OTSI Office of Transport Safety Investigations

FERRY SAFETY INVESTIGATION REPORT

COLLISION OF MV *FRESHWATER* WITH MANLY WHARF

Sydney Harbour

22 June 2013

FERRY SAFETY INVESTIGATION

COLLISION OF MV *FRESHWATER* WITH MANLY WHARF

SYDNEY HARBOUR

22 June 2013

Released under the provisions of
Section 45C (2) of the *Transport Administration Act 1988* and
46BBA (1) of the *Passenger Transport Act 1990*

Investigation Reference: 04606

Published by: The Office of Transport Safety Investigations
Postal address: PO Box A2616, Sydney South, NSW 1235
Office location: Level 17, 201 Elizabeth Street, Sydney NSW 2000
Telephone: 02 9322 9200
Accident and incident notification: 1800 677 766
Facsimile: 02 9322 9299
E-mail: info@otsi.nsw.gov.au
Internet: www.otsi.nsw.gov.au

THE OFFICE OF TRANSPORT SAFETY INVESTIGATIONS

The Office of Transport Safety Investigations (OTSI) is an independent NSW agency whose purpose is to improve transport safety through the investigation of accidents and incidents in the rail, bus and ferry industries. OTSI investigations are independent of regulatory, operator or other external entities.

Established on 1 January 2004 by the Transport Administration Act 1988, and confirmed by amending legislation as an independent statutory office on 1 July 2005, OTSI is responsible for determining the causes and contributing factors of accidents and to make recommendations for the implementation of remedial safety action to prevent recurrence. Importantly, however, OTSI does not confine itself to the consideration of just those matters that caused or contributed to a particular accident; it also seeks to identify any transport safety matters which, if left unaddressed, might contribute to other accidents.

This OTSI investigation was conducted under powers conferred by the Transport Administration Act 1988 and the Passenger Transport Act 1990. OTSI investigators normally seek to obtain information cooperatively when conducting an accident investigation. However, where it is necessary to do so, OTSI investigators may exercise statutory powers to interview persons, enter premises and examine and retain physical and documentary evidence.

It is not within OTSI's jurisdiction, nor an object of its investigations, to apportion blame or determine liability. At all times, OTSI's investigation reports strive to reflect a "Just Culture" approach to the investigative process by balancing the presentation of potentially judgemental material in a manner that properly explains what happened, and why, in a fair and unbiased manner.

Once OTSI has completed an investigation, its report is provided to the NSW Minister for Transport for tabling in Parliament. The Minister is required to table the report in both Houses of the NSW Parliament within seven days of receiving it. Following tabling, the report is published on OTSI's website at www.otsi.nsw.gov.au.

OTSI cannot compel any party to implement its recommendations and its investigative responsibilities do not extend to overseeing the implementation of recommendations it makes in its investigation reports. However, OTSI takes a close interest in the extent to which its recommendations have been accepted and acted upon.

CONTENTS

TABLE OF PHOTOGRAPHS

TABLE OF DIAGRAMS

ACRONYMS AND ABBREVIATIONS

CCTV	Closed Circuit Television
DIP	Directly Involved Party
FLIR	Forward Looking Infrared
GPH	General Purpose Hand
HCF	Harbour City Ferries
MCR	Machinery Control Room
OTSI	Office of Transport Safety Investigations
RMS	Roads and Maritime Services
RSJ	Rolled Steel Joist (Universal Beam)
SMS	Safety Management System
VDR	Voyage Data Recorder
XY Lever	Control lever similar to a joystick used to control forward, astern and transverse movement and speed of a ferry

EXECUTIVE SUMMARY

On 22 June 2013, the Harbour City Ferries' ferry MV *Freshwater* experienced a control failure resulting in the ferry coming into collision with the timber arrester (known as the backboard) on the western side at the northern end of Manly Wharf.

A deckhand at his station to secure the ferry realised that the vessel was not slowing as it made the wharf and shouted a warning to passengers to brace before the impact. None of the 17 passengers onboard at the time were injured. However, a Harbour City Ferries' technician working in the engine room suffered a minor injury to his shoulder when he was thrown off balance.

The bow of *Freshwater* suffered major damage in the collision with two tears to the steel hull plating, fortunately above the water line. The backboard suffered significant structural damage in the impact. A pile was snapped off, the timber fascia smashed and steel backing beams displaced and bent.

The loss of control of *Freshwater* was determined to have been caused by the malfunctioning of a potentiometer operated by the control lever on the main console in the No.1 wheelhouse. As a consequence the vessel was propelled full ahead when full astern had been selected in preparation for berthing.

Harbour City Ferries has now replaced the potentiometers in the control systems of all of its four Freshwater class ferries. The company has also established an appropriate maintenance regime for the tracking and replacement of potentiometers. Given the action taken no recommendations for further safety action are considered necessary.

While the backboard was being repaired Manly ferry services were required to operate from the eastern side of the Manly Wharf. The timber backboard in that location was observed to lack necessary functional robustness in comparison to the backboard on the western side. It is recommended that Roads and Maritime Services undertake engineering and risk assessments to establish its current suitability for Manly ferry operations.

PART 1 FACTUAL INFORMATION

Overview

1.1 At 07:22[1] on 22 June 2013, the Harbour City Ferries' (HCF) MV *Freshwater* experienced a control failure resulting in the ferry coming into collision with the timber arrester (known as the backboard) situated on the western side at the northern end of Manly Wharf. The ferry was on approach to the wharf to berth and disembark its 17 passengers when the control failure occurred.

1.2 No passengers were injured in the collision as they were all alerted by a deckhand who recognised there was a problem and shouted out the warning to 'hang on'. However, a HCF technician working in the engine room did not hear the warning and was thrown off balance on impact. He suffered an injured shoulder as the result of striking a generator.

1.3 *Freshwater* sustained damage to the bow plating, which was dented inwards, and two tears to the hull plating near the stem of the ferry. The stem was also bent. Some damage was also occasioned to the inner frames in the bow section with the stem and hatch distorted.

1.4 The backboard suffered significant structural damage as a result of the impact. A pile was broken, its timber cladding was smashed and steel backing beams were bent.

MV *Freshwater*

1.5 The Freshwater class of ferries (more commonly known as the 'Manly ferries') are the largest vessels operated by HCF on behalf of the NSW Government. The class comprises of four ferries, *Freshwater*, being the first of its class to be launched, then *Queenscliff, Narrabeen* and *Collaroy*. They were introduced into service in 1982, 1983, 1984 and 1988 respectively. The class operates passenger services exclusively between Circular Quay No.3 wharf and Manly.

[1] All times are in Australian Eastern Standard Time (EST), 10 hours ahead of Coordinated Universal Time (UTC +10).

