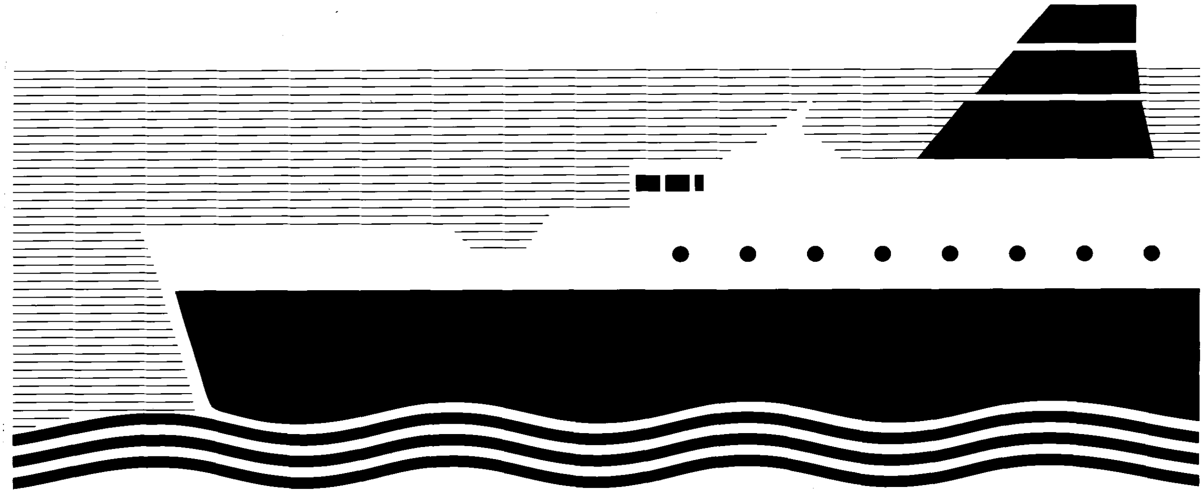

MARINE OCCURRENCE REPORT

05-210 **restricted limit passenger vessel *Milford Mariner*, engines' stall resulting in grounding, Harrison Cove, Milford Sound** **18 September 2005**

TRANSPORT ACCIDENT INVESTIGATION COMMISSION
NEW ZEALAND

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

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Report 05-210

restricted limit passenger vessel
Milford Mariner

engines' stall resulting in grounding

Harrison Cove
Milford Sound

18 September 2005

Abstract

On Sunday 18 September 2005, the *Milford Mariner* was on a cruise of Milford Sound with the Master, 9 crew and 56 passengers on board. At about 1438, both of the ship's main propulsion engines stalled and just as they were restarted the ship ran aground.

The ship grounded on the rocky shore on the eastern side of Harrison Cove. The Master was able to restart the engines and regain control. After confirmation that the hull was intact, the Master manoeuvred the ship clear of the shore and returned it to the wharf at Milford Sound without assistance. There were no injuries to the passengers or crew. A dive inspection found that the hull plating was dented but not punctured.

Safety issued identified included:

- a latent stalling problem that had not been fully addressed by the operator
- difficulty in restarting the ship's engines in an emergency situation
- an inexperienced helmsman being supervised by a person who was unfamiliar with the bridge operation.

Safety recommendations were made to the Director of Maritime New Zealand and the Chief Executive Officer of Real Journeys to address these issues.

The *Milford Mariner*

Contents

Figures

Abbreviations

ADH	advanced deckhand
ECU	electronic control units of an engine control system
FW	fresh water
GPS	global positioning system
ILM	inshore launchmaster
kW	kilowatt(s)
m	metre(s)
m^3	cubic metre(s)
mm	millimetre(s)
PA	public address system
RPM	revolutions per minute
VHF	very high frequency

Glossary

con (control)	direct the course and speed of a vessel
dipswitches	set of small on-off switches
displacement	when describing a hull form, indicates a vessel that remains fully immersed in the sea, rather than planing
hot key	start button that was directly wired to the start system of the engine
monohull	single-hulled vessel
pitch	the angle of propeller blades, expressed as the distance of theoretical travel in one revolution of the propeller
self-furling	a sail that is rolled onto its stay to enable it to be set or stowed easily.

Data Summary

Ship particulars:

Name:	*Milford Mariner*
Type:	passenger ship
Limits:	restricted area
Safe ship management:	Fiordland Travel Limited
Length overall:	40.0 m
Breadth:	10.0 m
Draught:	2.10 m
Gross tonnage:	620
Built:	Bluff in 2000
Propulsion:	2 x TAMD Volvo 389 kW 6-cylinder diesel engines, each driving through a reversing gearbox to a fixed-pitch 4-bladed propeller
Service speed:	11 knots
Owner/operator:	Real Journeys, a trading arm of Fiordland Travel Limited
Port of registry:	Invercargill
Minimum number of crew:	3
Maximum number of passengers:	enclosed waters: 150 inshore waters: 64

Date and time:	18 September 2005 at 1438[1]
Location:	Harrison Cove Milford Sound
Persons on board:	crew: 10 passengers: 56
Injuries:	nil
Damage:	hull plating indented and internal frame set up
Investigator-in-charge:	Captain Doug Monks

[1] Times in this report are New Zealand Standard Time (UTC + 12 hours) and are expressed in the 24-hour mode.

