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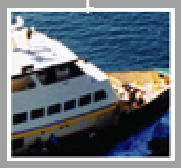


# FERRY SAFETY INVESTIGATION REPORT

## COLLISION OF RIVERCAT *BETTY CUTHBERT* NUMBER 5 EAST WHARF, CIRCULAR QUAY

23 SEPTEMBER 2005

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## COLLISION OF THE RIVERCAT *BETTY CUTHBERT* NUMBER 5 EAST WHARF, CIRCULAR QUAY 23 SEPTEMBER 2005

**OTSI File Ref: 04205**

**23 February 2006**

**Office of Transport Safety Investigations**
**Level 21, 201 Elizabeth Street**
**Sydney NSW 2000**

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.

Established on 1 January 2004 by the *Transport Administration Act 1988*, the Office 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.

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Information about OTSI is available on its website or from its offices at:

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The Office of Transport Safety Investigations also provides a Confidential Safety Information Reporting facility for rail, bus and ferry industry employees. The CSIRS reporting telephone number is 1800 180 828.

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# GLOSSARY OF TERMS AND ABBREVIATIONS

| | |
|---|---|
| BHP | Brake Horse Power. An engine power output rating distinct from Shaft Horse Power (SHP). |
| Bow | Front area of vessel. |
| CCTV | Closed Circuit Television equipment used for monitoring and recording. |
| CRM | Crew Resource Management. The training designed to ensure the use of all available resources to achieve safe and efficient operations by enhancing communication, teamwork and the capacity to respond to emergencies. |
| D&A tests | Drug and Alcohol Tests. Testing which may be conducted within Sydney Ferries Corporation, on a random or targeted basis or following an accident or safety incident, to determine whether an employee's Blood Alcohol Count (BAC) exceeds a specified limit, or to detect the presence of drugs, both illicit and prescribed, known to affect behaviour and/or performance. |
| Evolutions | Ferry crew training drills and procedures undertaken by Sydney Ferries as programs forming part of its safety management system (SMS). |
| FAID | Fatigue Audit InterDyne™ is the name given to a range of fatigue risk management software, developed by InterDynamics Pty Ltd. |
| Fendering | Timber or other buffers, adjacent to berths used by vessels securing at locations such as Circular Quay and just clear of the pedestrian concourse breastworks. |
| FERP | Sydney Ferries' Fleet Emergency Response Plan. |
| Ferry | A vessel which carries more than eight adult persons, as defined by the *Passenger Transport Act NSW 1990.* |
| GPH | A General Purpose Hand, or Deckhand, is a duly qualified crew member not engaged in navigational or engineering duties. |
| ISM Code | International Safety Management Code .The purpose of this Code is to provide an international standard for the safe management and operation of ships and for prevention of pollution at sea. Promulgated by the International Maritime Organisation (IMO). |
| Knot | Unit of speed, used in nautical and aerial navigation, equal to approximately 1.85 km/hr. |
| kW | Kilowatt. |
| NSW | New South Wales. |

| | |
|---|---|
| OTSI | The Office of Transport Safety Investigations. |
| PTA | *Passenger Transport Act NSW 1990.* |
| Port | The left-hand side when facing forward on board a vessel. |
| Public Passenger Service | The carriage of passengers for a fare or other consideration by means of a vessel within New South Wales waterways. |
| RPM | Revolutions Per Minute of running equipment and machinery. |
| SMS | Safety Management System. The series of programs, policies, processes and procedures by which Sydney Ferries seeks to integrate its safety management, in compliance with a requirement stipulated by the NSW Maritime Authority. |
| SOPs | Standard Operational Procedures. Such procedures describe a range of actions required to operate a vessel under normal and abnormal conditions and actions that may be required following an accident or incident. |
| Starboard | The right-hand side when facing forward on board a vessel. |
| Stern | Rear area of vessel. |
| TAA | *Transport Administration Act 1988.* |
| Taylor Report | A report commissioned by the Minister for Transport in 2001 and prepared by the then Waterways Authority, titled 'Independent Review of the Operations of Sydney Ferries'. |
| USL Code | The Uniform Shipping Laws Code is the current national maritime standard reference for various safety matters relating to vessel construction, equipment, crewing and operation. |
| VOM | Vessel Operations Manual. The prime reference issued by Sydney Ferries Corporation containing technical information and operating instructions for each class of ferry. |

# EXECUTIVE SUMMARY

At 06:55am on Friday 23 September 2005, Sydney Ferries' *RiverCat* class ferry *Betty Cuthbert* collided with a steel pile in the vicinity of its intended berth at No. 5 East Wharf at Circular Quay in Sydney Cove.

The Master lost control of *Betty Cuthbert* when the steering control handle he was using started to rotate freely on its spindle.

There were no passengers embarked at the time of the accident and the Master and the General Purpose Hand (GPH) were not injured. *Betty Cuthbert* sustained minor damage above the waterline on the port bow.

## Findings

In relation to those matters prescribed by the Terms of Reference as the principal lines of inquiry, OTSI finds as follows:

***Causation.*** The collision was caused by mechanical failure and human error, in that:

a. The Master lost control during the final stages of berthing when a steering control handle he was using to manoeuvre the vessel from the starboard side of the bridge became inoperable. The control handle was rendered inoperable by the dislodgement of the vector indicating/securing pin that was intended to lock the handle to the spindle.

b. The Master was required, as a part of a series of pre-departure checks specified in the vessel's operations manual (VOM), to physically inspect the controls at each control station before departing Sydney Ferries' Balmain shipyard, but did not do so.