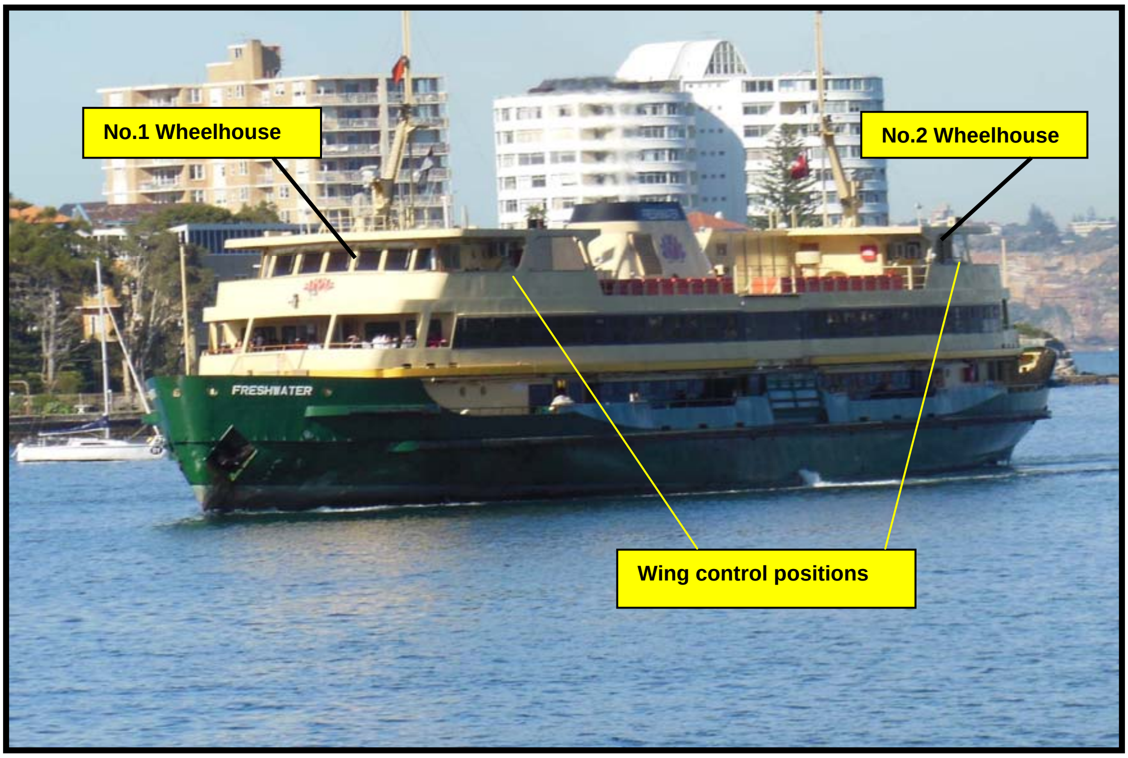
1.6 The Freshwater class are a monohull double-ended ferry consisting of a steel hull and aluminium on steel superstructure. They are in survey to carry up to 1100 passengers. *Freshwater* was in current NSW 1D survey[2], Identifying Number 15841. The ferries are 70.4 metres long, have a loaded displacement of 1140 tonnes and are powered by two 2238 kW diesel engines. The engines can be used independently or together to drive one or both propellers.

1.7 All vessels are equipped with radar, automatic identification system (AIS) class A, forward looking infrared (FLIR) cameras, very high frequency (VHF) radio and a HCF internal radio network. (See more details at *Appendix 1*.)

1.8 At the time of the incident *Freshwater* was carrying a crew of six consisting of the Master, Engineer and four general purpose hands (GPH). A technician, not part of the regular crew, was onboard to service a pump in the engine room. The Master held a current Master IV Certificate of Competency as well as a local knowledge certificate issued under Section 7 of the *Marine Pilotage Licensing Act 1971* to operate vessels over 30 metres in length within the Port of Sydney. The Master had 31 years experience operating within Sydney Harbour and was very experienced in the control of Freshwater class ferries.

1.9 The Freshwater ferries have identical bridges at both ends, designated No.1 wheelhouse and No.2 wheelhouse (see *Photograph 1*). This configuration allows the ferry to be operated on return trips from Circular Quay to Manly without having to turn around. At both Circular Quay and Manly wharves, the ferries have to manoeuvre to a position where hydraulic passenger ramps located on the wharves align with the hydraulic ramps on the ferries.

[2] Survey Class 1D identifies the vessel as a passenger carrying vessel permitted to operate in sheltered waters (partially smooth water operations).



Photograph 1: *Freshwater*

1.10 The main helming position is amidships on the bridge in use at the time and the ferries are steered using the rudder at the opposite end of the ferry from the wheelhouse in use. There are port and starboard wing positions situated outside both wheelhouses which afford the Master good vision of the wharves on arrival and departure. The wing bridge controls are independent of the main bridge controls once control is transferred.

Ferry Operation

1.11 The Master controls the vessel by a single lever telegraph, known as the XY lever. It is similar to a joy-stick which allows the Master to select ahead or astern propulsion by engaging the appropriate clutch. The lever also allows the Master to select side propulsion by engaging both propellers and rudders to move the vessel sideways. Engine speed is also controlled using this control lever.

1.12 Each ferry has six XY control levers, one located on each bridge console and one in each of the four wing positions. The XY lever has two potentiometers, one controls the forward and astern movements and the other controls side or transverse movement. The potentiometers are mounted at right angles to each other.

1.13 Freshwater class ferries operate in two modes of propulsion, *sailing* and *manoeuvring* modes. In *sailing* mode the variable pitch propeller at the stern or rear end drives the ferry forward. To stop or go astern, the same propeller operates in the reverse direction by changing the pitch of the propeller blades. When operating in *sailing* mode the forward rudder is locked amidships and cannot be used. (See *Diagram 1*) Under normal operations the passage between Circular Quay and Manly is carried out in *sailing* mode with the ferry reaching a cruising speed of 13 - 14 knots (24 - 26 kph).

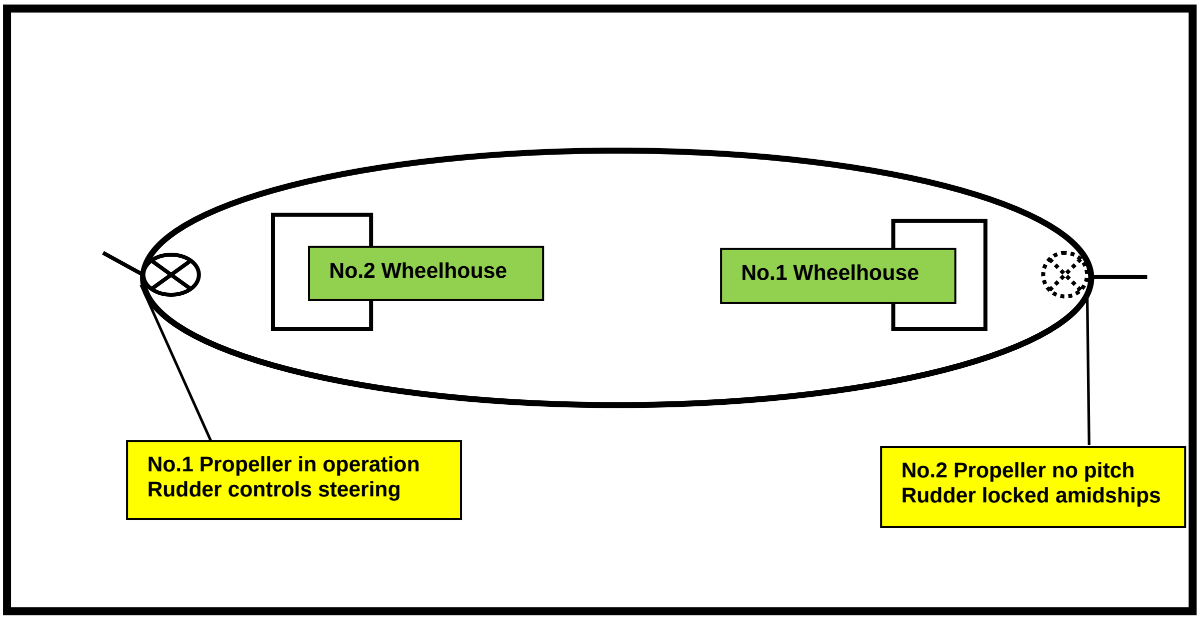


Diagram 1: Freshwater sailing mode

1.14 In *manoeuvring* mode both propellers and rudders are utilised in different combinations allowing the vessel to move sideways or swing one end or the other. To change from *sailing* mode to *manoeuvring* mode the vessel's speed must be reduced to below 5 knots to avoid damage to the system and allow time for the variable pitch propeller to engage. (See *Diagram 2*)