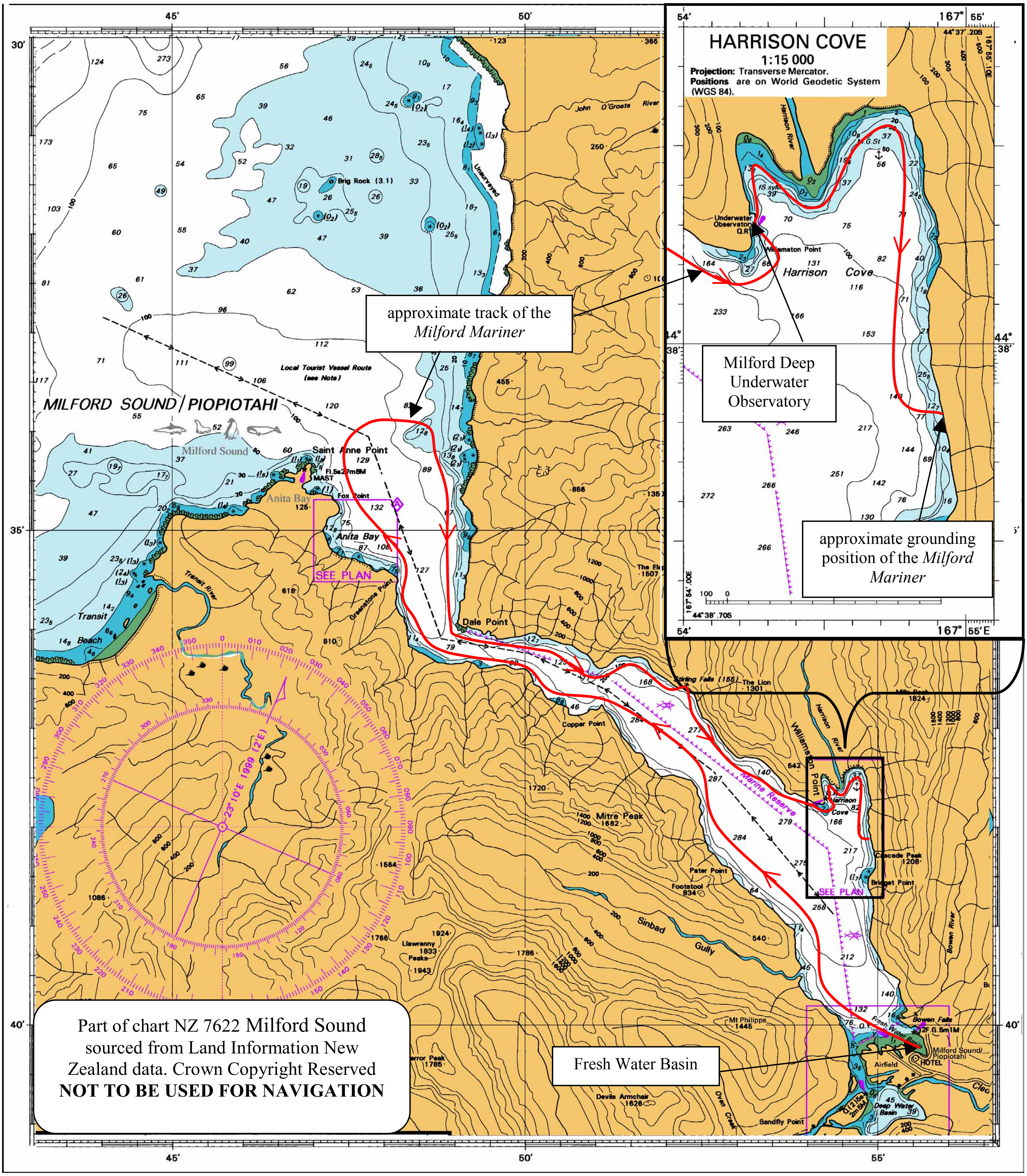

Figure 1
Chart of Milford Sound

1 Factual Information

1.1 Narrative

1.1.1 On Sunday 18 September 2005 at about 0915, the restricted limit passenger ship *Milford Mariner* berthed at Fresh Water Basin, Milford Sound to disembark passengers from an overnight cruise. The crew then prepared the ship for its next cruise.

1.1.2 At 1230, with the Master, 9 crew and 60 passengers on board, the ship left its berth for a nature cruise; a trip around Milford Sound that included commentary on the wildlife, the topography and the history of the area. Over the public address system (PA) a Nature Guide commentated on the flora and fauna encountered during the voyage and the Master commentated on the topography and history.

1.1.3 At about 1300, soon after the ship had cleared the channel from Fresh Water Basin, one of the crew took the helm, under the supervision of the Master, as part of his ongoing training. The trip progressed normally with the ship going up the western side of the Sound, before turning to the east at Saint Anne Point and crossing over to the eastern shore to head back down the Sound. The Master reassumed full control of the ship before they reached Stirling Falls.

1.1.4 Shortly before 1430, the ship berthed at the Milford Deep Underwater Observatory to disembark 4 passengers. The ship continued its trip into the 2 bays that formed the head of Harrison Cove. Once clear of the bays and heading southwards down the eastern side of Harrison Cove, another of the crew took over the helm as part of her training. The Master had been operating the ship from the port-side control station during the berthing at the observatory and passage around the 2 bays, and instructed the trainee helmsman how to change the steering and engine controls to the central control station. Also on the bridge, although not taking part in the ship's navigation, were the Chef and the Team Leader of the hospitality staff.

1.1.5 As they headed south down Harrison Cove, parallel to and about 150 m to 200 m off the shore, the Master decided that he needed to leave the bridge in order to operate a fresh water (FW) valve in the forward compartment of the lower deck. Before leaving the bridge, he confirmed that the Chef would supervise the helmsman.

1.1.6 About 2 minutes after the Master had left the bridge, the Nature Guide, who was roaming around the decks, saw, and made an announcement over the PA, that there was a Fiordland crested penguin swimming close to the port side. On hearing this, the trainee helmsman decided to slow the ship to allow the passengers more time to view the penguin. She pulled the engine control levers back, but almost immediately both engines stalled. The Chef ran to the central control station and tried, unsuccessfully, to restart the engines. The Master, who had heard the engines stall while he was at the lower deck, rushed back to the bridge and on his arrival took over the attempts to restart the engines at the central control station, but without success. All the while the ship had continued moving ahead, slowly turning to port, towards the shore.

1.1.7 The Master eventually went to the port-side control station where he used the hot key engine starter buttons to start the engines. However, the engine control system was not active so the Master could not take control of the engines at the port station. At about 1438, just as the engines restarted, the ship grounded on the eastern shore of Harrison Cove.

1.1.8 The ship rode up the steep shore before easing back, but remained aground. The Master re-established full control of the engines by going through the complete starting procedure at the centre console, then used the engines to keep the ship aground while a damage assessment was carried out. The port side of the hull was found to be set in, in way of the lower deck forward, but there was no penetration of the hull and no ingress of water. The Master then reversed the ship off the shore and continued directly back to Fresh Water Basin, where the passengers were disembarked and a diver inspected the hull.

1.2 Ship information

1.2.1 The *Milford Mariner* was operated by Real Journeys, the trading arm of the parent company and owner of the ship, Fiordland Travel Limited. Real Journeys had many tourist operations including coach services, accommodation, cruise boats and general attractions, throughout Fiordland, Queenstown and Stewart Island. The Milford Sound boat operation was divided into 2 main parts, daytime (or scenic) cruises and overnight cruises, however the overnight vessels also undertook day cruises. The scenic boats were the *Milford Monarch*, the *Milford Sovereign* and the *Milford Haven* and the overnight boats were the *Milford Mariner*, the *Milford Wanderer* and the *Friendship*.

1.2.2 The *Milford Mariner* was purpose-built for the Fiordland tourism industry. It was a restricted limit passenger ship, of monohull form, the hull of which was constructed of 10 mm steel plating. Fiordland Travel Limited built the ship at its facility in Bluff. The keel was laid in 1999 and construction was completed in September 2000. The ship was certified to carry 150 passengers in the enclosed area and could carry, and had berths for, 64 passengers in the inshore area. The ship had a length overall of 40.0 m, a gross tonnage of 620, a breadth of 10.0 m and a design draught of 2.10 m.

1.2.3 The ship was powered by 2 Volvo Penta TAMD 163A 6-cylinder, in-line, marine diesel engines each rated at 389 kW at 1600 revolutions per minute (RPM), which drove, through ZF BW 161-1 reversing gearboxes of 3.605 to 1 ratio, 4-bladed fixed-pitch propellers. The propellers each had a diameter 1300 mm and pitch of 1200 mm. The ship was fitted with 3 self-furling sails that were set automatically using the electronic ship management system.

1.2.4 The Master usually conned the ship from the central, cockpit-style steering position (see Figure 2), which had the main controls within easy reach. The ship was fitted with the following navigation equipment:

- a JRC 700FX depth sounder/global positioning system (GPS) plotter
- a JRC JMA-2254 radar
- an Allen-Bradley electronic ship management system
- a Twin Disc engine control system
- a Si-Tex Mariner very high frequency (VHF) radio.

1.2.5 The cockpit style of the central control console required that the person steering the ship sat in the chair, so it was usual for the helmsman to operate all the main controls, including the engines and other equipment. In addition to the central console, there were control stations on the port and starboard sides of the bridge.

1.2.6 The engine control was a Commander EC 200 manufactured by Twin Disc Incorporated that used a single lever to control both the throttle and transmission of each engine. The Commander EC 200 control system was a combination of electronic and cable control. The 3 bridge control heads were electrically linked and they controlled 2 electronic control units (ECUs), one for each engine, situated in the engine room. The ECUs were linked by cables to the engine and transmission actuators. Only one of the 3 control heads could be active at any one time. A red indicator light on each head unit showed when that station was active (see Figure 3). A yellow light indicated when neutral was selected. An idle speed switch allowed selection of 3 different idle speeds, a useful function when manoeuvring in close situations where selective increased speed was required.

