small margin.

With the operating draught deeper than the stated design draught, and fitted with a Becker rudder, there is no reason to believe that it would not comply. In fact the Becker rudder, providing more lift than a conventional rudder, would make the ship turn better than with a conventional rudder. In spite of this, the Becker rudder has to be used carefully in low speed handling, a topic which is discussed further in Section 5.3 below.

5.2 Other Checks

The broad geometric parameters which define the ship can be used in an empirical fashion to give an indication as to whether the ship is likely to be directionally stable or not.

The length/beam ratio of 5.419 is reasonably low and lies in the region where excessive response to rudder action might become apparent, although the deeper load draught would improve matters. The fact that the ship was fitted with a Becker rudder in its deeper-draught manifestation may in fact signify that the original design was difficult to steer and needed the extra steering control afforded by the flapped rudder.

Further rough checks may be made from plots derived from empirical data and, although approximate, can give an indication as to whether the ship is course stable or not.

The first plot is shown in Figure 2 and is taken from Reference 1. Boundary lines are plotted as stability boundaries with the “stable” and “unstable” regions marked. It is seen that the ship as originally designed fell on the “unstable” side of the boundary for block coefficients around 0.8 and was improved at the deeper draught, although still classed as unstable.

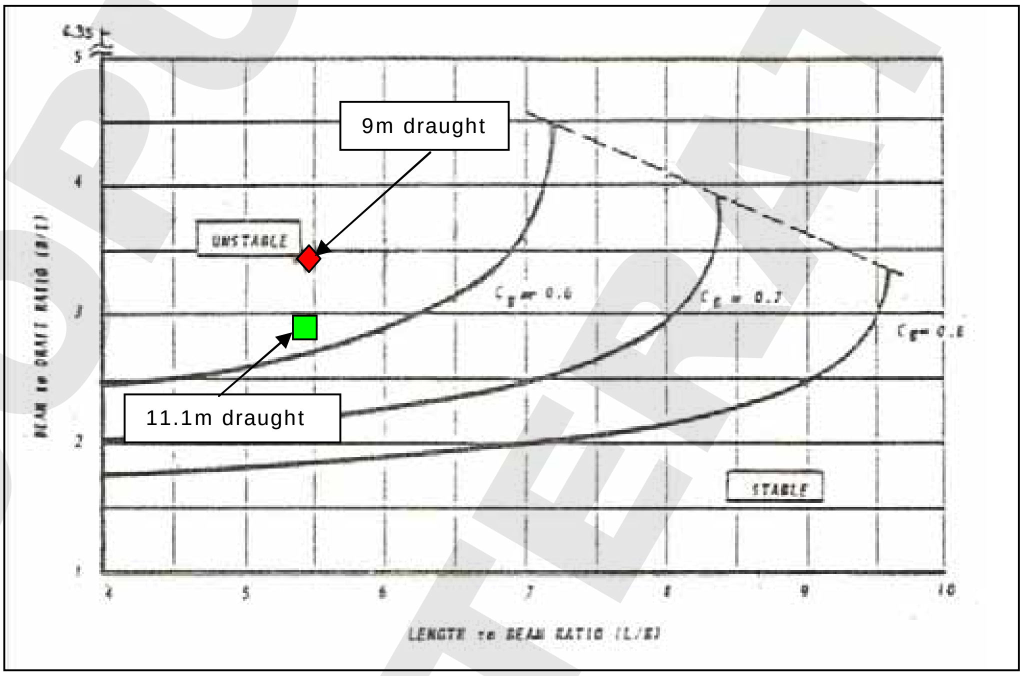

Figure 2: Directional Stability Check 1 from Reference 1

Figure 3 shows an alternative plot from Reference 2 which shows the Vallermosa to be more stable (and just on the stability margin) at the deeper load draught, by virtue of its smaller beam/draught ratio.

These two plots suggest that the Vallermosa at the time of the incident may have had a tendency to directional instability as is often the case with ships having block coefficients in excess of 0.8 and length/beam ratios less than 5.5.