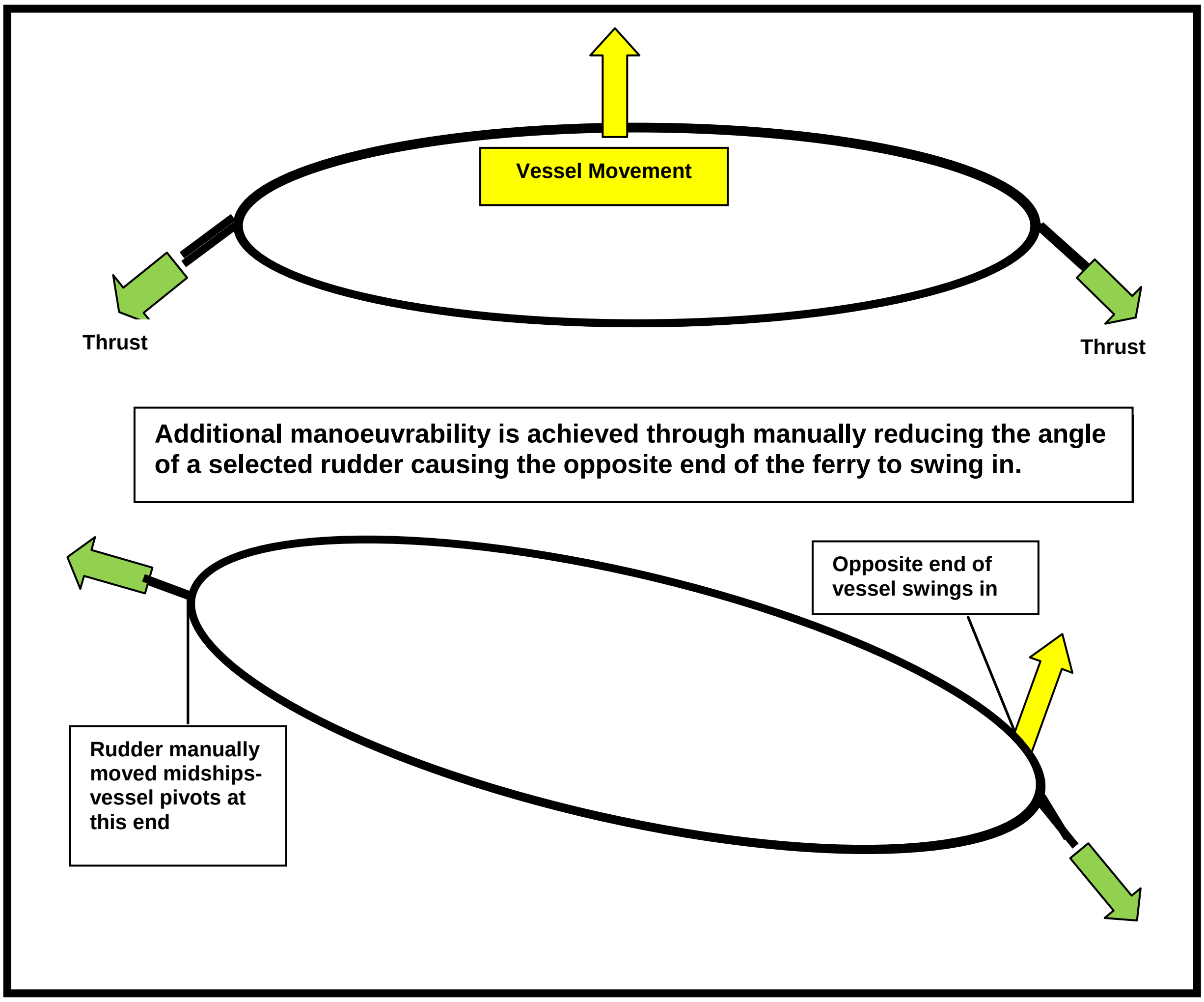


Diagram 2: Freshwater manoeuvring mode

1.15 *Manoeuvring* mode is selected when the vessel is required to commence a berthing operation or a tight manoeuvre. In this mode, the inactive bow propeller is taken out of feather to a 0° pitch state. This transition takes approximately 17 seconds, during which time the bow propeller shaft commences to spin due to the force of the water passing over the now pitched propeller blades. When 0° pitch is reached, the bow propeller is engaged and the stern and bow propellers and rudders work in combination. This enables the vessel to be highly manoeuvrable, including the sideways movement necessary for berthing. In *manoeuvring* mode the bow propeller provides the majority of the reverse thrust and control while the stern propeller provides the greater forward thrust.

1.16 In either mode, a back up control function is available for use in the event of a control system failure or when controls fail to respond as directed. Should both normal and back up control functions fail, all engine and propeller control can be transferred to the Engineer below in the Machinery Control Room (MCR).

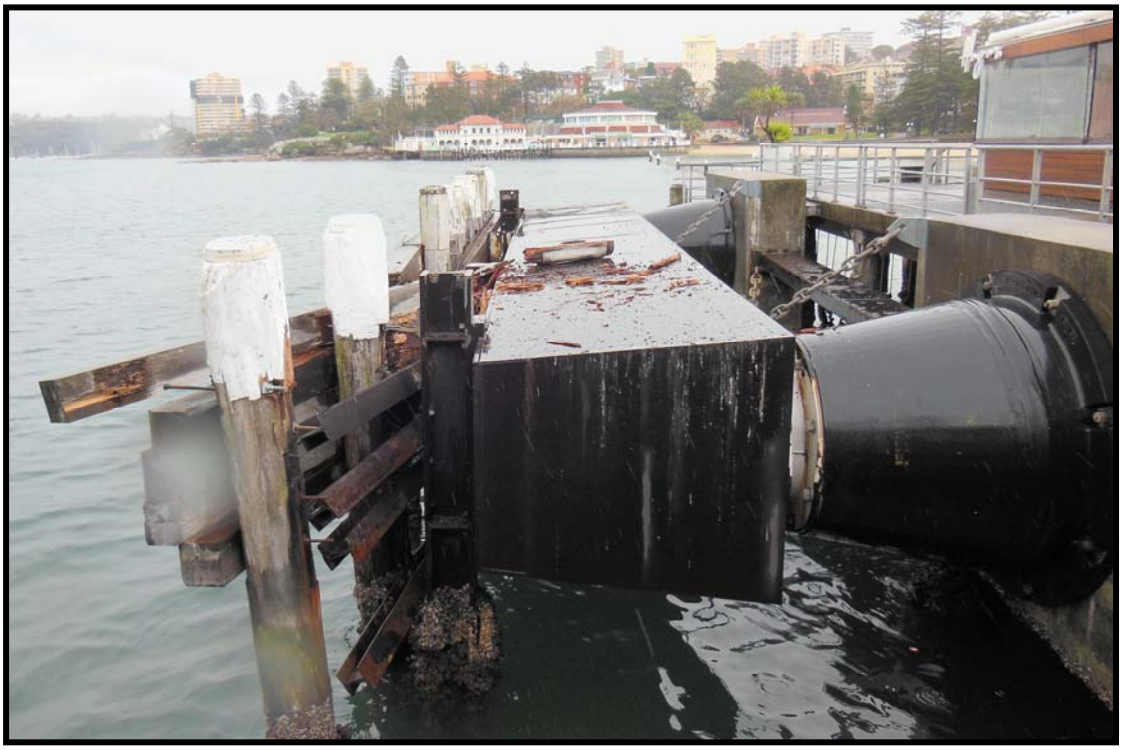
1.17 Back up control utilises a combination of hard wiring and micro-processors. In back up control, the XY lever is isolated and steering control is affected via a rudder control lever and a pitch control lever. These levers are located to the left of the main control console in the wheelhouse.