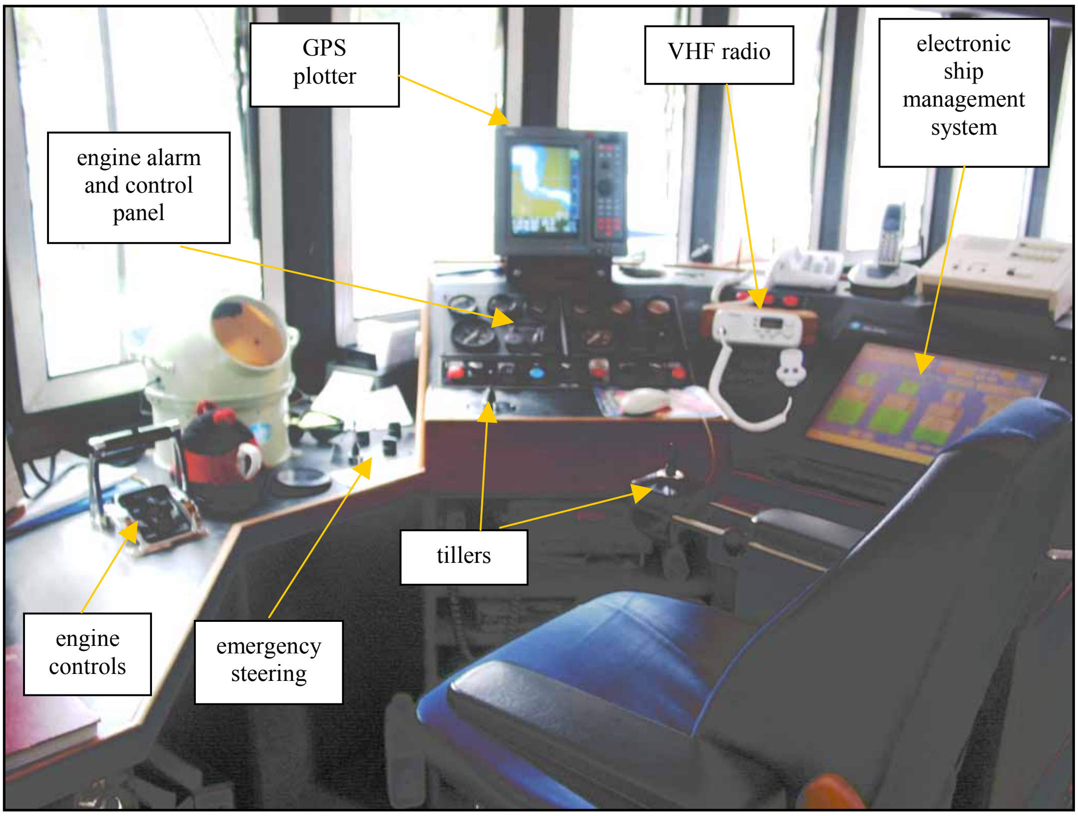

Figure 2
The central control station

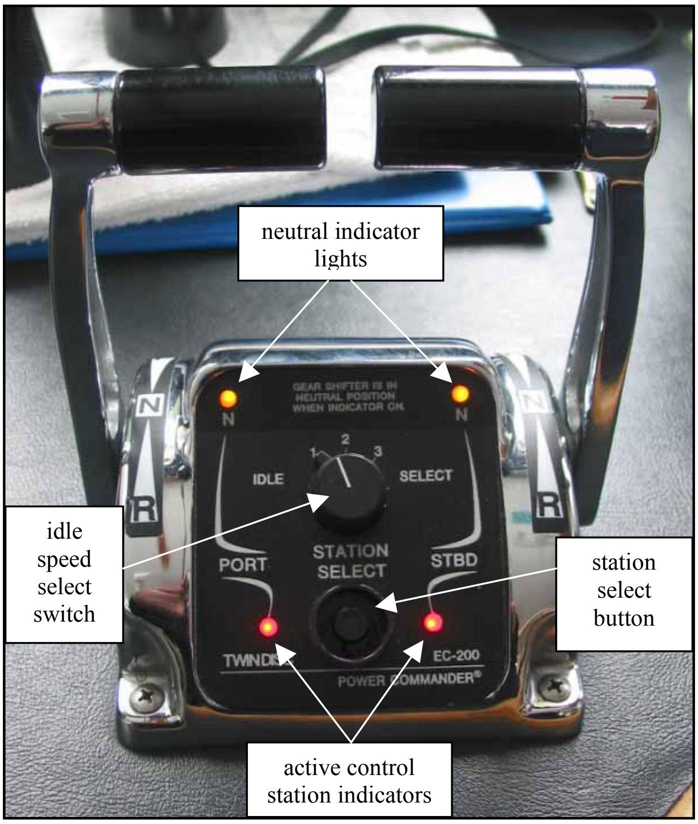

Figure 3
Engine control, with indicator lights showing it is active and both levers are in neutral

1.2.7 The Volvo Penta engine control and instrumentation panels were mounted on the bridge console (see Figure 4). The Commander EC 200 was interlinked with the Volvo Penta engine control system. The starting sequence for the engines was:

- turn the ignition key switch to the on position
- ensure the engine control levers are in the neutral position
- press the "station select" button on the Commander EC 200
- turn the ignition key switch clockwise against its spring to activate the starter motors
- once the engines start, allow the ignition key switch to return to the on position.