Further assessments of this were made using data from the Vallermosa VDR for the period of time from her leaving the anchorage to exit from the Thorn Channel. Figure 4 shows the rate of turn plot against time of day for a period from 08:40 UTC to 08:46 UTC, a time when, as can be seen from Figure 1, the ship was on a nominally steady course in the Nab Channel off the eastern extremity of the Isle of Wight.

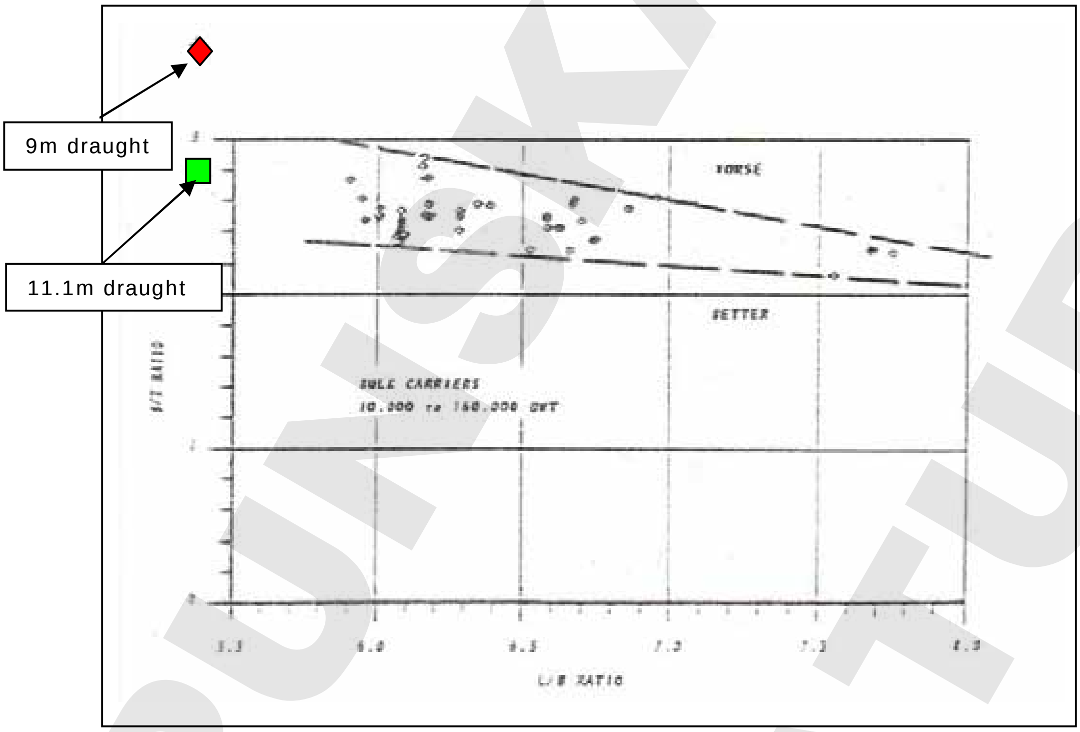

Figure 3: Directional Stability Check 2 from Reference 2

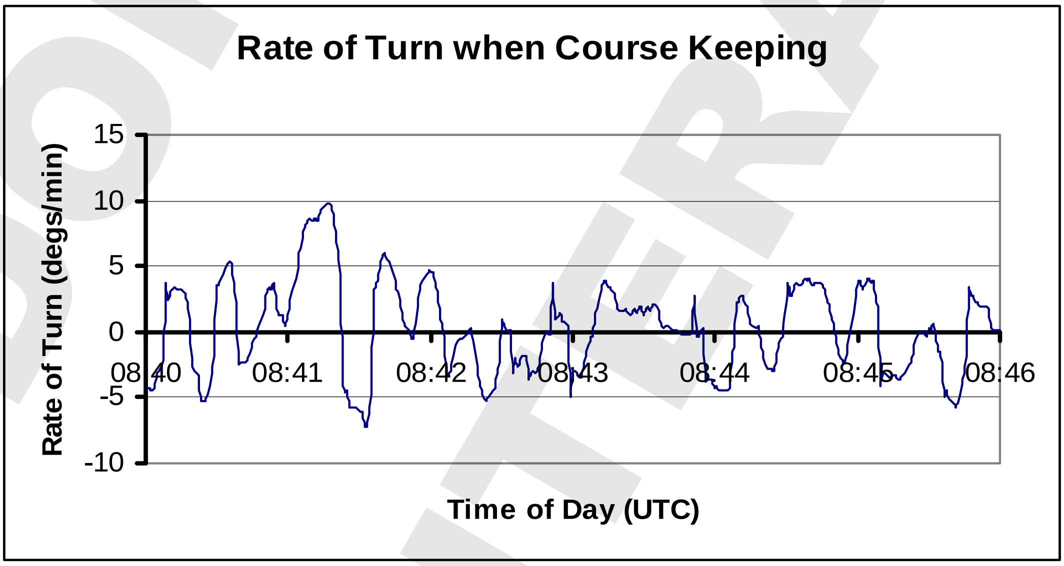

Figure 4: Vallermosa Measured Rate of Turn while on a Steady Course

It is seen that the rate of turn is hardly ever steady or close to zero, as one might have expected on a day when the winds were light and the sea slight. The plot in Figure 4 was made from data sampled every second, so the undulations, whose periodicity is well in excess of the sampling period, cannot be ascribed to noise in the equipment. Rates of turn are not negligible and their magnitude and periodicity suggests either a measure of over-control or a ship which is not entirely directionally stable. As will be seen when rates of turn over the whole track from 08:30 onwards are discussed in Section 6 below, this continual variation in turn rate was common to the whole track under consideration.

The conclusion reached from this discussion is that the Vallermosa was prone to some course instability which, while not excessive, needed constant vigilance and correction to maintain a steady course. Course instability in the right amount is not necessarily a bad thing, provided the ship remains controllable. The subjective feature of ship behaviour referred to as “handling qualities” requires the correct mix of directional stability and instability to satisfy the role the ship must fulfil. As examples, a container ship which spends much of its time traversing the oceans of the world on nominally direct routes needs good inherent directional stability, whereas a tug, which must turn rapidly and be “handy”, benefits from a greater degree of directional instability.

5.3 Becker Rudder

Before leaving the topic of the Vallermosa’s manoeuvrability, it is useful to mention some aspects to be borne in mind when a Becker rudder is used for the low speed control of a single screw ship.