1.18 On nearing the completion of a service run, at a distance well off the wharf, the normal procedure is to reduce the speed of the ferry to below 5 knots then change from *sailing* to *manoeuvring* mode. Once *manoeuvring* mode is acquired, the Master will test the system by going astern briefly before making the approach to the wharf. The ferry is then moved to the wharf and stopped at a position where the ferries' hydraulic passenger boarding ramps are in line with the hydraulic ramps on the wharf. The Master will then leave the wheelhouse and go to the wing position from which to manoeuvre the ferry into its final position alongside the hydraulic ramps on the wharf. The ferry is then secured and passengers disembarked.

Backboard

1.19 A large timber arrester structure (backboard) attached to timber piles is positioned approximately 5½ metres from the concrete promenade end of the Manly Wharf on the western side and is 15 metres in length. This is intended to act as a barrier separating vessels from the concrete promenade on shore in the event of a ferry overshooting the wharf (see *Photograph 2*).

1.20 The backboard was constructed of timber piles driven into the seabed with large timber beams fixed horizontally to the piles above the water. Behind the timber fascia beams are four steel RSJs also mounted horizontally. The structure also consists of a large metal casing which houses additional steel RSJs placed strategically within the casing to soften impact. The steel casing is attached to the concrete walkway of the wharf structure with two large rubber buffers which are also designed to absorb impact.



Photograph 2: Manly Wharf western side backboard

The Collision

1.21 The collision occurred on the western side of Manly Wharf as *Freshwater* was completing its first passenger service of the day. It had departed Circular Quay at 06:50 and arrived at Manly Wharf at 07:22. The wharves at Manly are referred to as 'dead end' wharves as ferries berth in the forward direction then have to reverse out or, in the case of double-ended ferries, be operated from the alternate wheelhouse.

1.22 On approach to Manly the Master was driving from the No.1 wheelhouse. At a distance well to the south of the wharf, he reduced speed and transferred from *sailing* mode to *manoeuvring* mode after slowing the ferry to around 4 – 5 knots. In accordance with normal practice he then successfully tested the system by briefly engaging astern propulsion. On drawing level with the wharf he engaged astern then full astern. Astern engaged momentarily then, inexplicably, instead of slowing, the ferry continued ahead at an increased speed. The ferry was not stopping or slowing as it should have and the Master observed he had lost pitch on the forward propeller. The ferry was too close to the backboard for there to be time to transfer control to the Engineer and so the ferry proceeded to collide with the backboard then bounce backwards after impact.

1.23 The impact of *Freshwater's* bow on the backboard snapped one of the vertical timber piles, snapped the horizontal timber fascia and dislodged steel RSJs. The rubber buffers attaching the arrester to the concrete walkway also showed slight creasing as a result of the cushioning impact. The extent of damage to the backboard can be seen in *Photograph 3*.

Photograph 3: Damage from the collision

1.24 After the collision, the Master was able to transfer control to the starboard wing position where he successfully regained control and manoeuvred the ferry alongside without further incident. After the ferry was secured and passengers disembarked, an inspection was made for possible breaching of the watertight integrity and damage occasioned in the collision (see *Photograph 4*). The Master tested all the controls from the wing position in consultation with the Engineer and they operated as normal. HCF Operation Control was notified of the incident as was the Sydney Ports Corporation (SPC), the Vessel Traffic Service (VTS) operator and Roads and Maritime Services (RMS).

Photograph 4: Damage to *Freshwater*

1.25 *Freshwater* was secured alongside the wharf and removed from service pending examination by RMS surveyors, HCF engineers and an investigator from OTSI. NSW Water Police attended and conducted drug and alcohol testing of *Freshwater's* crew all of whom returned a negative result. A relief crew was sent to take charge of *Freshwater* until initial examinations were completed.

1.26 While alongside the wharf all the control and back up systems were again tested by a relief Master and Engineer in the presence of the OTSI investigator without any system failures being detected. These tests were made from the No.2 wheelhouse and its wing positions but not the No.1 wheelhouse.

1.27 After these initial examinations two tugs attended *Freshwater* to assist with its return passage to the HCF shipyard at Balmain should they be required. RMS vessels also escorted the ferry. For the journey *Freshwater* was driven from the No.2 wheelhouse by the relief Master. On the way, in an area clear of other traffic, all control systems were again checked. An attempt to transfer control from the No.2 wheelhouse to the No.1 wheelhouse failed.

Freshwater Operating Systems

1.28 The Freshwater class ferries are powered by two 2238 kW (3000BHP) Daihatsu diesel engines which drive fully feathering, controllable pitch propellers at each end of the vessel. The propellers and propulsion system in both wheelhouses were designed and manufactured by LIPS B.V. of Holland.

1.29 The main engines operate through twin input, single output, back-to-back, gearboxes which were manufactured in Germany. Each gearbox input shaft is fitted with a clutch and each propeller shaft with a brake. The arrangement of each engine / clutch / gearbox / brake is such that both engines, together or individually, can drive one or both propellers. Each engine has a variable speed range of 325 to 600 RPM (with clutch engaged) that converts through the gearbox to a range of 160 to 270 RPM at the propeller. The gearboxes are both unidirectional. (See *Diagram 3*)