***Effectiveness of the Emergency Response***. Actions taken by Sydney Ferries to assist *Betty Cuthbert's* crew and to prevent environmental damage were effective, and those agencies which responded to the incident did so quickly and efficiently. However, the following matters indicate the limitations of certain actions and organisational arrangements:

a. The Master might have regained some control over the vessel had he moved to the adjacent centre set of controls, but would have had to have done so immediately after the onset of the failure for such an action to have had any effect.
b. Sydney Ferries' Standard Operational Procedures for *Rivercats* require masters to deploy crew following a collision to assess, amongst other things, the watertight integrity of the vessel, but the Master omitted to do so.
c. The failure to follow designated procedures, both prior to and after the collision, was not reflective of good crew resource management and it is apparent to OTSI, as a consequence of this and other investigations conducted over the period 2005-2006, that Sydney Ferries' approach to competency and emergency training does not provide a strong foundation for effective and timely crew action in the face of emergencies.

***Effectiveness of SFC Risk Management Strategies***. The following findings indicate limitations in the risk management strategies adopted by Sydney Ferries Corporation and, in some instances, actions taken/being taken to overcome such limitations:

a. Sydney Ferries relies heavily on the recording of defects and there was no record of vector indicator/securing pins having previously being identified as defective. However, OTSI was provided with anecdotal accounts of crew noticing such problems and simply replacing the pin themselves. If such individual maintenance was being effected, it might have prevented a wider

organisational understanding of the limitations of a single securing pin.

b. Under Sydney Ferries' maintenance regime, critical components in the Rivercat's propulsion control system and specifically the mechanical linkages connecting the three bridge control stations to the *Schottel* propulsion units, had only been required to be inspected on an annual basis.

c. Following the accident, Sydney Ferries implemented an interim modification to strengthen the fastening of the steering control handles on its *Rivercats*.

d. In response to recommendations contained in previous investigation reports, Sydney Ferries had installed fittings to secure domestic appliances, such as microwaves and kettles, on the bridge to reduce the prospect of crew being exposed to injury in the event of sudden deceleration. However, on 23 September 2005, the Master and the Helmsman on the *Betty Cuthbert* were exposed to such risk from the contents of a privately-owned, and unsecured, frying pan.

e. The range of emergencies that may be encountered on a *RiverCat* and other classes of vessels operated by Sydney Ferries, and the responses required of crews in the face of those emergencies, are not adequately described in Vessel Operating Manuals.

***Other Safety Matters***. Other matters arising from the investigation that impact on the safety of ferry operations include:

a. Sydney Ferries is not required to equip its vessels with data loggers. The absence of data loggers on *RiverCat*s, together with the limitations of those recorders which are fitted to its other vessels, reduce the accuracy with which investigators can reconstruct the circumstances of an accident and further complicates the identification of measures that might prevent the recurrence of such accidents.

b. The absence of safety backboards at No.6 Wharf at Circular Quay, and at the Southern end of Manly Wharf, presents a continuing risk, but OTSI notes that the NSW Maritime Authority has programmed works to occur throughout 2006-2007 to mitigate this risk.

c. CCTV coverage of vessels approaching, berthing and departing Circular Quay is neither comprehensive, nor reliable, but OTSI notes that the NSW Maritime Authority has a project in place to upgrade CCTV coverage in key locations around Port Jackson, including Circular Quay.

## Recommendations

In order to prevent a recurrence of this type of accident, the following remedial safety actions are recommended for implementation by the organisations specified below:

a. **Sydney Ferries Corporation**

i. Review the adequacy of the interim modifications made to secure the *Schottel* control handles on the *RiverCat* ferries.

ii. Ensure that any modification made to improve the security of the Schottel control handles is reflected in relevant documentation, manuals and/or technical publications.

iii. Ensure that all of the linkages in the *RiverCat*s' *Schottel* control system are included in periodic inspection and maintenance programs.

iv. Issue an instruction reinforcing the requirement for *RiverCat* masters to check the operability of controls at all control stations, in accordance with the pre-departure procedures set out in the VOM for this class, and emphasise this requirement during training.

v. Issue an instruction reinforcing the requirement for masters to deploy crew to inspect void space and below water compartments following any incident that might compromise a vessel's watertight integrity.

vi. Issue an instruction reinforcing the requirement for crew to report any actual or potential defects in accordance with Sydney Ferries' defect reporting system.

vii. Critically review its approach to crew resource management to identify the actions required within Sydney Ferries to bridge the gap between current and best practice.

viii. Require safety critical issues during start-up and emergency procedures to be the subject of specific communication between crew members.

ix. Conduct periodic inspections to enforce the prohibition on the use of privately-owned kitchen appliances onboard Sydney Ferries' vessels.

x. Critically review the current fleet emergency situation response plans (FERPs), contained in VOMs, to more fully describe the actions required of crew members in response to such situations.

b. **NSW Maritime Authority**

i. Ensure that the *Schottel* control handle securing pin arrangements on board the *RiverCat*s meet its survey standards.

c. **NSW Ministry of Transport**

i. Require all Sydney Ferries' passenger vessels, under contract or other arrangements, to be equipped with data loggers/event recorders.