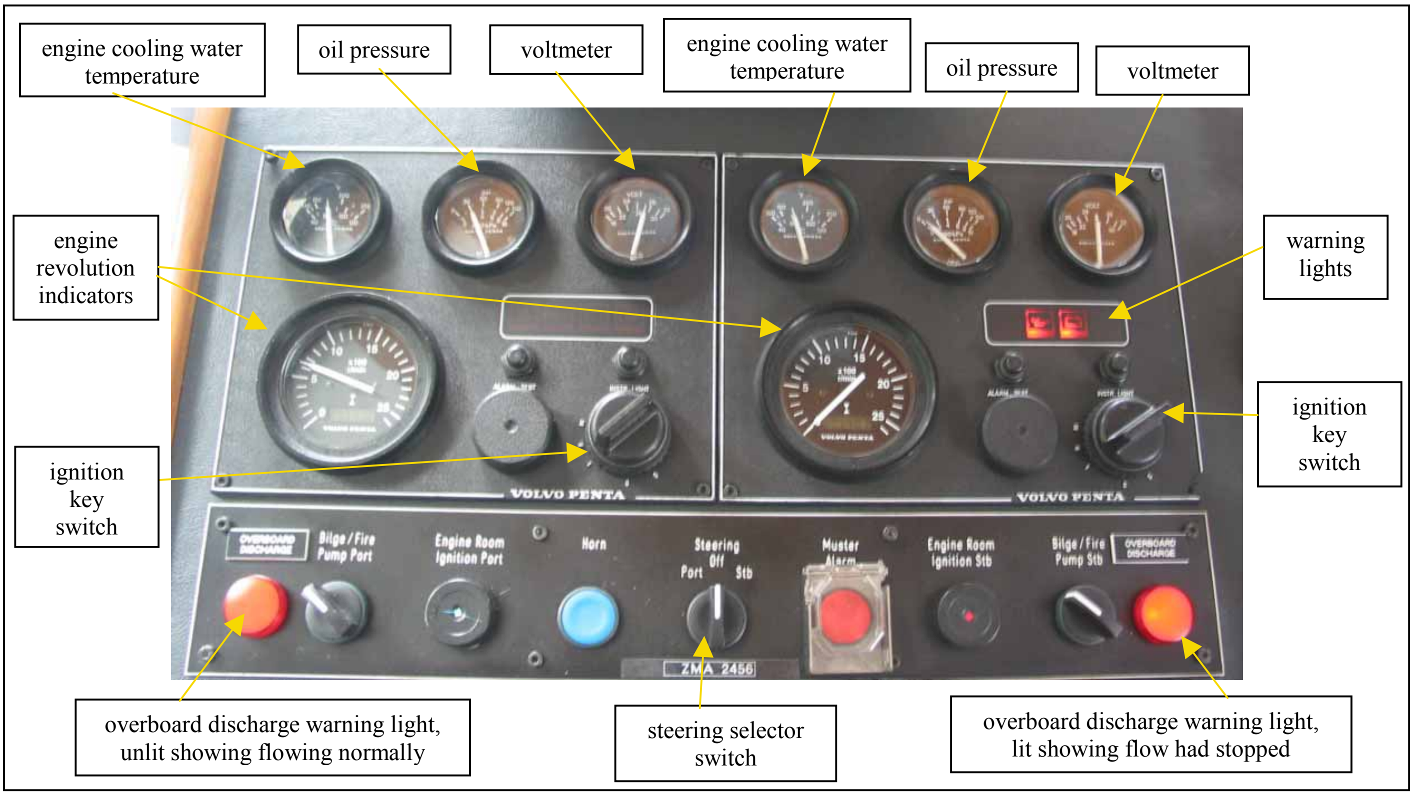

Figure 4
Engine control panel – port engine running and starboard engine stopped but ignition switch on

1.2.8 In addition to the start sequence, the ignition key switch had a built-in restart inhibitor, which prevented the key being moved to the start position unless it had first been returned to the stop position. This was a safety feature to prevent possible damage to the starter motor that could be caused if an operator tried to start an engine that was already running.

1.2.9 Engine control was transferred between each of the control stations by pressing the "station select" button on the head unit at the desired control station. Before taking control at a control station, it was usual for an operator to set the levers on the new control station to an approximation of those on the active control station before pressing the "station select" button, otherwise when it was pressed the system would try to take up the speed and direction of the levers at the new control station, which could result in an unexpected change in speed or direction.

1.2.10 Engine cooling water overboard discharge warning lights and alarms had been retrofitted to warn when the discharge of cooling water stopped. If an engine stopped, for example if it stalled, the overboard discharge alarm was one of the first to sound.

1.2.11 The electronic ship management system enabled the Master to monitor and control the majority of the mechanical systems on the ship from the central control position. This system also alarmed when an engine stopped.

1.2.12 There were steering controls at each of the 3 control stations on the bridge. A steering selector switch was fitted, on the engine control panel, so that the steering controls that were not being used were deactivated to prevent accidental helm being applied by someone inadvertently leaning on the tillers (see Figure 4). The "off" position indicated that each of the wing stations was immobilised and the steering was set to the central console.

1.2.13 Soon after the ship had been launched, the ship's masters noticed that it had a tendency to stall when the engines were put astern, particularly when it was moving ahead at a speed above 6.5 knots. On one occasion, the engines had stalled while approaching the wharf at the Milford Deep Underwater Observatory, causing the ship to collide with, and damage, the wharf and a building on the wharf. The controls for starting the engines were situated at the central console and the Master manoeuvred either from that or the port control station. Should the engines stall while the Master was conning the ship from the port control station, he had to go to the central console to restart them, which took time. To reduce the time necessary to restart the engines, hot keys were retrofitted at the port control station that allowed the engines to be restarted at the push of the buttons without going through the full engine start sequence (see Figure 5).

1.2.14 On this occasion, after the Master had gone to the port control station and used the hot keys to start the engines, he still did not have control of the engines. He pressed the "select station" button on the port engine control head but the Commander EC 200 system was inactive, because the ignition key switches had probably been left in the off position after the previous attempts to restart the engine from the centre console.

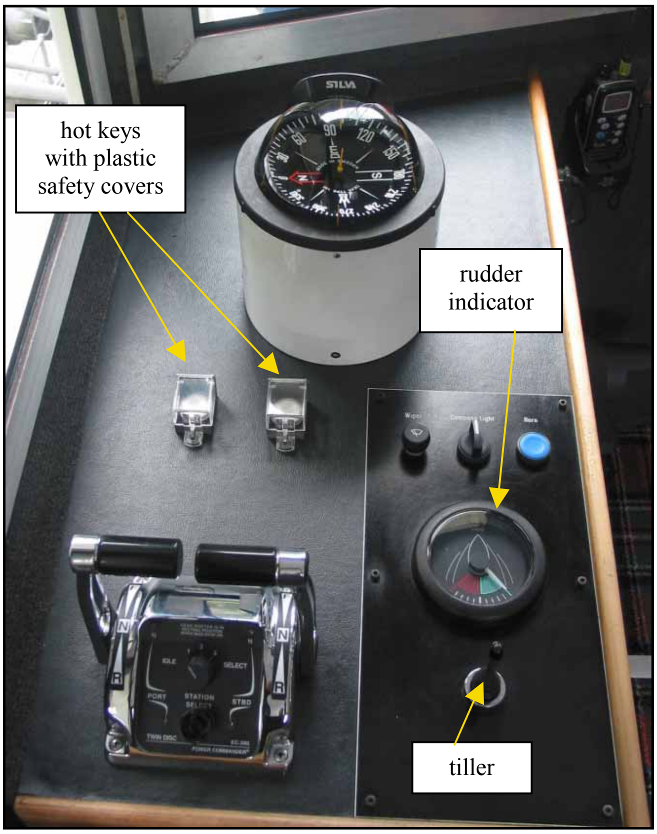

Figure 5
Port control station

1.2.15 The Commander EC 200 had the ability to allow preset shift delays of up to a maximum 9.4 to 10.6 seconds to be set on dipswitches located inside a panel of the ECU. The shift delay was proportional to the speed of the ship and the elapsed time at that speed. With a delay of 9.4 to 10.6 seconds set on the dipswitches, a ship travelling at full speed for longer than one minute would experience the maximum delay, but when manoeuvring at slower speeds for periods less than one minute there would be no or very little delay. These delays determined the speed at which the engine responded to commands for changes of direction, and were usually set by the control manufacturer when the installation was commissioned. However, in this case the ship builder installed the control system and a Twin Disc Incorporated representative had not been engaged to commission the equipment.

1.2.16 In December 2005, the Real Journeys General Manager Maintenance and Supply checked the position of the delay dipswitches on the *Milford Mariner* and found they were set for no shift delay, which was the default factory setting. Consequently, the engines were set to respond immediately to direction shifts.

1.3 Design of the *Milford Mariner*

1.3.1 The ship was designed specifically to operate out of Fresh Water Basin, Milford Sound. The controlling depth of the basin was less than 3 m and the manoeuvring area had a diameter of less than 80 m, consequently the ships operating there needed to be shallow draughted and highly manoeuvrable.

1.3.2 The design of the *Milford Mariner* was similar to that of the traditional sailing scows that used to operate around the New Zealand coast. The 3 sails were primarily decorative but did assist the speed when sailing downwind.

1.3.3 The required manoeuvrability of the ship was addressed by using 2 propellers and spacing them as far apart as possible to give the optimum turning lever. The propellers were also made as large a diameter as the hull configuration would allow. The design naval architect made calculations to determine the optimum engine/gearbox ratio/propeller size for the ship at its maximum design displacement and for the required speed. He established that a total power of 642 kW (321 kW per engine) would be required at the propellers.