This type of control device is a flapped rudder, so called because it possesses a flap on its trailing edge which is caused to move to an angle approximately twice that of the main rudder blade. This gives a crude camber to the rudder chord which causes greater lift, in the same way that trailing flaps are deployed at low speeds in aircraft to augment lift when taking off or landing. Because this additional lift is not needed in normal cruising flight, the aircraft stows the flaps when cruising, partly because the additional lift causes extra drag and if used for control could give rise to excessive control forces.

It is not possible to reduce the size of a Becker rudder at cruising speeds on a ship, so small movements of the Becker rudder (generally smaller than those of a conventional rudder) are all that is required for course keeping. The ability to maintain course with small angles means that the drag penalties at large angles are avoided. This in turn means that the otherwise higher drag form of the Becker rudder does not cause an excessive drag penalty. Indeed a wheelhouse poster of the Vallermosa explains that rudder angles about one third the magnitude of those with a conventional rudder are needed for course-keeping, especially when the auto-pilot is engaged.

Becker rudders can be set to large rudder angles, but this must occur at low speeds only, occasions when they are very useful for some berthing manoeuvres where a side force is required without very much longitudinal force.

However, although a Becker rudder is able to generate large lift forces, it can do so only if it acts in a propeller slipstream. Without such a slipstream it loses its effectiveness because, at high angles, flow will separate over its surface, lift will be lost and a large unsteady drag force will result.

When running astern at low speeds with a Becker rudder hard over, the blade acts as a shield to the propeller, preventing inflow and thereby reducing the magnitude of the astern thrust from the propeller. This is stated clearly in a Vallermosa wheelhouse poster which recommends returning the rudder to midships when reducing speed with the propeller running astern. The poster further emphasises the futility of using large angles for low speed ahead manoeuvring due to flow separation over the rudder blade which significantly reduces the generated lift. The use of rudder angles less than 35° is recommended for such low speed manoeuvring.