# PART 1 INTRODUCTION

## Notification and Response

1.1 At 07:16am on 23 September 2005, the Office of Transport Safety Investigations' (OTSI) Duty Officer was notified by Sydney Ferries that one of its *RiverCat* class ferries, *Betty Cuthbert*, had collided with a steel pile next to No.5 East Wharf at Circular Quay at approximately 06:55am.

1.2 Based on the information provided by the reporter, the Chief Investigator directed the deployment of OTSI Investigating Officers to the incident site.

## Initiation of Investigation

1.3 As a result of the primary evidence collected by OTSI's Investigating Officers at the incident site, the Chief Investigator determined that the incident constituted a Category 2 accident and initiated a Ferry Safety Investigation in accordance with s46BA of the *Passenger Transport Act 1990.*

1.4 On 11 October 2005, the Chief Investigator notified all Directly Involved Parties (DIP) that OTSI was investigating the collision and requested that an officer be nominated in each organisation to act as the point of contact for all inquiries made by the appointed OTSI Investigator in Charge. The Terms of Reference for the Investigation were provided to the DIPs with this notification.

## Terms of Reference

1.5 The Chief Investigator established the following Terms of Reference to determine why the accident had occurred and what to do to prevent recurrence:

a. establish why the accident happened and what caused it;

b. ascertain whether this type of accident had been, or should have been, anticipated and whether there were appropriate contingency plans in place to manage the related risk/s;

c. assess the effectiveness of emergency actions that were initiated in response to the accident;

d. identify whether there were any organisational, operational, logistic, financial, administrative, human or other factors which compromised vessel operating safety systems and contributed to the cause/s of the accident and

e. make recommendations to prevent, or at the very least minimise the potential for, recurrence of this type of accident.

## Interim Factual Statement

1.6 An Interim Factual Statement notifying OTSI's investigation and describing the incident in terms of what had happened was published on the OTSI website on 11 October 2005.

## Methodology

1.7 The methodology adopted for this investigation is based on the Incident Cause Analysis Method (ICAM) and involves the process of:

a. Collection of primary physical evidence at incident site;

b. Collection of witness evidence;

c. Collection of documentary evidence;

d. Collection of other relevant and/or corroborating evidence, including results of technical inspections and/or test results;

e. Analysis and interpretation of evidence;

f. Determination of those factors which:
   i. contributed directly to accident causation;
   ii. contributed indirectly to accident causation, and
   iii. are relevant safety issues but did not contribute to accident causation;
g. Establishing the cause of the accident, and
h. Determining recommendations to improve safety and prevent recurrence.

1.8 The underlying feature of the methodology is the Just Culture principle with its focus on safety outcomes rather than the attribution of blame or liability.

## Consultation

1.9 On 13 December 2005, a copy of the investigation Draft Report was forwarded to the Sydney Ferries Corporation, the NSW Maritime Authority and the Independent Transport Safety and Reliability Regulator (ITSRR). The purpose was to provide DIPs with the opportunity to contribute to the compilation of this Final Report by verifying the factual information, scrutinising the analysis, findings and recommendations and providing any commentary that would enhance the structure, substance, integrity and resilience of the Investigation Report. DIPs were requested to submit their comments by 13 January 2006. Submissions were received from all of the DIPs.

1.10 The Chief Investigator considered all representations made by DIPs and where appropriate, reflected their advice in this Final Report. On 10 February 2006, the Chief Investigator informed DIPs which matters from their submissions had been incorporated in this Final Report and where any proposal was not included, the reasons for not doing so.

## Investigation Report

1.11 This report describes the collision which occurred at No 5 East Wharf at Circular Quay on 23 September 2005 and explains why it occurred. The recommendations that are made are designed to contribute to the maintenance of safe ferry operations and to minimise the potential for a recurrence of this type of accident.

# PART 2 FACTUAL INFORMATION

## The Incident

2.1 At 06:30am on Friday 23 September 2005, *Betty Cuthbert* departed Sydney Ferries' Balmain shipyard facility at Mort Bay for Circular Quay to begin its daily scheduled passenger services on Sydney Harbour. *Betty Cuthbert* was crewed by a master/engineer and a general-purpose deckhand, hereafter referred to as "the Master" and "the GPH" respectively.

2.2 The Master advised that he completed a standard series of pre-departure machinery and equipment checks and inspections at Balmain. On departure, he moved from the vessel's bridge port control station to the centre console, the usual position employed by masters once a *RiverCat* is underway. He described the short passage from Balmain, as illustrated in *Figure 1*, as uneventful and his entry speed into Sydney Cove, in preparation for berthing at No 5 East Wharf, Circular Quay, as being below the maximum permitted limit of eight knots (14.8 KPH).

2.3 Immediately prior to commencing the final approach to the berth, the Master recalls being alone on the bridge, moving to the starboard control station and seeing the GPH standing on deck in front of the bridge and preparing to deploy the berthing lines. However, the Master was uncertain of events immediately prior to and immediately after the loss of control. He believes that he first became aware of the loss of control when he moved the propulsion unit controls astern as part of the normal process of slowing and then stopping the vessel at its berth and in the process, discovered that the control handle in his left hand was rotating freely and appeared to be loose on its spindle. At this point, the Master was unable to exercise control over the port propulsion unit. He then attempted to stop the ferry by again applying

astern propulsion, but instead of stopping, *Betty Cuthbert* continued, driven by the unaltered settings on the port propulsion unit. The Master believes that he must have applied maximum astern power because he recalls the starboard propeller cavitating, or over-revving, but there being no braking effect.