1.3.4 The *Milford Monarch,* one of the scenic boats at Milford Sound, had been fitted with 2 Cummins engines, each of which produced 261 kW at 1800 RPM, but the company found that operating at that speed the vibration and noise were high. In an attempt to reduce the noise the company decided to run those engines at the slower rate of 1600 RPM. However, when the engines were being ordered for the *Milford Mariner*, Cummins would not warrant the new engines if they were to be used continuously at 1600 RPM. Consequently, Real Journeys chose to use Volvo Penta engines whose warranty would not be compromised by their being run continuously at 1600 RPM. However, the engine manufacturer did warn the company that the engines would be less efficient at the lower speed. The TAMD 163A engines were rated to give a continuous power of 389 kW at 1600 RPM, sufficient to propel the ship at 11.5 knots.

1.3.5 After the ship was launched, engine trials were undertaken, but due to operational difficulties the full trials could not be completed in one voyage and the test results were not fully recorded. The Managing Director of the authorised agent of Volvo Penta in Christchurch, New Zealand said that although some aspects of the engine trials had not been completed, he was confident that the data he had recorded showed that the engines were operating within their design specifications. Real Journeys later stated that because it was responsible for the construction of the ship "proving tests for contract and specification compliance of the ship were not required. Such sea trials as were necessary to demonstrate satisfactory stability and handling and engine performance were carried out".

1.3.6 An independent engineer was consulted by the Commission to confirm that the engines, gearbox and propeller were appropriate for a ship the size of the *Milford Mariner*. He calculated that the shaft horsepower needed to propel the ship at 11.5 knots was 642 kW, and as the engines produced a combined power of 778 kW at 1600 RPM, he concluded that the engines were of adequate size. The gearboxes were each rated to 464 kW and so were suitable. On the information available, the engineer calculated the required propeller size to be comparable with the actual propellers on the *Milford Mariner*. He emphasised that propeller calculations are varied and subjective because they are a theoretical part of propulsion design and do need to be tested fully during a sea trial.

1.4 Personnel and manning

1.4.1 The Master went to sea in 1970 as a fisherman. He fished in many types of inshore and offshore vessels until 1993, when he joined Real Journeys. He had worked in Doubtful Sound and Milford Sound on both the scenic and the overnight vessels. He held a certificate of competency as a skipper of a coastal fishing boat, which was issued on 21 May 1975, and an engineer local ship certificate, which was issued on 31 May 1995. He had been on the *Milford Mariner* for a little over a year, but had been on its sister ship, the *Fiordland Navigator*, for the previous 3 years.

1.4.2 The Chef had joined Real Journeys in 2000 and had been on the *Milford Mariner* exclusively. During that time he had taken part in the company training and had gained an advanced deckhand (ADH) certificate on 27 January 2003. However, during the 2 years before this accident he had not steered the ship, nor started the engines.

1.4.3 The Team Leader started work with Real Journeys in August 2003 and had no previous maritime experience. Her job did not require her to learn to steer the ship and she had never trained to do so. The job of Team Leader involved organising the hotel function of the ship including staff rosters and timetables, akin to a hotel manager.

1.4.4 The Nature Guide started with Real Journeys in August 2003 and had no previous maritime experience. In addition to giving commentary on the flora and fauna, he did assist in the day-to-day cleaning tasks on the ship. He was training towards an ADH certificate.

1.4.5 The trainee helmsman had joined Real Journeys in February 2003; she had no previous maritime experience. Initially she was employed as a boat host on the day cruises, and in August 2004 had started work as a boat host on the *Milford Mariner*. On 14 October 2004, she gained an ADH certificate, which included a steering certificate. However, before this occurrence she had only steered the *Milford Mariner* for about an hour. During pre-season training in August she had completed and been signed off on 21 of the 35 components of the crew training competencies, including lifesaving and emergency procedures, basic engineering and electrical systems.

1.4.6 Maritime Rule Part 31B Crewing & Watchkeeping – Offshore, Coastal & Restricted (Non-Fishing Vessels) required that vessels carrying more than 100 passengers in the enclosed area operate under a minimum crewing document. The owner was required to prepare and submit to the Director of Maritime New Zealand a proposal for the minimum safe crewing level for the vessel. The proposal was assessed by staff at Maritime New Zealand before it was approved by the Director.

1.4.7 In the enclosed area the minimum crewing document for the *Milford Mariner* required a total complement of 3 persons, which was to include a master holding an inshore launchmaster certificate (ILM), an engineer and an ADH. The certificate did not specify that the engineer may be the Master, but Maritime Rules Part 31B Crewing & Watchkeeping – Offshore, Coastal & Restricted (Non-Fishing Vessels) allowed the Master to also be the engineer and this was how Real Journeys had interpreted the minimum crewing document.

1.4.8 The minimum crewing document carried the following condition:

> Note also the additional requirement in maritime rule 31B.6(1) to have on board the number of crew necessary to operate the vessel safely at all times.

There were 10 crew on the ship at the time of the accident comprising, the Master, 6 boat hosts including the Team Leader, the Chef, a galley hand and the Nature Guide.

1.4.9 The Master's qualifications were superior to the ILM certificate required by the minimum crewing document. The Chef and trainee helmsman held ADH certificates.

1.4.10 The 6 boat hosts were primarily employed as hospitality staff and their duties were based around tending to the comfort and needs of the passengers, but they had all been trained in emergency procedures as part of the company's training programme.

1.4.11 The Master's duties covered the overall running of the ship and were many and varied. Those duties included the safe navigation of the ship, checking and operating the main engines and the generators, providing commentary to passengers during the voyage in conjunction with the Nature Guide, bunkering the ship and overseeing the day-to-day cleaning and preparation of the exterior of the ship. None of the crew was directly assigned to assist the Master, although they did handle the mooring ropes and could be diverted from their usual duties if required by the Master. The Safe Ship Management Manager later stated that other masters on the ship did delegate the valve operation, and other duties, to crewmembers.

1.4.12 The tourist operations at Milford Sound were of a seasonal nature, with a high season between 1 October and 30 May and a low season over the remainder of the year. The staff were contracted for the high season and could then choose to work or take leave over the low season. In preparation for the new high season, the staff commenced, or returned to, work in mid-August, so that they could become familiar with the ships before the high season commenced. The accident occurred during the low season, but with the crew for the coming high season on board. During the high season, the ship's staff were rostered on a week-on, week-off basis.

1.5 Climatic conditions

1.5.1 The weather forecast for the Milford area issued at 0300 on 18 September 2005 had a gale warning in force which read:

> Southerly 15 knots rising to 25 knots in the morning and to southwest 35 knots tonight. Sea becoming very rough. Southwest swell 2 metres at times.

1.5.2 The most recent analysis and forecast maps and weather forecast were supplied to each of the ships every morning by the staff of the Milford Sound shore office.

1.5.3 The Master said that during the voyage the wind was about 15 knots from the southeast; sufficiently light to enable him to set the sails to assist their passage towards the mouth of the Sound. On the return part of the voyage, the sails were furled as the ship was heading into the wind that was funnelling down the Sound.

1.5.4 The crewmembers indicated that at the time that the engines stalled the wind was blowing across the Sound into Harrison Cove from a southwest direction.

1.5.5 Westport was the standard tidal port from which the Milford Sound tides could be calculated. A full moon occurred on 18 September 2005, consequently it was spring tide. The following were the calculated times and heights of the tides on the day of the grounding.

High water		Low water	
Time	Height	Time	Height
1103	2.4 m	1710	0.0 m

1.5.6 The tide was falling at the time of grounding, but because the shoreline was steep the Master was able to reverse his ship off the ground using the ship's engines.

1.6 Topography and characteristics of Milford Sound

1.6.1 Milford Sound is smaller than many of the other sounds in Fiordland and is entered from the Tasman Sea between Saint Anne Point and Yates Point. At Dale Point the Sound turns almost 90° towards the east and decreases to a least width of about 450 m. In this area the shore becomes precipitous with sheer cliffs rising towards the adjacent mountains. Once past Copper Point the Sound increases to about one mile in width. Harrison Cove lies on the eastern side of the inner Sound; the Milford Deep Underwater Observatory lies close to Williamston Point at the entrance to this Cove. Fresh Water Basin lies at the southeastern extremity of the Sound and is where the local tourist vessels berth. Further towards the southern side of the Sound lies Deep Water Basin, which is used principally for fishing vessels.