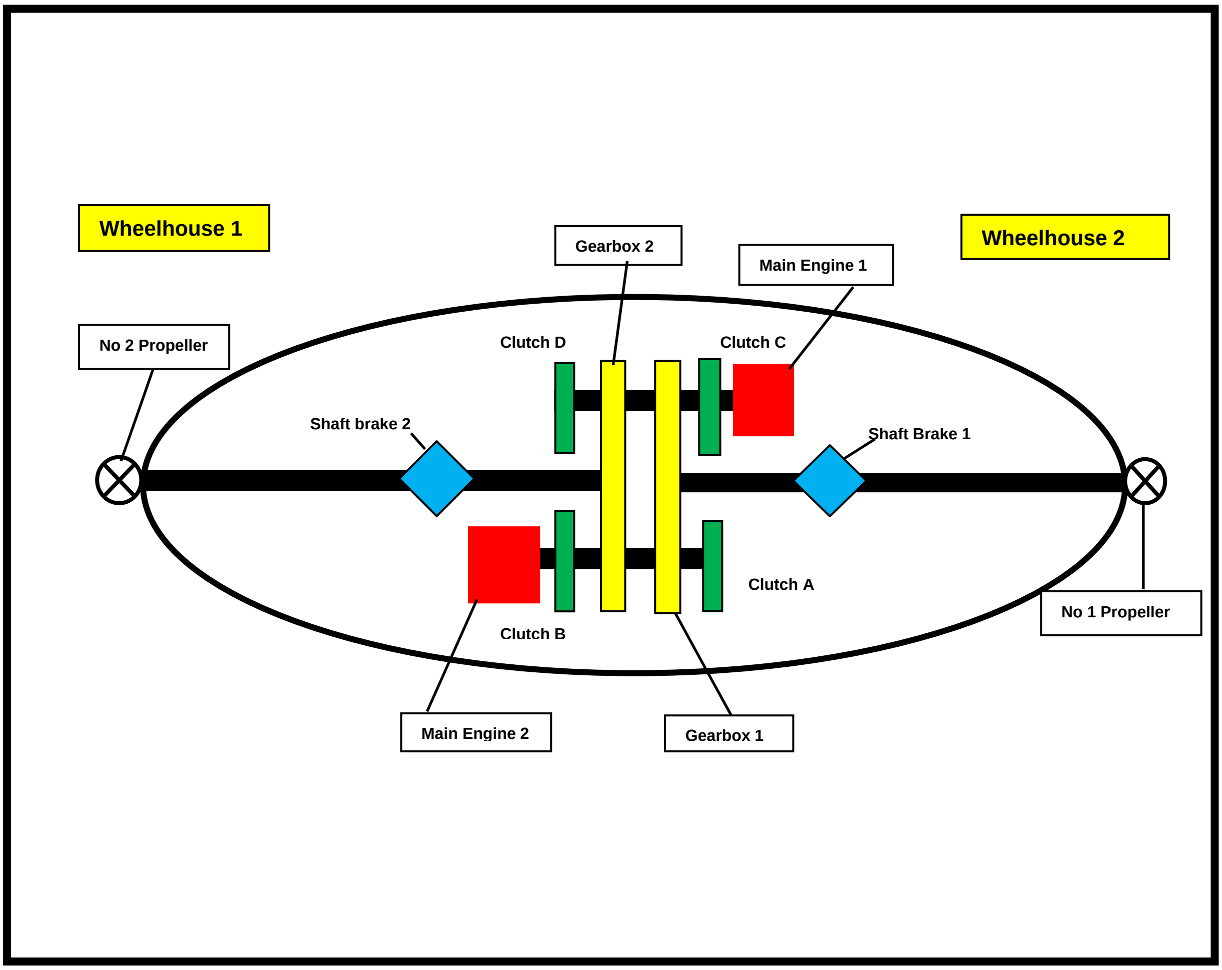


Diagram 3: Freshwater engine operating systems

1.30 The complete propulsion system consists of five major subsystems linked together:

a. Wartsila Lipstronic Propeller Pitch Control system. This system provides a power demand signal to the propulsion machinery from the wheelhouse controls within the constraints of safe plant operational conditions. It is made up of four separate processors (LMPs). Normal control is achieved through LMP1 or LMP2, both run together with the selected LMP controlling the situation and the other on standby. At start up each day the Engineer will select which LMP is to be used for control and which is to be on standby. If a failure occurs in the running LMP, the standby LMP will automatically take over in a 'bumpless' change over. If both LMPs fail (1 and 2), LMP3 and LMP4 can be engaged through a back up system. LMPs 3 and 4 can be alternated in the same manner as LMPs 1 and 2, with one processor always on automatic standby. However, for LMPs 3 and 4 to be engaged, they must be activated by the Engineer in the MCR.

b. Woodward governor system.

c. L & S Clutch engage / disengage system.

d. Tenijford steering system.

e. Daihatsu main engines.

A Siemens data acquisition and display system monitors the above systems and provides a log of alarms.

Environmental Conditions

1.31 Although visibility was described as good at the time of the incident, it was raining at Manly, heavily at times, and south-westerly winds were gusting to 20 knots. The tide[3] at Manly on 22 June produced a high of 1.47 metres at 06:54 ebbing to a low of 0.38 metres at 12:39. The prevailing tide and weather conditions did not cause or contribute to the incident.

[3] The tide heights are in metres above Prediction Datum and are measured from Fort Denison.

PART 2 ANALYSIS

Introduction

2.1 The investigation involved detailed examination of the relevant onboard FLIR, radio communications and voyage data recorder (VDR) recordings, as well as CCTV footage captured by a camera on Manly Wharf. The vessel's Safety Management System (SMS), logs, Standard Operating Procedures (SOPS), Vessel Operating Manual (VOM) and maintenance and service records were examined and the Master and the Engineer were interviewed.

2.2 Human factor issues were explored to determine if fatigue or human error may have been contributing factors in the incident. From an examination of rosters and the interviews with the Master and the Engineer, no evidence was identified that would indicate this to be the case.

CCTV Recording

2.3 A CCTV camera is positioned on the western side at the northern end of Manly Wharf facing south. As the position is almost directly in front of berthing vessels, it recorded the whole incident and was used to verify the Master's version of events.

2.4 The CCTV footage showed the ferry on a normal approach at slow speed. It then showed the bow propeller going into reverse propulsion and reducing the ahead momentum momentarily. The astern function then ceased and the ferry increased speed ahead before coming into collision with the backboard.

Equipment Failure

2.5 Downloads from the Siemens monitoring system provided information on the operation of the Wartsila control system on a second by second basis. An analysis of control signal and rudder angle records revealed that both LMP1 and LMP2 failed at 07:31:22.

2.6 The downloaded graph of the control commands shows that the No.2 (bow) propellers pitch was engaged in astern propulsion initially which then increased to full pitch astern momentarily. The graph then shows the No.1 (stern) propeller engaged giving full pitch ahead despite the XY lever still being in the astern position. That is, engagement without the Master having selected a change. The Siemen's system downloads therefore served to corroborate the evidence from the CCTV footage and the Master's recollection of events. (See *Appendices 2 and 3*)

2.7 The XY lever uses two Bourns® potentiometers as position transducers. The potentiometer is a three terminal resistor with a sliding contact (wiper) that forms an adjustable voltage divider. *Diagram 4* shows the basic components of a typical potentiometer. *Photograph 5* shows the potentiometers involved in the incident.