2.4 The Master described *Betty Cuthbert*'s twin bows as then swinging slightly to port, away from the wharf and subsequently colliding with a steel pile located mid-way between Wharves No. 4 and No. 5, as shown in *Figure 2*. After the collision, *Betty Cuthbert* ended up in a stationary position to the North of No 5 Wharf with its bows facing East. The Master then berthed the vessel, without further incident, using the centre control station, and contacted Sydney Ferries' operations staff. These staff alerted the Sydney Water Police, the NSW Maritime Authority and OTSI. The Master and the GPH then checked the vessel for signs of damage.

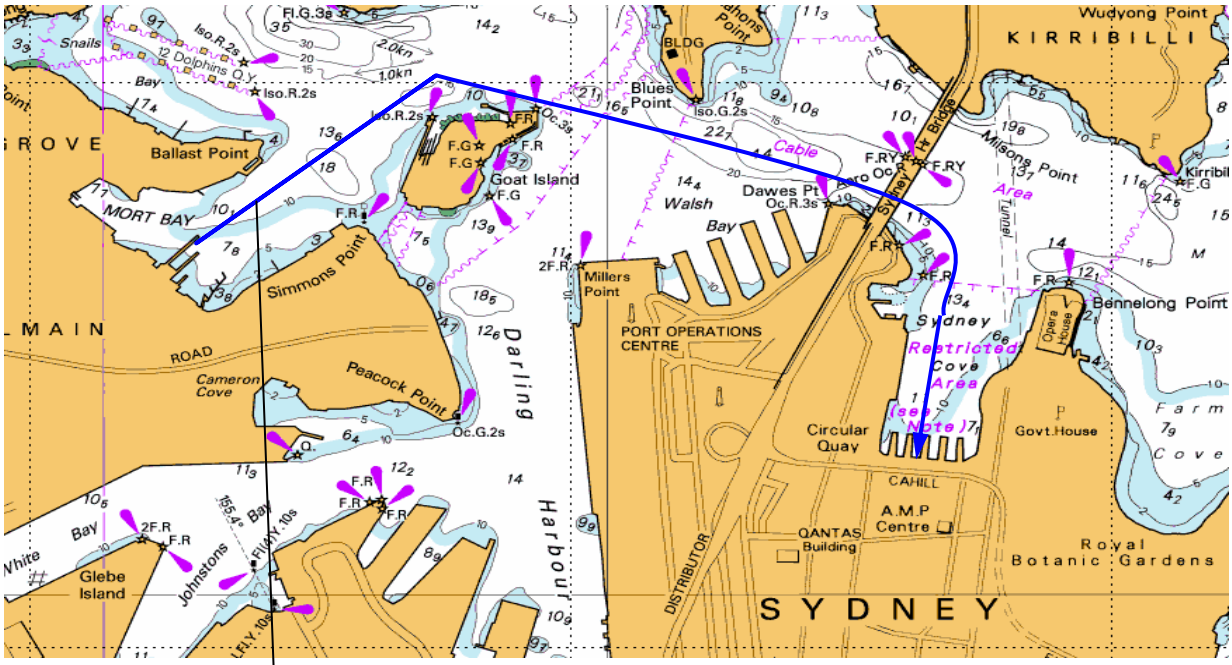


**Figure 1. Extract from Chart Aus 202**

Approximate track of the '*Betty Cuthbert*' from the SFC Balmain facility to No. 5E Wharf, Circular Quay


**Figure 2. B*etty Cuthbert* alongside No 5E Circular Quay and the pile it struck at left.**

## Damage

2.5 *Betty Cuthbert* sustained only minor damage to the leading edge of its port bow, above the waterline, as shown in *Figure* 3, and the pile it struck was undamaged.

**Figure 3. Damaged bow area.**

## Location Description

2.6 Circular Quay is Sydney's busiest wharf facility. It is sited at the Southern end of Sydney Cove and comprises five 78.5 metre long pile-supported piers and pontoon wharves, aligned North/South, which provide access and egress for ferry and charter vessel passengers. More than 10 vessel movements may occur in Sydney Cove concurrently and in recent years, there has been an increase both in traffic frequency and the size of vessels operating therein. Significantly, Circular Quay is less than 300 metres wide at its Southern end.

2.7 The incident occurred at No. 5 East Wharf. *Betty Cuthbert* stopped short of the backboard when its momentum was arrested by the pile.

## CCTV Coverage at Circular Quay

2.8 CCTV coverage from and at Circular Quay is limited and OTSI has noted, in the context of other investigations, that it is not always reliable. In this instance, OTSI was initially advised by Sydney Ferries that there was no footage of the accident because the cameras that should have captured the event were unserviceable. This was not the case and the CCTV footage made available to OTSI, by the NSW Maritime Authority, showed *Betty Cuthbert's* approach and the collision.

## Crew Information

2.9 *RiverCats* are crewed by a master who must hold a USL Master Class Four qualification, a valid local knowledge pilotage certificate and be accredited by Sydney Ferries for each class of vessel he/she operates. The master of a *RiverCat* is also the engineer which requires that he/she must also hold a minimum qualification of a USL Code Marine Engine Driver Class 3 Engineer certificate of competency.