1.6.2 The Admiralty Sailing Directions NP 51, the New Zealand Pilot makes the following comment in regard to the weather that can be expected in the Sounds:

> Weather conditions within the sounds are likely to be very different from those outside. In the sounds local katabatic winds may be experienced in strong wind conditions. Strong local gusts are common especially when the wind is from the north.
> Weather forecasts for the area should be treated with caution and mariners are warned barometric anomalies may be experienced along the coast.

1.6.3 Observations by masters who regularly operated in Milford Sound were that the weather conditions could change quickly and their severity varied at different positions within the Sound. The direction of the wind often differed from that predicted in the weather forecasts and that experienced to seaward, due to deflection from the mountainous terrain. During summer months strong afternoon sea breezes combined with the prevailing winds to give localised gale- or storm-force winds. Winds in excess of 50 knots were often experienced.

1.6.4 Of all the Fiordland sounds, Milford Sound is the only one with road access. It also has an airport, which has up to 200 movements each day during the high season. Its relatively easy access makes Milford Sound a popular tourist destination. In 2002 the Department of Conservation estimated that there were 410,000 visitors to Milford Sound annually. An unknown source suggested that the number had increased to about 500,000 by 2005. Although not all the visitors take a cruise, the vast majority do, and there are at least 12 vessels offering cruises on the Sound. The economic significance of the tourist industry in the Fiordland area cannot be underestimated.

1.6.5 Although connected by road to Te Anau, Milford Sound is relatively isolate, being at least 1.5 hours' drive from Te Anau. The road is liable to closure by snow and avalanche danger. Consequently, should there be an accident or injury the immediate response has to be either by air or handled locally.

1.7 Safe ship management and procedures manuals

1.7.1 Real Journeys maintained its own safe ship management system through its parent company Fiordland Travel Limited. The *Milford Mariner* held a current safe ship management certificate that was issued on 9 September 2004 and, subject to periodic audits and inspections, would remain valid until 9 September 2008. SGS M&I conducted the ship surveys, inspections and audits on behalf of Fiordland Travel Limited.

1.7.2 The *Milford Mariner* had a safe ship management manual that gave details of the company organisation, policies and responsibilities and the operation of the safe ship management system. To supplement the management manual there was a general procedures folder that contained instructions and flow charts for specific operations.

1.7.3 The designated person ashore was the Safe Ship Management Manager, who also filled the role of Chief Launchmaster.

1.8 Training

1.8.1 Real Journeys had an extensive training programme for its entire staff, but particularly those employed on the vessels. During August, in preparation for the coming high season, the company held a week-long training course on board one of its vessels for all staff, including sales and office personnel. The staff were issued with a training manual, but that manual was predominantly concerned with hospitality. In addition, for those working on the ships, there were deck crew training notes that required the trainees to be conversant with the deck procedures, both general and emergency. A training record was required to be completed by a trainee and signed by the trainer. It was the vessel handling part of this training that the trainee helmsman was undergoing.

1.8.2 When a master joined the company or changed vessels they had to complete a familiarisation programme that included an itemised training record, which was signed off by the training master. When considered competent, the trainee master was cleared to operate alone.

1.9 Damage

1.9.1 The damage to the *Milford Mariner* was limited to the hull in way of the port bow. There were 2 areas of the hull where the plating was gouged and indented, but not punctured (see Figure 6). The maximum indentation was about 100 mm and frame 10 was deformed about 100 mm inwards. The watertight bulkhead at frame 8 remained undamaged and intact.

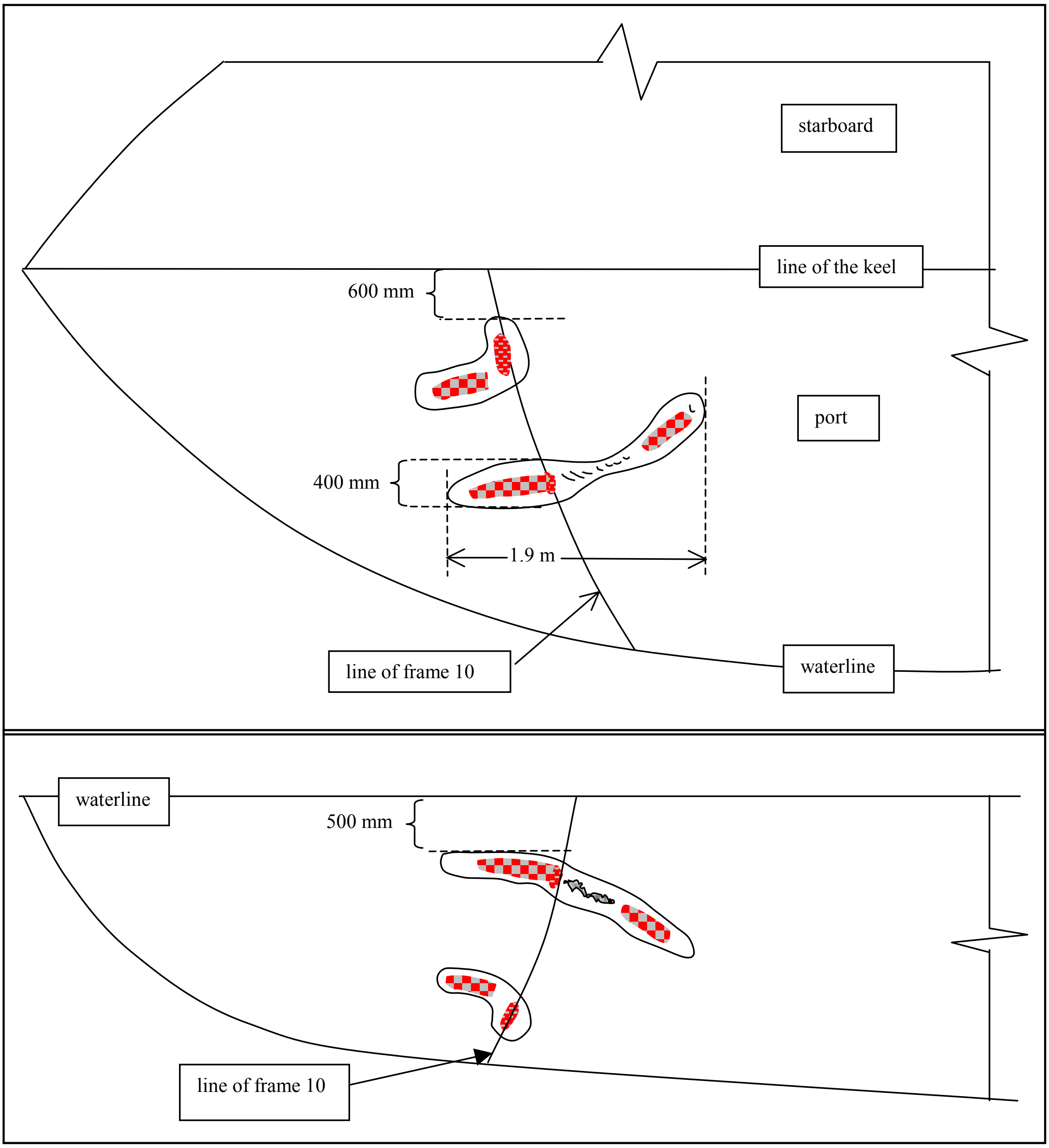

Figure 6
Plan and profile drawings as completed from the dive inspection

1.9.2 Only the forepart of the ship made contact with the ground. There was no damage to the propulsion or steering systems.