In summary, it is clear that, although the Becker rudder has advantages, especially for low speed manoeuvring, it has special operational requirements if it is to be effective.

6. Analysis of Events Leading to the Incident

In this Section a detailed assessment is made of the Vallermosa's passage from the anchorage to the point of collision. Most of the discussion centres on information from the VDR and the engine log, the results from which are amalgamated in Figures 5 and 6. Also shown is an enlarged plot of the final portion of the Vallermosa's track to the point of collision and beyond (Figure 7). For ease of reference, Figure 6 has been annotated with various key events in the passage; Figures 5 and 7 deal with the final stages of the passage, while Figure 6 deals with passage from the Nab Channel to collision.

The timescale is split into segments for individual discussion and, after this, the questions posed by the client (see Section 2.1) are answered in Section 7.

It should be noted that, in what follows, a standard, and consistent, sign convention has been used in which:

- A rate of turn to starboard is shown as positive and one to port as negative
- A rudder angle to starboard is shown as negative and one to port as positive

6.1 From 08:30 to 10:00

Passage from 08:30 to 10:00 took the vessel from entry to the Nab Channel to Ryde Middle. It is seen from Figure 1 that the track shows no anomalies and the transit over this part of the passage appears quite normal. Figure 6, however, reveals a continuous turn rate variation about zero which reinforces the comment, made in Section 5.2 above, that the ship was not able to steady on a course on a day when the weather was benign. Any turns appear to be hesitant with a number of incremental heading changes, a feature which is seen frequently in the whole passage.

6.2 From 10:00 to 10:21

The period from 10:00 to 10:21 takes the vessel from Ryde Middle around the West Bramble bend and into the Thorn Channel. The entry to the West Bramble bend was decisive, but on exit many heading adjustments were carried out before the ship settled on a straight course to the next bend around Calshot Spit. However, after the successful West Bramble bend the ship was well-positioned on exit to begin its turn to port around Calshot Spit.

Once again the number of changes in the rate of turn plot in Figure 6 suggests a ship that was slightly course unstable and liable to wander off course if not checked.