2.10 A minimum of one GPH is required on *RiverCats* with an additional GPH being required if more than 150 passengers are embarked. GPHs do not require a marine certificate of competency but must obtain an endorsement issued by the NSW Maritime Authority, after qualifying for a Pre-Sea Safety Certificate.

2.11 The Master and GPH held all of the requisite qualifications and had first been type-rated on the *RiverCat* class in October 2004 and August 2005 respectively.

## Medical and Toxicological Information

2.12 Both crew members underwent drug and alcohol testing within the prescribed time period and returned negative results.

## Vessel Information

2.13 *Betty Cuthbe*rt is one of seven *RiverCat* class aluminium catamaran ferries currently operated by Sydney Ferries. It is 34.98 metres long, 10.22 metres in beam and has a maximum draft of 1.3 metres. It has a normal service speed of 23 knots, a maximum carrying capacity of 230 passengers and is propelled by two 335kW Detroit V8 92TA marine diesel engines.

## On-board Data Loggers/Event Recorders

2.14 None of Sydney Ferries' vessels has what might be considered a comprehensive suite of event recorders, i.e., the facility to monitor and record mechanical, electrical and navigational functions. None of the *RiverCat* class vessels has any type of event recorder.

## Meteorological & Environmental Information

2.15 The Master reported that the weather at the time was fair, with variable winds and that his visibility was unaffected. The height of tide was 0.8 metre, with high water predicted at 11:52am.

# PART 3 ANALYSIS

## Propulsion Control System Overview

3.1 Control of the *Rivercats'* propulsion system is exercised through a *Schottel* control system which consists of a number of subsystems. The 'Speedronic' sub-system sets the engine speed and controls the engagement and disengagement of the clutch by way of an activating micro-switch that activates a solenoid. An electro-hydraulic Co-Pilot sub-system controls the rotation of the rudder/propeller units. These sub-systems are integrated into three sets of identical operating hand wheels located at port-side, centre and starboard-side consoles. Each set has two hand wheels. The port-side and starboard-side hand wheels in each set are linked to the port-side and starboard-side engines respectively and their clutch, propeller and rudder unit. The control configuration at the centre and starboard stations are depicted in *Figures 4* and *5* respectively.

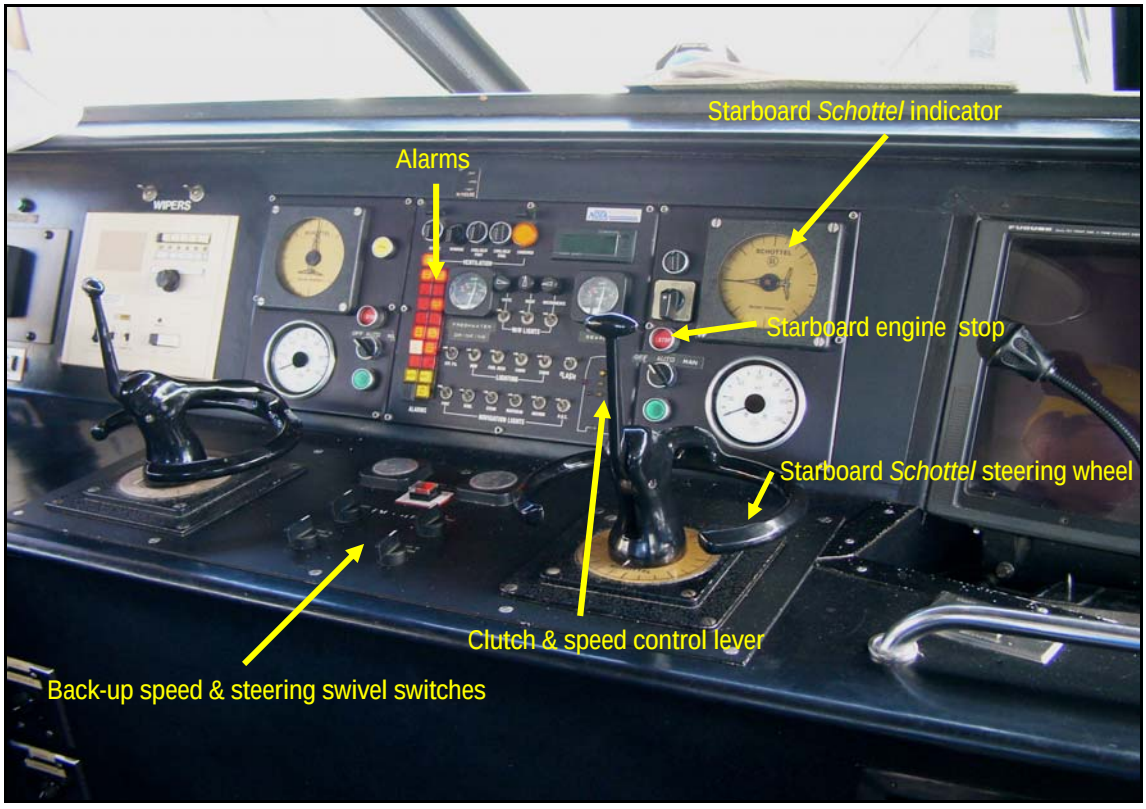


**Figure 4. Bridge, centre control station**


**Figure 5. Starboard control station and instrumentation.**

3.2 After the engine is started, the Speedronic sub-system is activated by the engine's control system with the clutch and engine speed being adjusted by the master, using the speed/clutch control lever. The first 'step' or notch in the control lever engages/disengages the clutch and further movement increases the engine speed. If the Schottel Speedronic sub-system fails, or there is a failure of the 24V power supply, a relay drops out and activates a 'speed' alarm on the monitoring panel in the bridge.