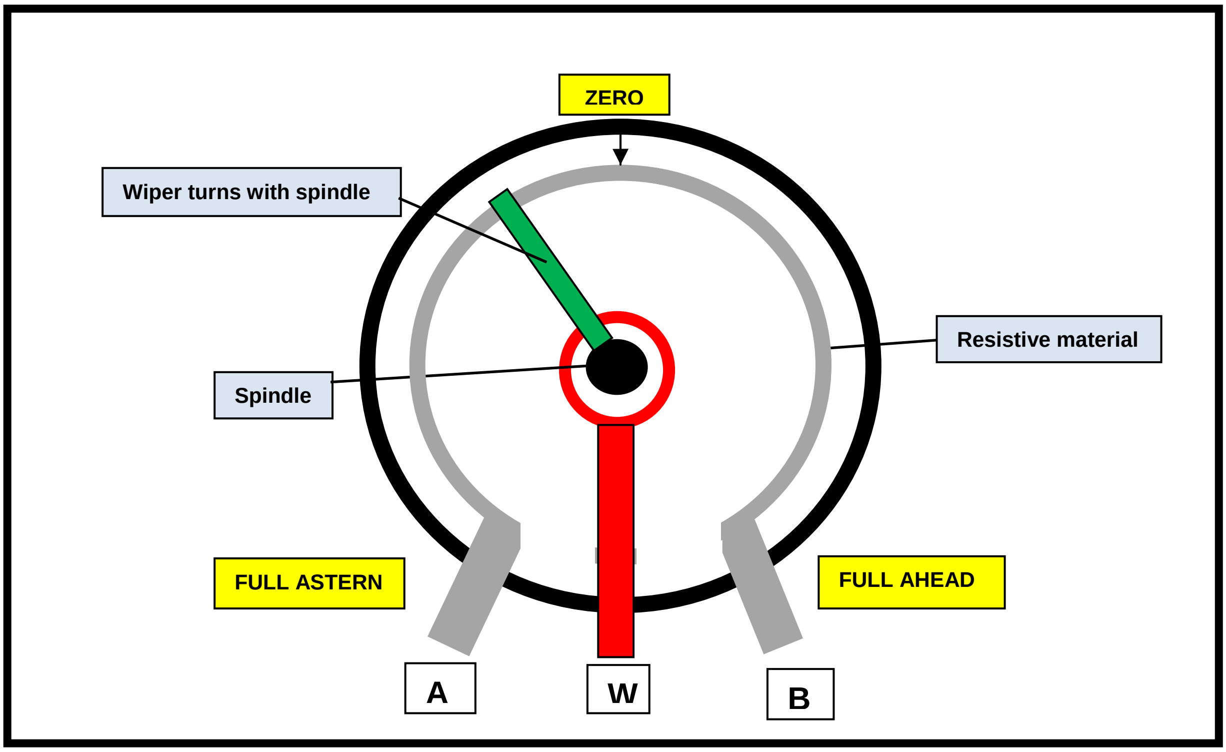
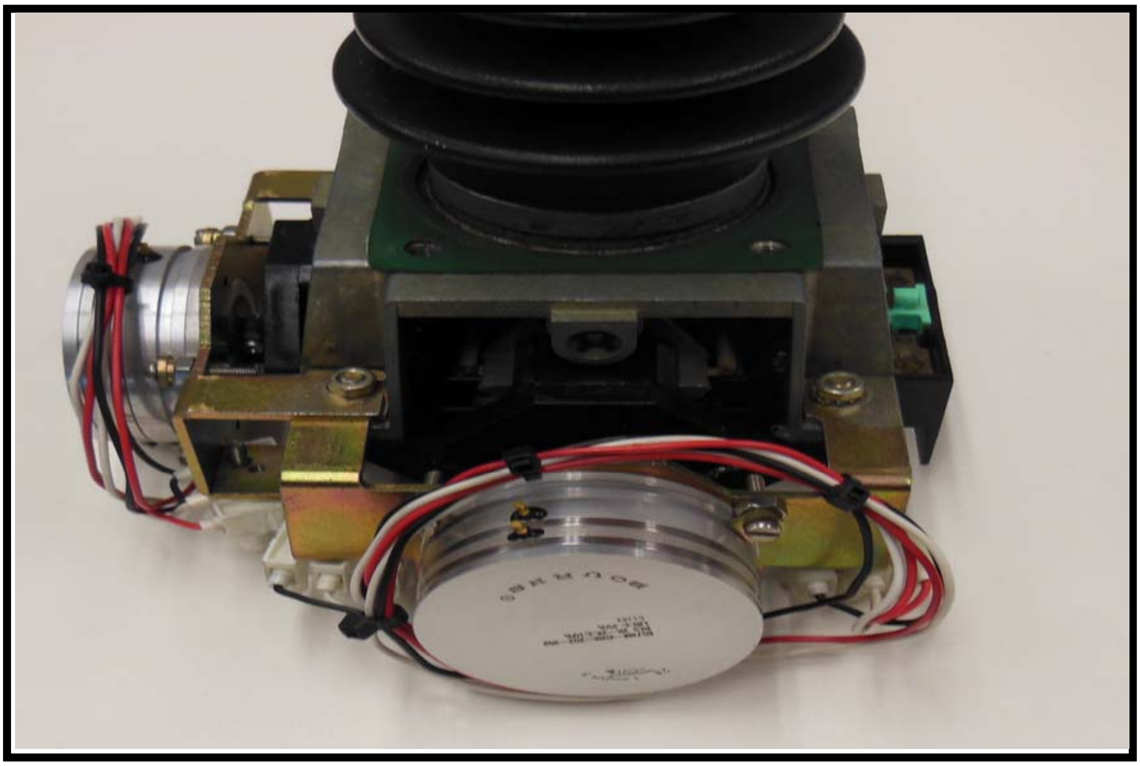


Diagram 4: Potentiometer

2.8 The potentiometer is typically calibrated as follows:

- The zero position (zero thrust) corresponds to a position of the wiper (W) at 12 o'clock.
- The position of maximum ahead thrust is at 'B'.
- The position of maximum astern thrust is at 'A'.
- The position between 'A' and 'B', through the shortest distance, is the no thrust ('dead') zone.

2.9 The potentiometer in action at the time of the loss of control was examined by HCF engineers and representatives from the propulsion control manufacturer, Wartsila. They concluded that the wiper was positioned at 'A" when the Master called for maximum astern thrust. However, it did not remain in the 'A' position. Instead, it turned through the 'dead' zone and positioned itself at 'B' which then engaged maximum forward thrust. The uncontrolled movement of the wiper was attributed to 'age related fatigue'.



Photograph 5: Control head showing potentiometers

2.10 The potentiometer failed when *Freshwater* was 18 metres from the backboard, travelling at 5 knots. This only provided 7 seconds for the Master to be able to revert to the backup system and so avoid the collision.

Maintenance and Servicing

2.11 The Technical Maintenance Plan in vogue with HCF called for the annual testing of all potentiometers by Wartsila. It was determined that the potentiometer in operation at the time of the incident was last tested on 22 March 2013 at which time no faults were identified. The potentiometer was stamped 'week 38 2003', indicating that it had been in operation for 3 months short of 10 years. The specifications for the 6574 model Bourns®

