# MARINE OCCURRENCE REPORT
M97C0054

STRIKING

"THOMAS RENNIE"
PASSENGER VESSEL
TORONTO HARBOUR
11 JULY 1997

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## *Summary*

The "THOMAS RENNIE" was arriving at the mainland dock, Toronto, Ontario, from Centre Island. The vessel did not slow to her normal rate of approach to the dock and she first landed heavily on a dolphin before striking the dock. The force of the striking was such that a passenger and a crew member were injured when they were thrown to the deck. After the vessel was successfully docked, both victims were taken to hospital by ambulance. There were five passengers aboard at the time of the striking.

# Other Factual Information

| | "THOMAS RENNIE" |
|---|---|
| Port of Registry | Toronto, Ontario |
| Flag | Canada |
| Registry/Licence Number | 193649 |
| Type | Passenger |
| Gross Tonnage | 424 |
| Length | 35 m |
| Draught | 2.5 m |
| Built | 1951, Toronto |
| Propulsion | 2 x D353 Caterpillar , fixed right-handed propeller, 1 at each end |
| Number of Crew | 6 |
| Number of Passengers | 5 |
| Registered Owner | Metro Parks and Culture, City of Toronto |

## *Vessel Description and Manoeuvring Characteristics*

The "THOMAS RENNIE" is a double-ended ferry designed to carry 1,000 passengers on two decks. There is seating for 500. The vessel has two propellers, one forward and one aft, each of which is driven by its own engine. The vessel may operate on two engines or, for reasons of economy, one. The cruising speed of the ferry on two engines is 9 to 10 knots. At this speed, about six seconds are required to reverse the direction of the propeller shafts. At full astern (1,250 rpm), the ferry can be effectively brought to a complete stop in another 21 seconds in a distance of about three ship's lengths. (+/- 100 m).

The engine throttle controls are on a console on the port side of the wheel-house. The air control and rpm gauges are on the same console, aft of the throttles. When the operator is in the conning position and looking ahead, the console is 90 degrees to the operator's left. The controls of the vessel's public address system are located behind the operator. The ergonomics of the bridge layout are such that the person operating the vessel cannot simultaneously operate the controls and use the public address system. The vessel's whistle is operated by a lanyard above the operator's head. (See photographs.)

## *History of the Voyage*

With six crew and five passengers, the "THOMAS RENNIE" departed Centre Island on 11 July 1997 at 1015 eastern daylight time (EDT)[1] bound for Toronto mainland city dock No. 2. The weather was fair and sunny with light winds at 5 knots from the NW.

The distance between docks is 1.05 nautical miles and the crossing normally takes about 9 or 10 minutes. The trip across the harbour was uneventful.

When the vessel was abeam of red buoy TT14 and approximately 350 m from the dock, the master throttled back both engines to the clutch ahead position. After 20 seconds, he set the engine controls to "stop." To prepare for docking, the first mate went below to the main deck, leaving the master alone in the wheel-house. A deckhand was on duty, standing immediately outside the wheel-house starboard side door. During the approach, he and the master conversed briefly on work-related subjects.

At a distance of about 100 to 150 m from the outer dolphins of dock No. 2, the master placed both engine controls in the clutch astern position. Normally, the docking procedure is done with the stern engine, with the forward engine idling and ready to assist if required. He estimated that the vessel was moving ahead at a speed of about four or four and a half knots at this time.

When the "THOMAS RENNIE" was about one ship's length from the outer dolphins, the master moved the stern engine throttle to the full astern position. At 1025, he noted that the vessel had not responded. In an attempt to reduce the vessel's speed, the bow engine throttle was set to full astern to cause the vessel to move astern. The vessel did not respond. At this time, the master was concentrating his attention ahead and did not notice what engine revolutions were indicated on the rpm gauges. To reduce the vessel's forward speed, the master allowed the vessel to make a glancing impact with the port outer dolphin.

In the engine-room, the engineer of the watch (EOW) reported that he observed that the stern engine tachometer indicated 1,000 rpm at this time. The revolutions at which full astern has the maximum effect is 1,250 rpm. The EOW did not notice the reading of the bow engine tachometer but indicated that a problem was not experienced with the machinery before the striking the dock.

Shortly afterwards, engine revolutions increased but the vessel struck the fendering of the dock at 1027. The vessel rebounded from the dock about 7 or 8 m. By this time, both engines were turning full astern. The vessel was then docked without further trouble and taken out of service.

The master did not employ either the ship's public address system or the ship's whistle to warn those on board the vessel or the dock workers of the impending impact.

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[1] All times are EDT (Coordinated Universal Time (UTC) minus four hours), unless otherwise indicated.