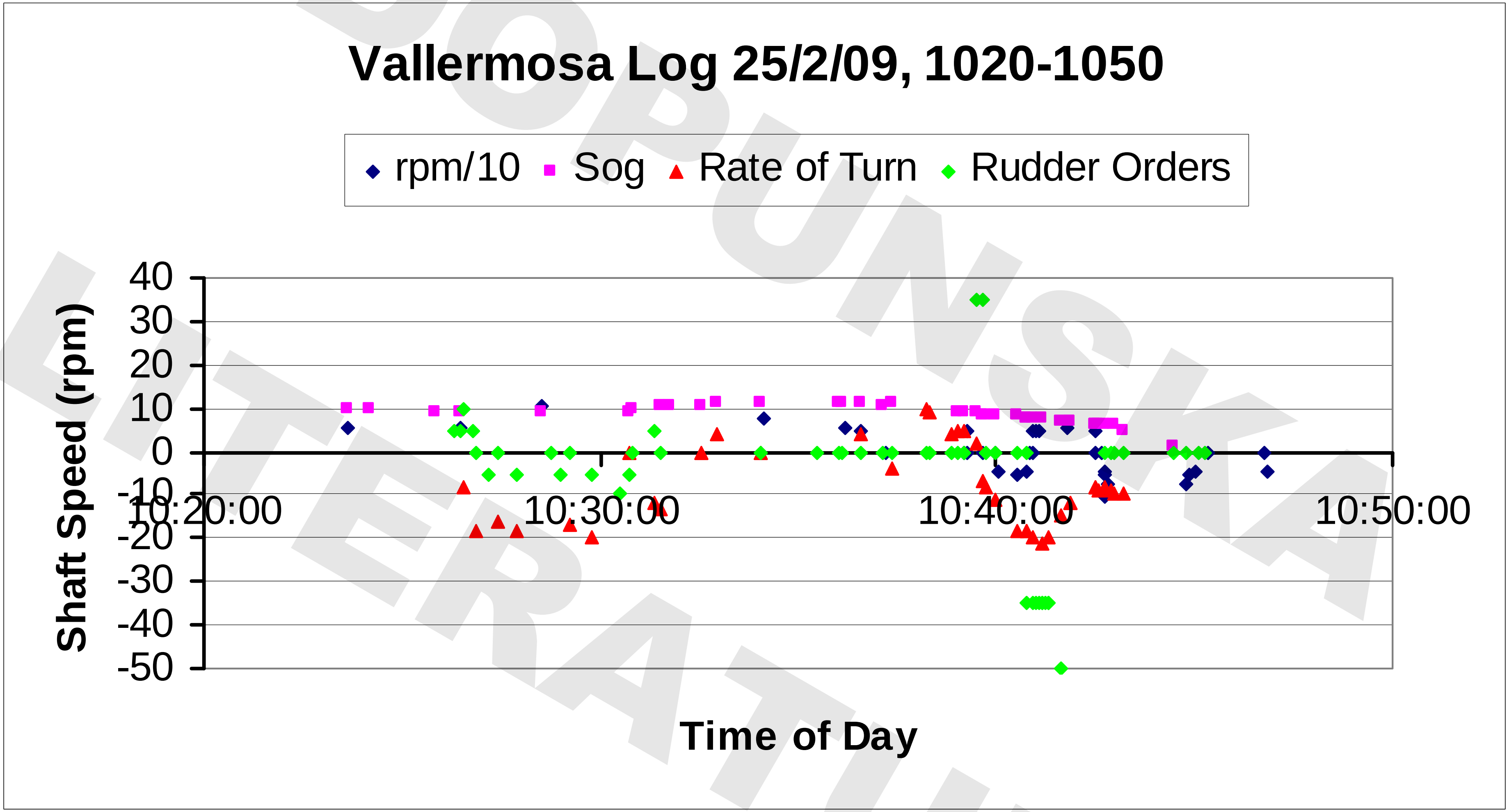

Figure 5: Data from Vallermosa VDR and Bridge Voice Recorder

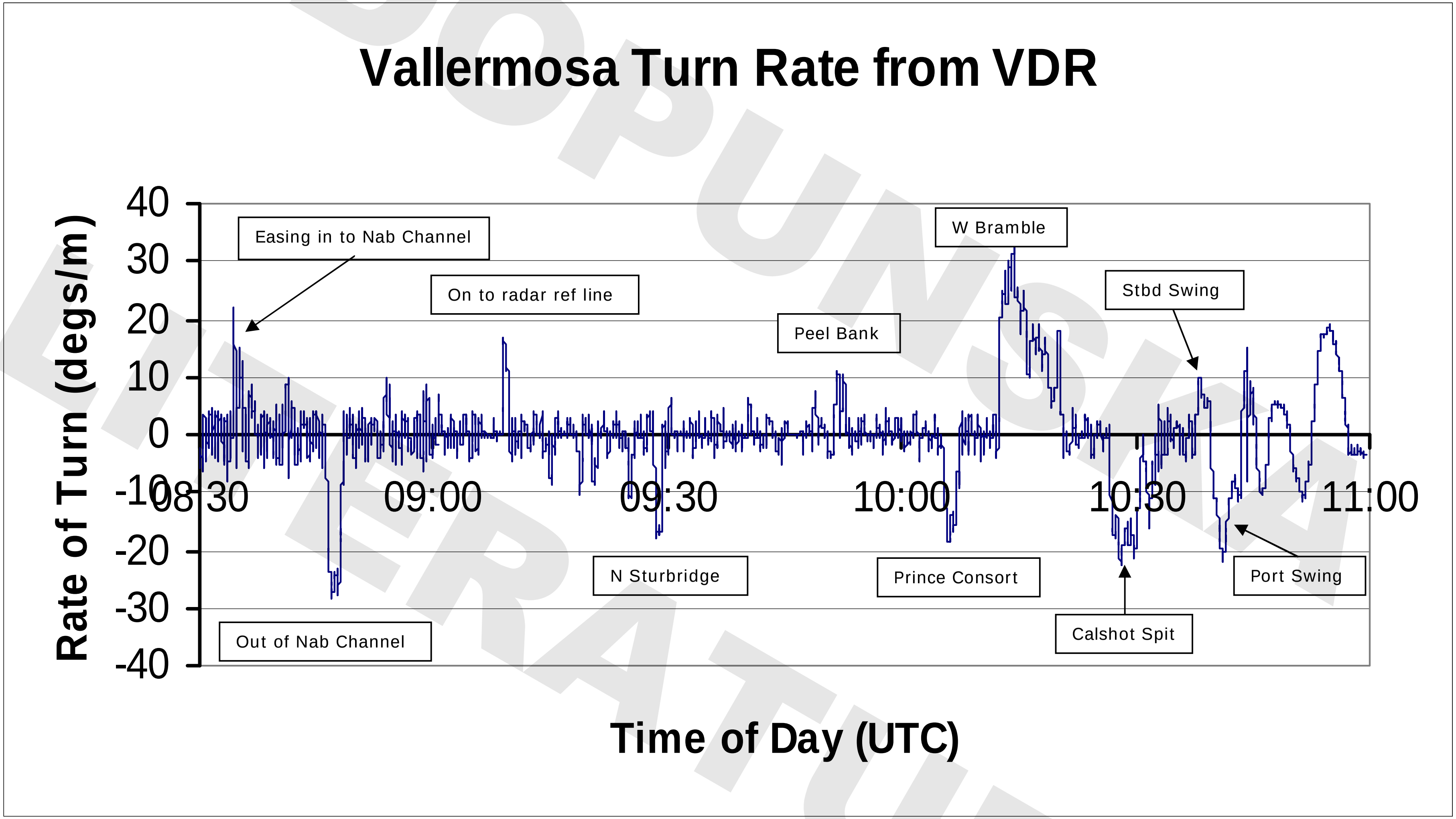

Figure 6: Rate of Turn Measurements from Vallermosa VDR

Figure 7: Final Portion of Vallermosa Track.

6.3 From 10:21 to 10:34

The period from 10:21 to 10:34 saw the ship navigating the bend round Calshot Spit successfully and heading to leave the Hook buoy to starboard. Figure 5 shows that the overground speed was of the order of 10 knots at this point and reducing, with the engine on slow ahead. Full ahead was achieved at about 10:28, as the ship was turning to port and about to exit the Calshot Spit bend. As can be seen from Figure 6, this may well have been to increase the turn rate to ensure the vessel made the turn, but it was quickly reduced as the vessel came out of the turn, only to be increased quite noticeably again as a further correction to port was made off the Reach buoy. This does not indicate a “good bend” and the upshot was that, as “full ahead” was maintained until about 10:34 (some 6 minutes later), the overground speed had increased to around 11 knots at the end of this leg, with the ship more-or-less steady on course.

It is believed that the conduct of this turn around Calshot Spit set in train factors which contributed to the final incident: the overground speed on exit was high, higher in fact than that at entry to the bend. It would have been expected to be lower had the bend been taken well and the extended period of full ahead had not been used.

6.4 From 10:34 to Collision

At 10:34 the ship was making about 11.5 knots over the ground with the engines on half ahead, having been reduced from full ahead. Figure 8 indicates the turn rate, rudder commands and engine orders over this last period.