1.9.3 No passengers or crew were injured during the grounding.

1.10 Water system

1.10.1 The *Milford Mariner* had a 31.2 m^3 main FW tank in the double bottom, which extended up the side of the ship for part of its length (see Figure 7). In addition, situated forward on the lower deck there were 6 stainless steel free-standing tanks for potable FW, which had a total capacity of 5 m^3. On the main deck right forward were 6 electric hot water tanks that had a total capacity of 2.7 m^3.

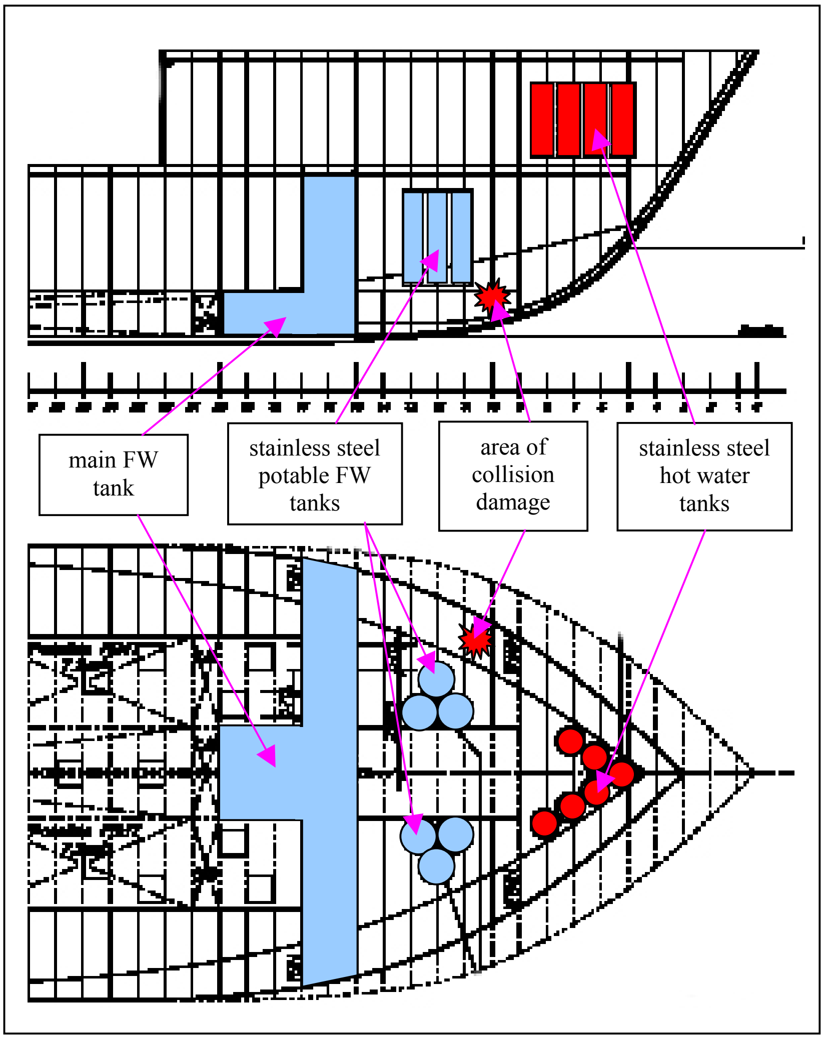

Figure 7
Forepart of the *Milford Mariner* showing the position of the water tanks and the area of hull damage

1.10.2 Separate filling pipes were provided for the main FW and potable FW tanks. The filler pipe for the main FW tank was 75 mm internal diameter while the pipe for the potable FW tanks was 50 mm. In the time available between trips, the masters found it difficult to fill the potable FW tanks through the smaller pipe, especially as they were filling 6 relatively small tanks through a single pipe. Consequently the masters, in conjunction with the company, had devised a "work-around" and had fitted a connecting pipe and valve between the water feed line from the main FW tank and the filler line for the potable FW tanks (see Figure 8). This allowed the smaller tanks to be filled slowly from the main tank during the voyage and so removed the necessity to fill them while alongside. It was the valve between the 2 systems that the Master had gone below to open at the time the engines stalled.

1.10.3 As part of the electronic vessel management system there was complete monitoring of the water system. However, the sensor in the potable FW water tanks had recently malfunctioned and so the masters were unable to monitor the amount of water in those tanks. Because of this, the Master decided to leave filling the potable FW tanks until near the end of the voyage, so that by the time they arrived back at the berth the tanks would be full and overflowing.

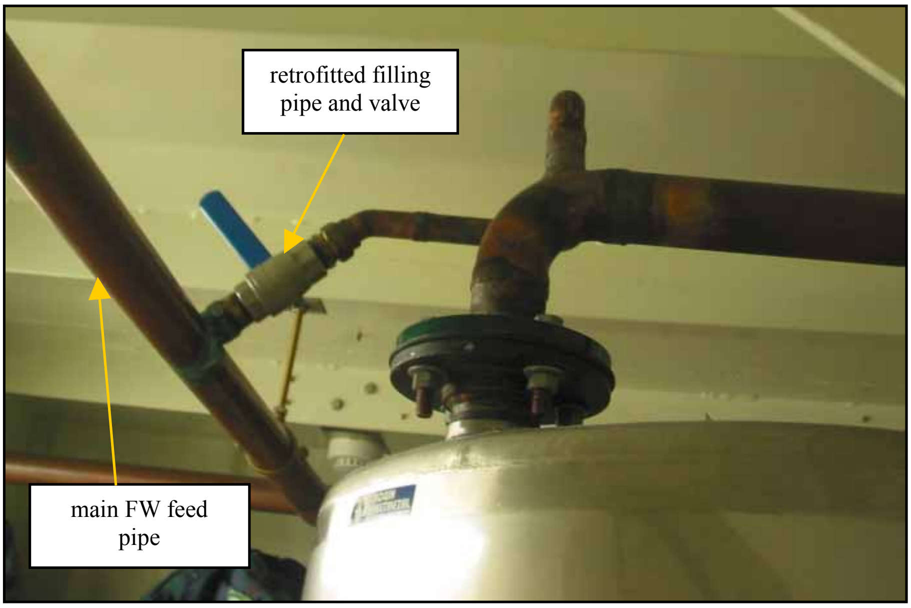

Figure 8
Stainless steel potable FW tank showing the retrofitted filling pipe and valve

1.10.4 In Milford Sound, all the FW supplied to the wharves came from the same catchment tanks, so was of equal quality when it was loaded on the ship.

1.11 Post-accident tests and modifications

1.11.1 In December 2005, the Real Journeys General Manager Maintenance and Supply attended the *Milford Mariner* and the sister ship the *Fiordland Navigator* to check the position of the shift delay dipswitches.

1.11.2 The *Fiordland Navigator* was also susceptible to stalling and suffered vibration at 1600 RPM. Consequently, while that ship was on the slip in August 2005, the company had reduced the diameter of the propellers by 50 mm and returned to running the engines at their design speed of about 1800 RPM. However, after these changes one of the engines continued to stall. The dipswitches for the engine that did not stall were found to be set for the maximum shift delay, but the engine that was still stalling had no delay set. The General Manager Maintenance and Supply changed the dipswitches so that both engines had the maximum delay set, but the engine prone to stalling continued to stall as it had before the change of settings.

1.11.3 The General Manager Maintenance and Supply also changed the dipswitches on the *Milford Mariner* so that maximum delay was activated, as per the manufacturer's advice. However, he said that on sea trials, while there was a noticeable delay when going from ahead to idle astern, there was "no discernible change to the engine's susceptibility to stalling".