As a result of the vessel striking the dock, an elderly passenger fell from a bench seat to the deck and injured her hip. On a below-deck stairway forward which leads to the main deck, a deckhand lost his balance, fell and injured his back. Both persons were taken to hospital by ambulance. Damage to the vessel was limited to minor distortion of the heavy fendering bracket at the bow.

Before the striking and before his fall, the injured deckhand did not feel the vibration normally caused by the use of the forward propeller. Other persons did not see the typical propeller wash of water ahead of the vessel and against the dock which they would normally see when the engines are working at full throttle.

*Personnel*

The master has been employed with the ferry operation for 16 years and had made more than 1,000 dockings at this berth. He was issued a Master Mariner's certificate in 1985. He was given a rating of "permanent mate." He has been given the alternate rating of master for 5 to 6 months each year since 1992. He is in good health, was not taking medication and was adequately rested. He was at the beginning of his shift.

The mate has been employed as deckhand and as first mate for nine years. He was duly certificated as a Watch Keeping Mate and Master Minor Waters.

The engineer had worked for several months, each year, for the last two years and was duly qualified, being the holder of a Second Class Motor Certificate issued in 1996. He had worked in an engineering capacity worldwide on ships since 1990.

*Bridge Procedures*

The essence of a Bridge Resource Management (BRM) is the effective utilization of all available resources to ensure safe completion of the operation. The company standing orders contained in the ferry operator's manual require that the officer of the watch remain in the wheel-house to assist the master as required during docking and undocking. This instruction was not adhered to, leaving the master alone on the bridge to attend to docking the vessel (berthing manoeuvres), handling engine controls, communicating with personnel involved in the berthing operations, and in case of an emergency, communicating with the passengers.

Those in charge of the conduct of the passenger ferry had not received any formal BRM training nor were they required to by regulations. While BRM training is not mandatory, Transport Canada Marine Safety (TCMS) encourages shipping companies to take the initiative in implementing BRM concepts on their vessels. The owners/operators of the ferry do not have a BRM training regime in place.

*Previous Occurrences*

Neither TCMS nor the Transportation Safety Board were made aware that there had been five other similar occurrences of "bumping" within the last year. Notwithstanding the *Transportation Safety Board Regulations*, TCMS reporting procedures did not consider these occurrences serious enough to be reported.

In the past, previous masters report having experienced a loss of control to the engines which was attributed either to the loss of compressed air which activates the controls or a loss of control of the transmission actuator. Two days before the occurrence, the master had informed the shore-based engineer that the vessel's engines were not delivering the rpm selected on the controls. This was denied by the shore-based engineer. It was at first thought that the difference between rpm demanded and rpm delivered was due to differing tachometer readings in the engine-room and on the bridge. The tachometers, however, were found to read within 30 rpm of each other. The bridge and engine-room tachometers were corrected and adjusted to correspond with each other on 23 July.

### *Pneumatic Systems*

The engine controls are pneumatic. There is an automatic pneumatic-hydraulic clutching mechanism which allows the transmission to switch to reverse as the rpm are decreased by the combined ahead/reverse/throttle control stick in the wheel-house. Compressed air is supplied from two air receiver tanks which are filled by two air compressors, one at each engine, driven by pulleys off the main shafts. There is an electric driven emergency compressor which will provide enough air pressure for the air receivers should the primary compressors fail. The air receivers are common and the air is further distributed via a logic master control unit to the pneumatic controls which consist of a pneumatic fuel control and a pneumatic-hydraulic actuator at the transmission. The ideal operating pressure is 120 pounds per square inch (psi).

The pneumatic throttle controls have a low air pressure alarm set at 74 psi; however, the controls are still functional at an air pressure of 35 psi. At this low pressure, the engine response to the controls is much slower. The main engine fuel pump is also pneumatic-hydraulic driven.

According to the system manufacturer's representative, a sudden rapid decrease in air pressure can affect the logic master which controls the distribution and air pressure of the compressed air which operates the various pneumatic controls and fuel pumps at the forward and stern main engines.

### *Testing of Pneumatic Systems*

After the vessel was properly secured and taken out of service, the TSB made a preliminary inspection of the engine-room and wheel-house navigation equipment and controls. There appeared to be a hairline crack in the casing of a relief valve between the air compressor and the air storage tank at the stern engine. Shore-based engineers from the Toronto Ferry operation were requested not to disturb the pneumatic systems until a more thorough examination could be completed by TSB and TCMS inspectors.

The engineers proceeded into the engine-room and reportedly tested and assessed the systems for about 45 minutes. Immediately after this assessment, TCMS inspectors examined the engine-room. Test manoeuvres and observations of the performance of the operating machinery and controls were made. At this time, all machinery was working properly. The problems reported by the master could not be duplicated. The pressure relief valve did not appear to be cracked and appeared to have been replaced. A TCMS Engineering Inspector advised the ferry management that he wished to be present before specialists from the company which serviced the air control equipment (the contractors) for the "THOMAS RENNIE" commenced examining and/or working on the system. The inspector arrived on board the next day at the time arranged to find that the contractor had commenced work some three to four hours previously.