3.3 A clutch 'engaged' indicator light and a clutch control selector switch are located on the console in the wheelhouse midships position. In normal operation, the switch is set to 'Auto' which means the clutches are controlled using the *Schottel* speed/clutch control lever on the hand wheels. The clutches are interlocked to prevent engagement above engine idle speed or disengagement at maximum engine speed.

3.4 After the engine is started, the Co-Pilot sub-system is activated by the engine speed sensor. The master may then rotate/control each rudder/propeller unit via the appropriate hand wheel. The Co-Pilot control system compares the position of the hand wheel with the position of the rudder/propeller unit and operates a hydraulic proportional valve to drive a hydraulic motor in the corresponding direction, allowing for the rotation of rudder/propeller units to the desired position. A position indicator for each rudder/propeller unit is mounted at each control station in the wheelhouse. These indicators operate independently from the control system.

3.5 A back-up steering system is fitted so that in the event of a failure of the Co-Pilot electronic control sub-system, a relay will automatically engage the back-up swivel switch and activate the 'steer' alarm on the monitoring panel in the wheelhouse. The back-up switch is hard-wired to the hydraulic control solenoid and is independent of the *Schottel* electronic control system.

## What Went Wrong?

3.6 There was little difficulty after the collision in establishing what went wrong at the starboard control station console. A securing pin, which also serves as a vector indicator and which was intended to lock the port-side control steering handle on its threaded spindle, became dislodged, disconnecting the control handle from the spindle and thereby rendered the port propulsion control system inoperable. When the pin was replaced, the control handle and propulsion control system functioned normally. *Figure 6* depicts the way the control handle was secured by the vector indicating/securing pin before the incident.


**Figure 6. Port *Schottel* control handle, before modification**

3.7 Sydney Ferries subsequently effected an interim modification to reinforce the security of the handle, by adding two 'grub' screws, as shown in *Figure 7*.

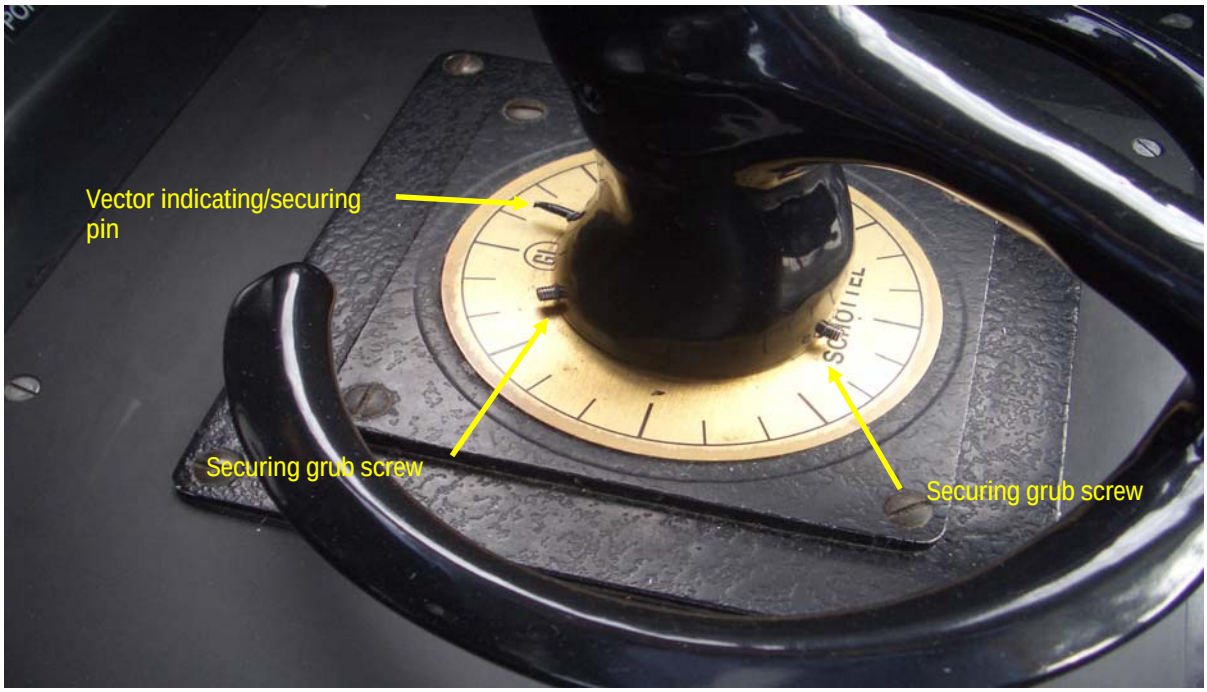


**Figure 7. Port *Schottel* control handle, after modification.**

## Anticipation and Management of Risk

### Design and Maintenance Issues.

3.8 OTSI noted that the *Schottel* propulsion installation in the *RiverCat* class incorporates a series of mechanical joints and linkages between the three bridge control stations which are continuously active when the vessel is underway. Up until the time of the incident, these linkages and the control handles were only required to be inspected on an annual basis. OTSI also noted that the vector indicating/securing pin was secured by an interference fit, i.e. it was driven or wedged, rather than being locked, into place. In the course of interviewing *Rivercat* crews, OTSI was informed that some masters had experience of the *Schottel* vector indicating/securing pin falling out in the course of normal operations, and that they had simply replaced the pin themselves. OTSI was unable to substantiate such accounts, but believes that if such practices are occurring, they should be strongly discouraged as they could lead to a situation where engineering and maintenance staff are unaware of what could be a significant vulnerability.