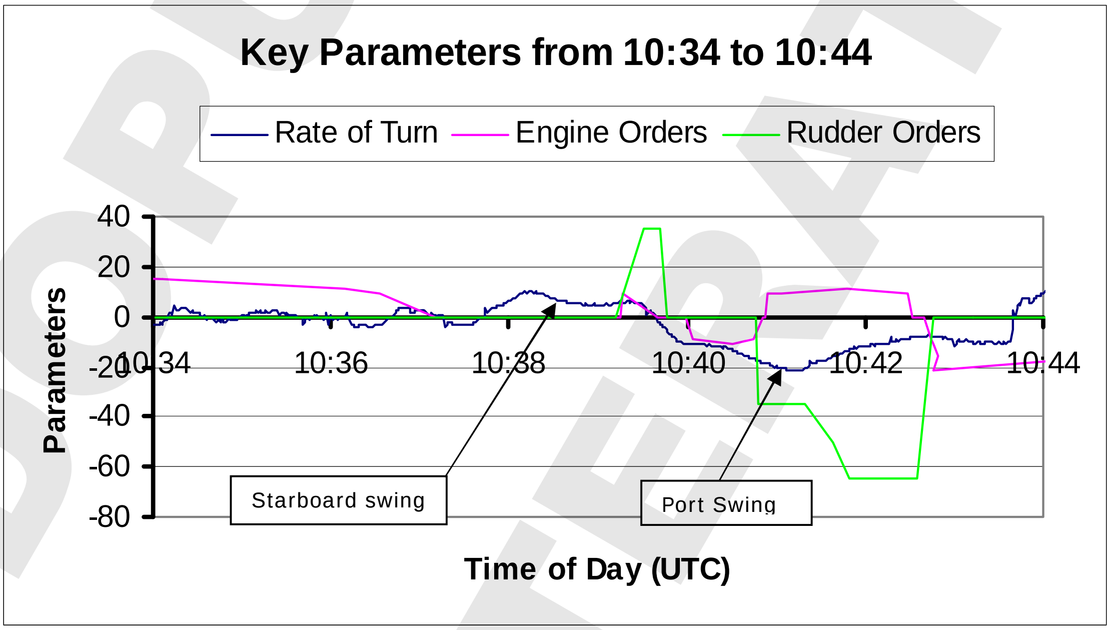

Figure 8: Measured Parameters in Period Leading to Collision

The sequence of events is as follows:

- Engine speed is gradually reduced from 10:34 to about 10:37 when the shaft stops. Overground speed at this time is about 11 knots.
- Almost immediately a swing to starboard begins.
- Port rudder of 35^{o} is used, combined with a kick of dead slow ahead, to stop the starboard swing, but it sets up a counter swing to port.

- Shortly after the port swing begins, the engine is moved astern and the rate of turn to port increases.
- Starboard rudder of 35° is then applied with the engines still astern or stopped; the port turn continues.
- The engine is then moved to dead slow ahead, followed by slow ahead, at which point the rudder is set to 50° and then 65° to starboard.
- This finally arrests the swing to port which begins to decrease until the engines are moved astern again. However, the residual swing to port continues and begins gradually to increase.

It is interesting that the starboard swing just before 10:38 begins as soon as the engine stops. It is seen from Table 1 that the rudder angle for zero screw bias is about 0.5° to starboard and, just prior to stopping the engine, the rate of turn was small and the ship reasonably steady on course. At the speed the ship was moving through the water at this time (about 10.5 knots) it might reasonably be supposed that some rudder was being used to counter the bias from the single screw which was trying to turn the ship to port. Once the engine stopped, the bias disappeared and any rudder to starboard, applied to counter its effect, would have tended to turn the ship to starboard, possibly exacerbated by the ship's tendency toward course instability. Although the rudder now no longer had the benefit of the propeller slipstream, the magnitude of the ship's speed through the water was probably enough for a Becker rudder to have some effect and cause the ship to swing slowly to starboard.

This swing was countered eventually by a kick ahead, combined with 35° of port rudder. Bearing in mind the statements made in Section 5.3 above with regards to the enhanced lift generated by a Becker rudder, this was almost certainly enough, not only to counter the starboard swing, but also to induce the swing to port. Unfortunately the engine was then moved astern after a brief period of "stop", and the rudder returned to midships. In such a situation, although a single screw ship moving ahead with its engine running astern might be expected to swing to starboard, this does not always happen, especially if a swing to port has already been induced. In addition, the slipstream from the astern-running propeller could have been moving along the starboard quarter causing a low pressure region there, enhancing the port swing.

Moving the engine ahead and setting the rudder to starboard finally checked the port swing, but the overall speed of the vessel was too high and a last attempt to stop by putting the engine astern failed and left some residual port swing.

From Figure 8, collision appears to have occurred just before 10:44 when a very rapid change of turn rate from port to starboard is shown on the VDR trace.

7. Answers to Questions

In Section 2.1, a number of questions are listed, all posed by the client. The answers to these now follow.