The contractor's serviceman indicated that the contract area of inspection and service for the operation of air controls started at the air tanks and not at the air compressors driven by pulleys from the engines. Normally, a check for operational efficiency was made of the bridge controllers, pneumatic fuel system and the pneumatic-hydraulic transmission system actuator. The air pressure on each side of the actuator piston determines the setting of the transmission. Low air pressure can cause the transmission to return from its setting to the neutral position.

In the past, a similar slippage has occurred when the oil pressure within the transmission case was low. The ship's shore-based engineer also indicated that, on several occasions, the actuator lever linkage pin had fallen out which resulted in the transmission setting remaining in ahead or astern. In these instances, a change in the control setting would affect only rpm and not the direction in which the engine was turning, e.g. a movement of the controls from half ahead to full astern would produce an engine movement of full ahead.

Up until two years ago, the contractor provided a regular preventative maintenance schedule and checked the air control systems on all vessels owned by the City of Toronto every Friday. After this service was discontinued by the Toronto Ferry operation, the contractor was called when required. Work and maintenance on the system done by the ferry's shore-based engineering staff would not necessarily be reported to the contractor.

*Stern Main Engine, Servicing and Chronology of Events*

At 1100 on 09 July, the stern engine was stopped to replace the cooling tube of the turbo-charger shield; however, the spare tube was not the correct size. The stern engine air compressor pulley guard was removed to renew the shaft oil seal to correct an oil leakage problem, but due to a lack of time, everything was re-assembled and the engine was back in operation at 1220.

The engineers of the day and afternoon-evening watches on 10 July noted in the engine-room log book that the stern engine oil pressure was dropping.

The bridge log book showed that, at 0800 on 11 July 1997, there were instructions to take the vessel out of service for repairs. At 0849, another entry indicated that the engineer stopped the stern main engine for repairs. The auxiliary drive for the air compressor was checked and the pulley and belt were removed. The ferry was required back in service to maintain its schedule and the unit was quickly re-assembled. No entry was made in the engine-room log book for this work.

The engine manufacturer's agent indicated that, when the engine is operated on continuous load (running at a constant speed), the lubricating oil should be sampled and analysed after 250 hours' running. Depending on the condition of the oil at this time, the service period of the oil may be extended.

The agent indicated that, when the engine is operated on non-continuous load (engine revolutions vary constantly), oil sampling should be more frequent as the oil is subject to more rapid deterioration. Oil changes are recommended after 250 hours.

In the summer months, the ferry may be operating from 0800 until midnight with 4 trips each hour. Each trip entails approximately 6 engine control movements. During the vessel's working day, there are about 200 of these movements which involve starting, stopping and thermal variations not associated with a similar engine operating on continuous load.

According to the shore-based engineer, when this type of engine accumulates 400 to 500 hours of running time and analysis of a lubricating oil sample confirms the requirement, the oil is changed. The stern engine had accumulated approximately 470 hours of running time since the last oil change.

# *Analysis*

At the time of departure of the "THOMAS RENNIE" from Centre Island (1015), the wind and weather were favourable and traffic was light. The crossing took 12 minutes up to the time of the striking — an average crossing time. The difficulty the master experienced in stopping the vessel was therefore not likely to have been due to the vessel having made its approach to the dock at a higher-than-average speed.

Neither passengers nor crew distracted the master from his conning of the ship. The striking occurred near the start of his shift and analysis of the master's work/sleep cycle showed that he was adequately rested. The tactic he employed to reduce the vessel's forward speed, steering the vessel to strike the dolphin a glancing blow, appears to confirm his alertness and resourcefulness in dealing with the emergency. The horn lanyard was overhead and accessible to the master and there were opportunities to warn the passengers and crew; however, this was not done.

## *The Forward Main Engine*

Because neither the master nor the EOW looked at the forward engine tachometer when the vessel was approaching the dock, no one observed if the engine responded and acted to cause the vessel to move astern. However, no wash was observed forward as the ferry approached the dock and the deckhand who was below deck forward did not feel the customary forward propeller vibration. Both these factors would appear to confirm that the forward engine, if it responded to the commands reportedly given by the master, did not produce the required rpm and was ineffective.

It is unknown why the forward engine was not effective; there may have been a mechanical or control failure or it may have been activated too late to have time to respond. The information available, however, is that the forward engine was activated in time. Further, it is unlikely that the master, with more than 1,000 dockings at this berth, would have forgotten to use the forward engine when he realized that the vessel was not slowing in response to the stern engine commands given.