3.9 In addition to reinforcing the security of the control handles on its R*ivercats* following the accident*,* Sydney Ferries introduced a Technical Maintenance Plan which specifically includes the requirement to inspect control handles every 500 hours. OTSI also notes that these measures were accepted as being satisfactory by the NSW Maritime Authority's Incident Review Committee on 23 November 2005.

### Pre-departure Checks.

3.10 A pre-departure check list in *Betty Cuthbert'*s VOM requires masters to test all three control stations on the ferry's bridge prior to leaving Sydney Ferries' Balmain shipyard. The Master admitted that he failed to test the controls at the starboard console before departing from

Balmain, or enroute to Circular Quay. Had he conducted a test of the controls, as required, the Master might have identified the control problem before commencing his berthing approach and might have had more time in which to move to another set of controls.

**Unsecured Equipment.**

3.11 OTSI has noted that in a number of previous incidents, crew were exposed to the risk of burns or scalding from cooking or heating appliances in the bridge during instances of sudden deceleration. Sydney Ferries responded to the identification of such risk by securing the appliances it has supplied in the bridge. However, the Master and the GPH on the *Betty Cuthbert* on 23 September 2005 were exposed to such risk from the contents of a privately-owned, and unsecured, frying pan. Following this incident, Sydney Ferries issued a directive prohibiting the use of privately-owned kitchen appliances on its vessels but in a subsequent investigation OTSI noted that the use of privately-owned equipment was still occurring.

## Emergency Response

3.12 The Master estimated that he was approximately a “boat length”, or approximately 35 metres, from the intended berthing position when the control failure occurred. While OTSI had no reason to doubt the Master’s description of the incident, the absence of a data logger/event recorder onboard *Betty Cuthbert* meant that key matters and in particular, the point at which the malfunction occurred and the speed the vessel was travelling at the time, could not be corroborated.

3.13 OTSI believes that it may have been possible for the Master to have relocated to another control position once control problems were apparent at the starboard console. OTSI noted that the Master and GPH had undergone emergency training as part of their initial type rating in October 2004 and August 2005 respectively, but that neither had participated subsequently in any emergency drills that would have

required them to respond to a control failure. In addition, neither had participated in any form of drill aboard *Betty Cuthbert*. Whilst *Betty Cuthbert'*s VOM listed a range of response actions for a variety of emergency situations, these were general in nature and did not identify specific actions required of the Master and the GPH. Notwithstanding this observation, OTSI noted that the Standard Operational Procedures, as contained in the VOM, specifically required the Master to deploy crew to, amongst other things, assess the watertight integrity of the vessel following a collision, but the Master omitted to do so.

3.14 In previous investigations, OTSI has found that there is a degree of Union dissatisfaction with the programming of emergency response training and that masters and engineers in particular do not have confidence in the design, delivery and evaluation of the refresher training that is intended to ensure they can respond to emergency situations. Sydney Ferries has acknowledged the limitations of its training regime in dialogue with OTSI and has recently engaged the services of the Australian Maritime College and the Australian Maritime Safety Authority to review such training. Sydney Ferries also appreciates that in addition to raising the levels of individual competency, it needs to reinforce crew competencies. More recently Sydney Ferries has commenced a training program designed to refresh its *Freshwater* class crews in the management of emergency situations. Crews have responded positively to these recent developments. Notwithstanding these initiatives, there are some fundamental organisational, industrial and cultural issues which are impacting on training and these matters are unlikely, in OTSI's view, to be resolved in the near term. OTSI intends to examine these matters in detail in the context of a systemic investigation, currently underway, into a series of collisions across the "Freshwater" class of ferries.

## Organisational Issues – Impairment & Fatigue

3.15 Both crew members returned negative results following drug and alcohol testing. An examination of Sydney Ferries' crew worksheets for the previous fortnight established that both the Master and GPH had worked on six and eight days respectively and their fatigue indices were well below the recognised safe threshold.

# PART 4 FINDINGS

4.1 In relation to those matters prescribed by the Terms of Reference as the principal lines of inquiry, OTSI finds as follows:

4.1.1 ***Causation.*** The collision was caused by mechanical failure and human error, in that:

a. The Master lost control during the final stages of berthing when a steering control handle he was using to manoeuvre the vessel from the starboard side of the bridge became inoperable. The control handle was rendered inoperable by the dislodgement of the vector indicating/securing pin that was intended to lock the handle to the spindle.

b. The Master was required, as a part of a series of pre-departure checks specified in the vessel's operations manual (VOM), to physically inspect the controls at each control station before departing Sydney Ferries' Balmain shipyard, but did not do so.