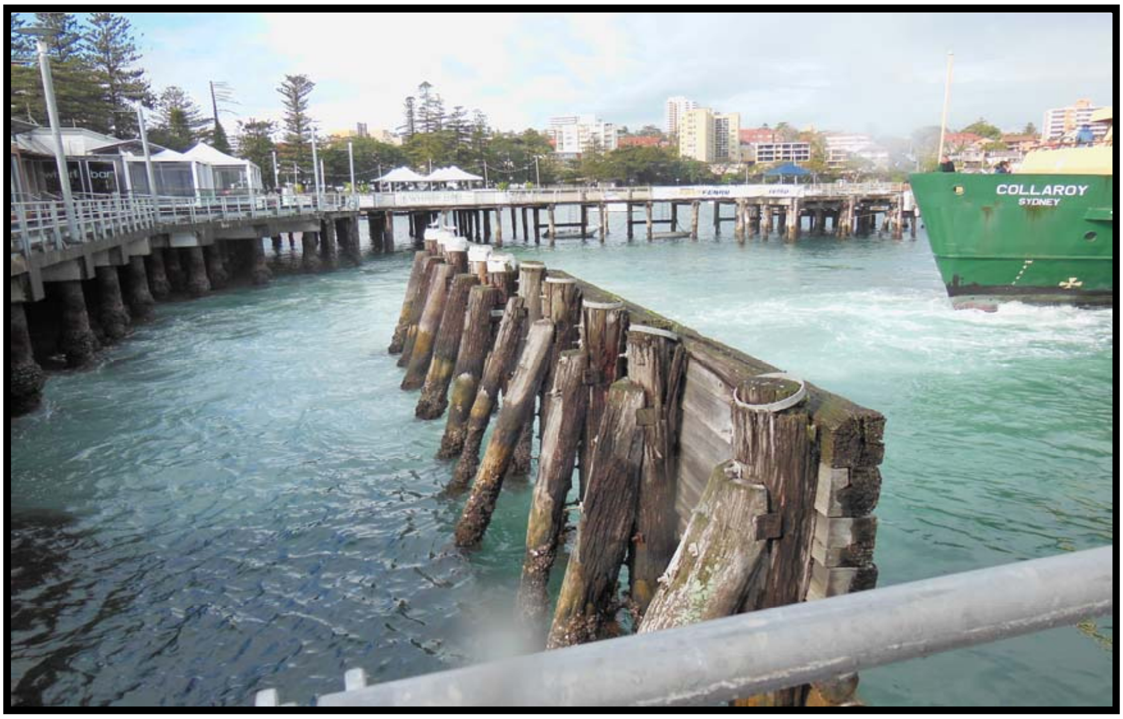
potentiometer indicated the rotational life as being 25 million shaft revolutions. When in service, the ferries operate for periods of up to 18 hours per day for nearly all days of the year. With such constant use, the potentiometer could possibly have exceeded its specified rotational life expectancy.

Effectiveness of the Backboard

2.12 The backboard with which the Freshwater collided proved to be an effective buffer in preventing the vessel from suffering more severe damage by coming into direct contact with the concrete wharf structure. The design also afforded adequate protection for pedestrians using the promenade walkway around the wharf's northern perimeter.

Other Safety Issues

2.13 Immediately after the incident Manly ferry timetabled services continued utilising the eastern side of Manly Wharf. It was observed that the timber backboard on that side was of an inferior design and far less robust compared to the backboard on the western side. Its design and condition were such that it was considered unlikely to function satisfactorily and survive an impact of the magnitude that occurred in the collision with the backboard on the western side*.* (See *Photograph 6*)



Photograph 6: Manly Wharf eastern side backboard

2.14 Out of concerns for the adequacy of the eastern side backboard, HCF implemented particular procedures for all Freshwater ferries which included the requirement to approach the wharf at a greatly reduced speed.

Remedial Action

2.15 When the cause of the control failure was established, all potentiometers on the fleet of Freshwater class ferries were immediately inspected and subsequently replaced. HCF has advised that the potentiometers in all Freshwater ferries will now be replaced rather than just tested annually.[4]

2.16 The damage to the bow section of *Freshwater* was repaired and the vessel inspected and cleared by RMS and Lloyd's surveyors for return to service.

[4] This action is consistent with that taken by the Sydney Ferries Corporation following a collision involving a RiverCat caused by the failure of a potentiometer in its control system. See OTSI Ferry Safety Investigation Report, *Collision Involving Sydney Ferries Vessel* Marjorie Jackson, *Balmain Shipyard, 2 August 2010*, available at www.otsi.nsw.gov.au

PART 3 FINDINGS

3.1 The collision of *Freshwater* with the backboard on approach to the Manly Wharf on 22 June 2013 was caused by the malfunctioning of a potentiometer operated by the XY control lever on the main console in the No.1 wheelhouse. As a result the vessel was propelled full ahead when full astern had been selected.

3.2 The exact reason for the failure of the potentiometer could not be determined. However, it is most likely that it failed due to 'age related fatigue' having exceeded its specified rotational life expectancy.

3.3 When the potentiometer failed the vessel was only 18 metres from the backboard protecting the wharf structure. This provided insufficient time and distance available for the Master to avoid a collision by transferring control to the back up system to regain control and stop the forward momentum.

PART 4 RECOMMENDATIONS

Harbour City Ferries

4.1 As Harbour City Ferries has replaced all potentiometers on all Freshwater Class ferries and instigated a robust tracking and replacement programme, no recommendations for further safety action are considered necessary.

Roads and Maritime Services

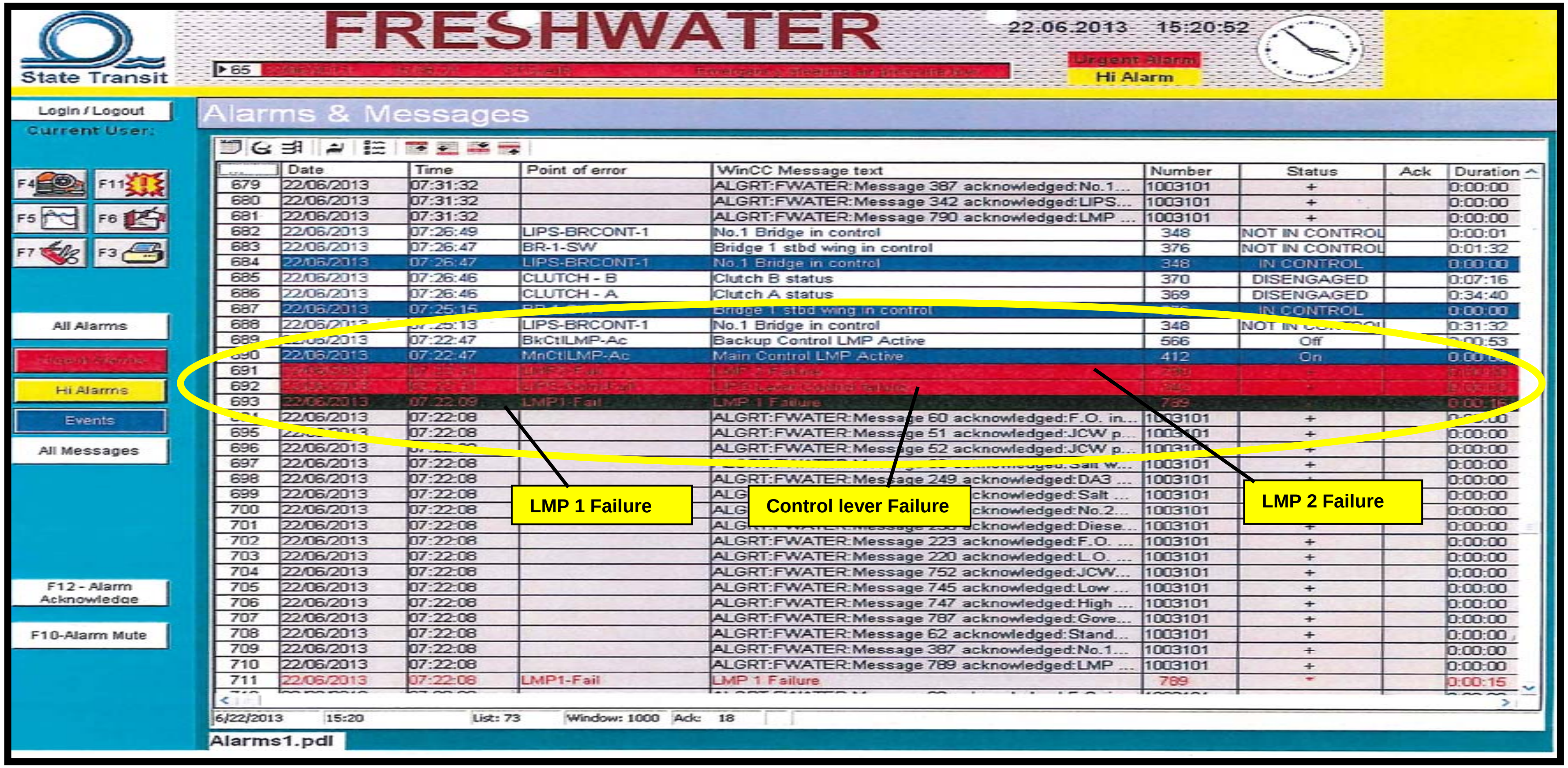
4.2 Given the apparent comparative lack of adequate functional robustness of the backboard on the eastern side of the Manly Wharf, it is recommended that the Roads and Maritime Services undertake engineering and risk assessments to establish its current suitability for Manly ferry operations.