## *The Stern Main Engine*

On 11 July, as the vessel was approaching the dock, the EOW noted that the stern engine was turning at 1,000 rpm. It is unknown why the stern main engine did not attain the 1,250 rpm commanded by the master. The difference between 1,000 rpm and 1,250 rpm is analogous to speeds of 6 and 10 knots (going ahead).

The hurried air compressor inspection and servicing work done before the occurrence may have accidentally affected one or a number of air lines in the area or have been the source of an undetected air leak. These lines serve both the transmission actuator and the pneumatic fuel valve. A drop in air pressure is known to affect the transmission actuator and to reduce the flow of fuel to the engine through the pneumatic fuel valve. The possibility of transmission actuator slippage and a reduction in fuel flow due to a drop in air pressure could explain why the engine attained only 1,000 rpm and did not deliver enough astern power to stop the vessel. The stern engine transmission can also slip due to low transmission oil pressure but there is no information to confirm that this occurred.

### *Servicing and Maintenance*

There is a history of engine control problems on the ferry.

The existence of engine control problems and the causes of these problems were known to both the ferry's and company's shore-based engineers. However, the amount of engine control preventative maintenance carried out by expert contractors had been reduced and there had been little or no preventative maintenance for the last two years.

Because an engine control problem of a similar nature arose several days after the occurrence, after considerable effort had been expended to rectify the problems associated with the occurrence, the problem does not appear to have been completely resolved before the ferry resumed its service.

It appears that a complete record was not kept of all maintenance carried out on the vessel's engines and control systems. In particular, the work done some two hours before the occurrence was not recorded.

### *Bridge Resource Management and Safety*

Despite the company's instructions to the contrary, the officer of the watch was permitted to leave the bridge and proceed to the main deck in preparation for the berthing of the ferry. This left the master alone on the bridge to conduct docking manoeuvres and attend to the emergency situation. The master was fully occupied employing his best effort to minimize the vessel's impact on the wharf's structure. In the rapidly developing situation, he could not divert his attention from the task at hand to take on the additional workload of warning the passengers of the impending danger. Consistent with good seamanship practices, established procedures with clearly identified responsibilities and roles distributed between bridge team members based on their area of expertise/experience — especially with respect to passenger safety — are essential for ferry operations. In this instance, the officer of the watch left the bridge to attend to a secondary function and the deckhand on duty was standing by with no specific task assigned. This would suggest that optimal use was not made of all available resources, and the important task of warning the passengers in a rapidly developing emergency situation could not be effected.

## *Findings*

1. On 11 July 1997, the "THOMAS RENNIE" was closing with Toronto mainland dock No. 2 at her normal speed of approach.

2. The stern engine went astern where and when ordered but it did not develop full power astern in time to stop the vessel from striking the dock.

3. The bow engine did not develop the full power astern ordered in time to assist in stopping the vessel.

4. Contrary to the company standing orders, the master did not retain the mate on the bridge to assist him in docking the vessel.

5. With no Bridge Resource Management (BRM) environment in place, no warning could be given to the passengers when the emergency situation developed.

6. A warning was not broadcast on the public address system nor sounded on the whistle to indicate to the passengers, crew or persons working at the loading apron that the vessel was about to strike either the dolphin or the dock.

7. A passenger and a crew member were injured as a result of the strikings and were taken to hospital by ambulance.

8. The engine repairs undertaken at the stern engine about one hour and a half before the occurrence were not logged into the engine-room log book.

9. The preventative maintenance program for the main engines and auxiliaries does not appear to be capable of preventing system failures or breakdowns.

10. There is a history of engine control problems on the ferry but detailed records of these problems and associated maintenance were not kept.

11. About two years before the occurrence, the existing program of preventative maintenance of the vessel's engine controls was reduced.

12. It is unlikely that a damaged air pressure control valve could have been the cause of the loss of engine control. However, the control valve was replaced before experts from Transport Canada Marine Safety had an opportunity to thoroughly examine and test the vessel's control systems.

## *Causes and Contributing Factors*

The precise mechanical cause of the striking was not determined but is likely to have been a failure of the engine control system due to a reduction in the level of scheduled preventative maintenance. The absence of a Bridge Resource Management environment prevented the master, who was alone in the wheel-house, from warning those on board and on the dock of the striking. A passenger and a crew member were injured as a result of the vessel striking the dolphin and the dock.

# *Safety Action*

## *Preventative Maintenance*

It is reported that the owners of the vessel, the City of Toronto, Metro Parks and Culture, have reviewed their procedures and as a result engaged a contractor to visually inspect the pneumatic control system at least twice a year, usually in the spring and fall.

## *Passenger Safety Announcements*

The owners have re-emphasized to their masters the need for passenger safety announcements before docking. These announcements remind passengers to remain seated until the vessel has docked. As a further measure, an automatic taped safety message is planned for the 1999 sailing season.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 19 October 1999.*