4.1.2 ***Effectiveness of the Emergency Response***. Actions taken by Sydney Ferries to assist *Betty Cuthbert's* crew and to prevent environmental damage were effective, and those agencies which responded to the incident did so quickly and efficiently. However, the following matters indicate the limitations of certain actions and organisational arrangements:

a. The Master might have regained some control over the vessel had he moved to the adjacent centre set of controls, but would have had to have done so immediately after the onset of the failure for such an action to have had any effect.

b. Sydney Ferries' Standard Operational Procedures for *Rivercats* require masters to deploy crew following a collision to assess, amongst other things, the watertight integrity of the vessel, but the Master omitted to do so.

c. The failure to follow designated procedures, both prior to and after the collision, was not reflective of good crew resource management and it is apparent to OTSI, as a consequence of this and other investigations conducted over the period 2005-2006, that Sydney Ferries' approach to competency and emergency training does not provide a strong foundation for effective and timely crew action in the face of emergencies.

4.1.3 ***Effectiveness of SFC Risk Management Strategies***. The following findings indicate limitations in the risk management strategies adopted by Sydney Ferries Corporation and, in some instances, actions taken/being taken to overcome such limitations:

a. Sydney Ferries relies heavily on the recording of defects and there was no record of vector indicator/securing pins having previously being identified as defective. However, OTSI was provided with anecdotal accounts of crew noticing such problems and simply replacing the pin themselves. If such individual maintenance was being effected, it might have prevented a wider organisational understanding of the limitations of a single securing pin.

b. Under Sydney Ferries' maintenance regime, critical components in the Rivercat's propulsion control system and specifically the mechanical linkages connecting the three bridge control stations to the *Schottel* propulsion units, had only been required to be inspected on an annual basis.

c. Following the accident, Sydney Ferries implemented an interim modification to strengthen the fastening of the steering control handles on its *Rivercats*.

d. In response to recommendations contained in previous investigation reports, Sydney Ferries had installed fittings to secure domestic appliances, such as microwaves and kettles, on the bridge to reduce the prospect of crew being exposed to injury in the event of sudden deceleration. However, on 23 September 2005, the Master and the Helmsman on the *Betty Cuthbert* were exposed to such risk from the contents of a privately-owned and unsecured, frying pan.

e. The range of emergencies that may be encountered on a *RiverCat* and other classes of vessels operated by Sydney Ferries and the responses required of crews in the face of those emergencies, are not adequately described in Vessel Operating Manuals.

4.1.4 ***Other Safety Matters***. Other matters arising from the investigation that impact on the safety of ferry operations include:

a. Sydney Ferries is not required to equip its vessels with data loggers. The absence of data loggers on *RiverCat*s, together with the limitations of those recorders which are fitted to its other vessels, reduce the accuracy with which investigators can reconstruct the circumstances of an accident and complicates the identification of measures that might prevent the recurrence of such accidents.

b. The absence of safety backboards at No.6 Wharf at Circular Quay, or at the Southern end of Manly Wharf, presents a continuing risk, but OTSI notes that the NSW Maritime Authority has programmed works to occur throughout 2006-2007 to mitigate this risk.

c. CCTV coverage of vessels approaching, berthing and departing Circular Quay is neither comprehensive, nor reliable, but OTSI notes that the NSW Maritime Authority has a project in place to upgrade CCTV coverage in key locations around Port Jackson, including Circular Quay.

# PART 5 RECOMMENDATIONS

5.1 In order to prevent a recurrence of this type of accident, the following remedial safety actions are recommended for implementation by the organisations specified below:

### 5.1.1 Sydney Ferries Corporation

a. Review the adequacy of the interim modifications made to secure the *Schottel* control handles on the *RiverCat* ferries.

b. Ensure that any modification made to improve the security of the Schottel control handles is reflected in relevant documentation, manuals and/or technical publications.

c. Ensure that all of the linkages in the *RiverCats*' *Schottel* control system are included in periodic inspection and maintenance programs.

d. Issue an instruction reinforcing the requirement for *RiverCat* masters to check the operability of controls at all control stations, in accordance with the pre-departure procedures set out in the VOM for this class, and emphasise this requirement during training.

e. Issue an instruction reinforcing the requirement for masters to deploy crew to inspect void space and below water compartments following any incident that might compromise a vessel's watertight integrity.

f. Issue an instruction reinforcing the requirement for crew to report any actual or potential defects in accordance with Sydney Ferries' defect reporting system.

g. Critically review its approach to crew resource management to identify the actions required within Sydney Ferries to bridge the gap between current and best practice.

h. Require safety critical issues during start-up and emergency procedures to be the subject of specific communication between crew members.

i. Conduct periodic inspections to enforce the prohibition on the use of privately-owned kitchen appliances onboard Sydney Ferries' vessels.

j. Critically review the current fleet emergency situation response plans (FERPs), contained in VOMs, to more fully describe the actions required of crew members in response to such situations.

### 5.1.2 NSW Maritime Authority

a. Ensure that the *Schottel* control handle securing pin arrangements on board the *RiverCat*s meet its survey standards.

### 5.1.3 NSW Ministry of Transport

a. Require all Sydney Ferries' passenger vessels, under contract or other arrangements, to be equipped with data loggers/event recorders.