PART 5 APPENDICES

Appendix 1: Vessel Information – *Freshwater*

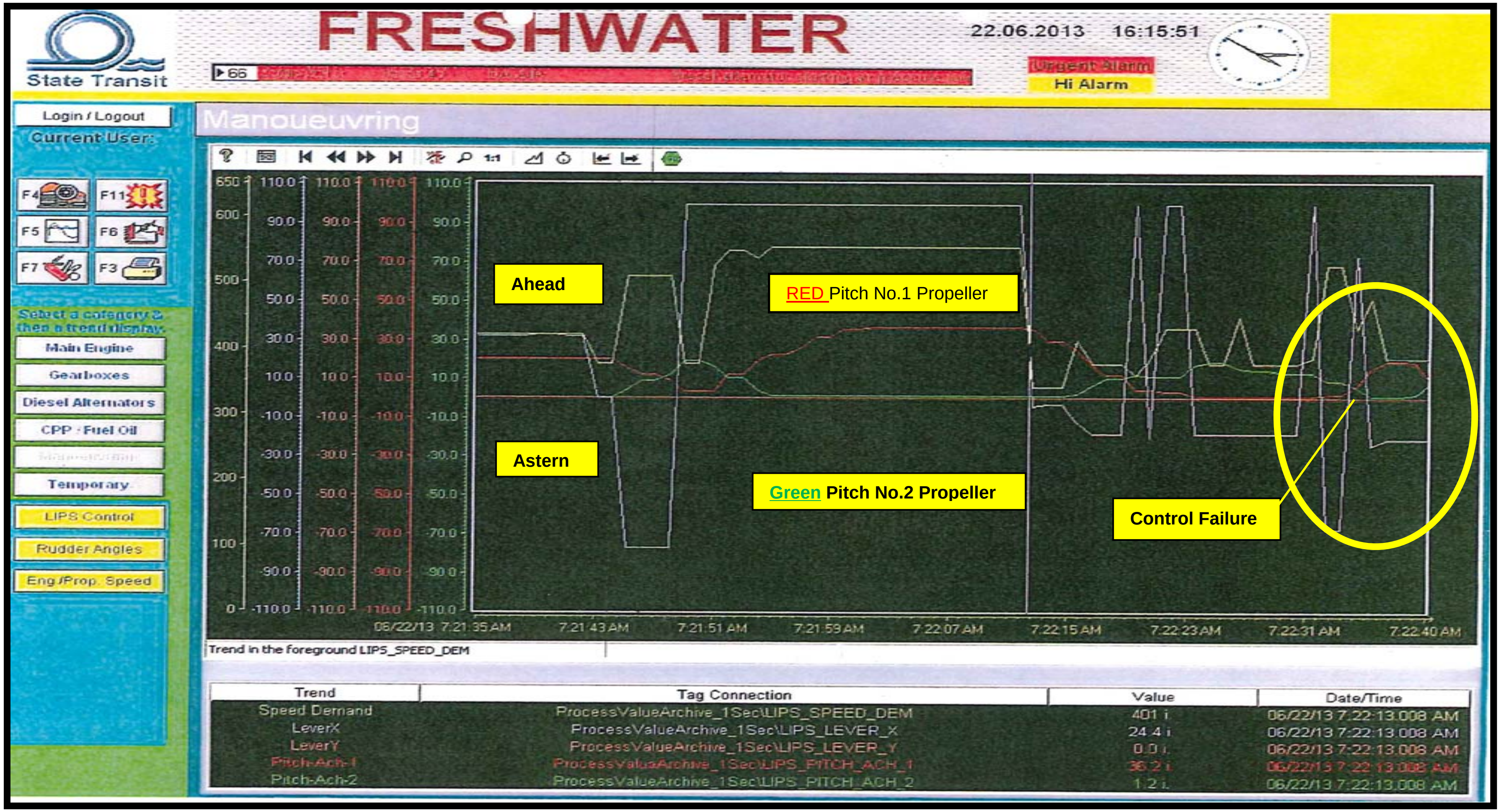
Name	*Freshwater*
Vessel Type	Double -ended Monohull ferry
Registered owner	NSW Government
Manager / Operator	Harbour City Ferries
Permit Numbers	NSW 15841 / Lloyds Class No 7923914
Survey	NSW 1D / Lloyds Class +100 A1+
Hull Construction	Welded Steel Hull Aluminium Upper Superstructure
Builder	Tomago - Newcastle, NSW
Commissioned	1982
LOA	70.4metres
LWL	67 metres
Beam	12.5 metres
Draught	3.35m
Full Displacement	1140 tonnes
Engines	2 X Daihatsu 8DSM-32 diesel engines developing 2238 kW at 600 RPM driving two Lips controllable pitch propellers.
Service speed	14 knots at 600RPM (90% MCR)
Full Speed	18 knots both engines (two engines)
Crew	6
Passenger capacity	1100 (815 seated within Sydney Harbour)
Equipment	AIS type A, FLIR, VHF Radio and Radar.

Appendix 2: Vessel Alarm Information



LMP1 Failure - Control Lever Failure - LMP2 Failure

Appendix 3: Vessel Control System Information



Graph showing pitch of No.1 and No.2 propellers

Appendix 4: Sources and Submissions

Sources of Information

- Harbour City Ferries

References

- Chart AUS 200
- *Passenger Transport Act 1990* (NSW)
- HCF Vessel Operations Manual - Freshwater Class

Submissions

The Chief investigator forwarded a copy of the Draft Report to the Directly Involved Parties (DIPs) to provide them with the opportunity to contribute to the compilation of the Final Report by verifying the factual information, scrutinising the analysis, findings and recommendations, and to submit recommendations for amendments to the Draft Report that they believed would enhance the accuracy, logic, integrity and resilience of the Investigation Report. The following DIPs were invited to make submissions on the Draft Report:

- Harbour City Ferries
- Roads and Maritime Services
- Transport for NSW

Written responses were received from the three DIPs who all concurred with the findings of the investigation.