1. *Was the Vallermosa likely to have had any unusual handling characteristics which could have led to her behaviour on 25 February last?*

It is possible that the Vallermosa was not particularly course stable which may have led to her being prone to turn off course if not corrected in time. The evidence for this comes partly from the proportions of the vessel and partly from the VDR rate of turn record.

2. *Did the vessel's hull form, propulsion, or rudder arrangement contribute to the loss of control of the vessel?*

The vessel's hull form, as mentioned above, and the Becker rudder, which was inappropriately used, both probably contributed toward the accident.

3. *Why was the rate of turn so difficult to kill particularly on the exit from the turn off Calshot Spit?*

Killing the rates of turn prior to the collision was made more difficult by the fact that the engine was inappropriately used and the approach speed was too high, combined with the probable tendency of the ship toward directional instability.

4. *Why was slowing down a problem and did the propeller speed and ship's speed through the water allow the ship to decelerate as expected?*

Slowing down was a problem mainly because speed on exit from the bend past Calshot Spit was too high, caused by an extended application of full ahead to help the last part of this turn. The subsequent astern engine movements were inadequate because speed was so high and a swing toward the Fawley Jetties had been allowed to develop.

5. *Did the pilot's actions make things worse while slowing down?*

Yes, inasmuch as he had approached the area at too high a speed and had allowed swings to starboard, and then port, to develop. So, at a time when he should have been reducing speed, he had to use kicks of ahead power in an attempt to correct the swings. His use of the engines also appeared to be somewhat tentative.

6. *Was the pilot's use of the Becker rudder appropriate, particularly when operating the rudder at large angles with the propeller turning astern?*

No. He used hard over rudder to kill the starboard swing when it would have been better to use a lower angle as recommended in the Becker rudder instructions displayed on the bridge. When the engine was moving astern in the final stages of the approach to the ships on the Fawley Jetty, the rudder was generally amidships, as far as can be seen, but stopping the engine and setting the rudder amidships just before collision left a residual rate of turn to port.

Had the ship left the bend round Calshot Spit at a proper speed, it would have been more appropriate to use the Becker rudder earlier, together with kicks ahead and astern, to turn short round to starboard in the Natural Deep or near the Hamble Terminal in order to head out to sea.

In passing, it would seem that the advice from Southampton VTS came a little late for the pilot to act upon, turn and head back out to sea.

8. Opinion

In my opinion, shiphandling error was largely causal to the incident because:

- The ship entered Southampton Water at too high a speed, resulting from prolonged use of full ahead power in the bend round Calshot Spit. This lay at the heart of all that went wrong subsequently.
- There was no allowance for the possibility of a sheer to starboard, once the engine was stopped, due to the cessation of screw bias effects.
- The Becker rudder was used inappropriately and in contravention of the recommendations for use of such rudders posted on the bridge.
- Use of the engine was poor in the final stages of the incident.

In mitigation, it would appear that the Vallermosa may have had some characteristics which may have made her more difficult to handle than a more course-stable ship.

9. Possible Further Work

Although the reasons for the incident would appear, on the basis of information presently to hand, to be fairly clear, further work could be carried out, mainly to see what should have been done so that lessons can be learnt. In addition, it might be thought useful to determine, given the status of the vessel on exit from the Calshot Spit bend, what actions could have been taken on the day to avoid what did in fact happen, and whether the ship could, in any event, have turned safely and made out to sea.

Such work would seem to be ideally suited to a shiphandling simulator, perhaps involving the pilot himself so that proper use of the Becker rudder and ship speed can be emphasised.

Exploratory work could be carried out on a desk top fast time simulator, especially for rapid exploration of “What If?” scenarios, but most work would probably be best done on a full mission, real time, simulator. The ability to model the course stability of the Vallermosa would be important to such exercises.

10. References

1. Clarke D, et al — “The Application of Manoeuvring Criteria in Hull Design using Linear Theory” The Naval Architect, March 1983

2. — “Design and Verification for Adequate Ship Manoeuvrability” Transactions of the American Society of Naval Architects and Marine Engineers, Vol 91, 1983,pp 351-401