2 Analysis

2.1 The accident occurred during the lead-up to the high season, when the crewmembers may not have been as familiar with the ship as they could have been. However, all those directly involved in the accident had been on the ship the year before and ought to have known its handling peculiarities.

2.2 It was unusual for a master to leave the bridge of his ship while it was under the con of an inexperienced crewmember, particularly when the ship was operating within 200 m of the shore. The Chef, the person to whom the Master had delegated his supervisory authority, held an ADH certificate and so was qualified to steer the ship, but he had not done so for at least 2 years and so was unfamiliar with the bridge operations. As such, the Chef should not have been expected to supervise the helmsman during her training period, even though he agreed to do so.

2.3 The trainee helmsman had an ADH certificate and as part of that she held a steering certificate, so should have been able to steer the ship. However, she had not received detailed training on the *Milford Mariner*, having steered only once before, and was not familiar with the engine controls. The function of helmsman on the *Milford Mariner* was more of a command role than would normally be expected of someone steering a ship and needed closer supervision than a more conventional helmsman might have required.

2.4 During the ship's summer schedule, the turnaround time was short so the masters had sought a more efficient way to take on FW. The system they devised allowed water to be loaded into the main tank at high pressure through its larger filling pipe and for the stainless steel potable FW tanks to be filled during the voyage via the retrofitted pipe. This system, however, defeated the object of having separate potable FW water tanks as all the water now passed through the main tanks. Even though the ship was not on the high season schedule at the time of the accident, the Master used the accepted system to fill the FW tanks. A more effective system might have been to consolidate the FW system such that all FW was drawn from the main tank. An alternative would have been to improve the filling system of the potable FW tanks to allow for rapid filling.

2.5 The Master was responsible for every aspect of the operation of the ship and was possibly overburdened with tasks that were outside his principal duty of ensuring the safe navigation of the ship. The crew were primarily engaged to tend the passengers and the only seamanship task that they were routinely called upon to assist was mooring the ship. Consequently, this Master had become used to performing personally many basic tasks that could otherwise have been delegated to members of the crew.

2.6 The company operations procedures listed the comprehensive responsibilities of the Master but did not address who should support him or assume command if he needed to leave the bridge for any reason. He was the designated engineer on board and as such would need to attend the engine room in the event of a failure.

2.7 The minimum qualification required to operate the *Milford Mariner* was an ILM certificate, which was a dual qualification covering both navigation and engineering. The ILM was intended for operators of smaller craft, less than 20 m in length, in the inshore area, not small ships such as the *Milford Mariner*. However, in this instance the Master held a skipper of a coastal fishing boat certificate, a superior qualification to the ILM; he also held an engineering qualification.

2.8 The *Milford Mariner* was 40 m in length and had a breadth of 10 m, a gross tonnage of 620, sleeping accommodation for 64 passengers, common rooms, a galley and full reticulated utilities. It was far larger and more complex than a launch; in every aspect the vessel was a small passenger ship.

2.9 The minimum crewing document only called for a crew of 3 when the ship was operating in enclosed waters. Such a level of crewing could not properly address the size of the vessel, its complexity, the remote and hostile environment in which it was operating or the number of passengers it could carry. In the event of an emergency, it would require more than 3 crew to assist up to 150 passengers while responding to whatever the emergency may be. The company recognised the need for a higher crew-to-passenger ratio and crewed the ship accordingly. However, none of the crew had been specifically assigned to assist the Master and so he had taken on the responsibility for a large number of auxiliary, and sometimes basic, tasks himself.

2.10 In response to the Nature Guide spotting the penguin, the trainee helmsman said that she slowed the ship by bringing the engine control levers back to neutral. However, the manufacturers of the engine control and the engine and the gearbox all agreed that for the engines to stall the controls would have had to be put into astern. It is therefore probable that when she pulled the levers back, they passed the detent at the neutral position and stopped at the detent for idle astern, the position where the engines were most vulnerable to stalling.

2.11 Since it had been launched, the *Milford Mariner* had had a tendency to stall its engines when they were put into astern while the ship was still moving ahead at speeds in excess of 6.5 knots. The masters had put in place informal procedures to minimise the stall potential. In order to overcome the forward momentum on the propeller when changing from ahead to astern, they either selected a higher setting on the idle speed selector switch or initially put the engine control lever well beyond the idle astern position for a short time before reducing it to the desired astern setting. Either method gave increased engine speed at the time astern was engaged.

2.12 However, those procedures had not been documented so the trainee helmsman could not have been expected to be aware of the stalling problem or the effect of putting the engines into idle astern. Even if she had intended to go astern, she would have been unaware of the need to increase the engine speed in order to overcome the forward momentum.

2.13 Prior to grounding, the ship deviated from its intended course, turning to port, towards the shore. It could not be determined whether this was due to residual helm that was set before the engines stalled, or to the helmsman unconsciously altering course to port when the penguin was reported, or whether the wind blowing from the southwest caused the bow of the ship to turn to port. The course deviation may have been a combination of all of the above.

2.14 Starting the engines required 4 distinct actions to be completed in strict sequence. In the urgency that followed the engines stalling, it is probable that haste prevented orderliness so led to the sequence being confused. Even when the Master, who was very experienced at starting the engines, returned to the bridge he was unable to restart the engines from the central console. He eventually went to the port control station, where he used the hot keys, which circumvented all the control interlocks, to start the engines, but by that time the ship was so close to the shore that grounding was inevitable. However, even after he had restarted the engines, the engine control system remained isolated so prevented him taking control of the engines. Most probably, after the attempts to start the engines from the central console were unsuccessful, the ignition keys had been left in the off position, thus isolating the engine control system. It was essential that the engine and engine control systems had safety interlocks to prevent starting the engines in gear, but the crew should have been sufficiently familiar with the equipment to be aware of the interlocks and the necessity of following the correct sequence to start the engines.

2.15 The restart inhibitor could have been another factor that confused the starting sequence and prevented restarting the engines. For those used to starting motor vehicles it would not have been usual practice after a failed engine start to turn the key to the off position before attempting to restart it. In this case it meant that an operator would have to start the whole sequence from the beginning following each failed engine start.

2.16 Real Journeys management had known for some time that this ship, and its sister ship the *Fiordland Navigator,* were prone to stalling. However, with the exception of the "work around" of installing hot keys, the cause of the engines stalling had not been fully investigated nor had a remedy been sought. The masters had adopted procedures to minimise the risk of stalling, but these had not been formally incorporated into the ships' operating and training manuals.

2.17 The Service Manager from the company that supplied the Twin Disc Incorporated engine control system said that on heavy displacement ships it was normal for a shift delay to be set in the engine controls, and the company would have normally checked the system and set the delay during the commissioning of the equipment. However, as the engine control system had been purchased and installed by Fiordland Travel Limited, a representative of Twin Disc Incorporated did not commission the system and the delay had not been adjusted from the factory default.

2.18 The operating environment of the ship necessitated positive handling characteristics, which could be compromised if a delay was imposed on all ahead-to-astern engine movements. However, the shift delay that could be programmed into the ECU was proportional and did not affect the engine response while manoeuvring at slow speeds. It only became active after at least a minute at higher speeds.

2.19 The engines, gearbox and propellers were calculated to be appropriate for the ship. However, the independent engineer suggested that slightly more horsepower from the engines, or smaller-diameter or less-coarse-pitched propellers, or both, would have reduced the chance of the engines stalling, but may also have affected the handling of the ship.

2.20 The engine trials after the ship was launched were not comprehensive and were interrupted, resulting in incomplete information being available on the test documentation. The trials were particularly important in this instance because the company intended to operate the engines at a lower speed than that at which they were designed to operate, notwithstanding that the engine manufacturer was satisfied for the engines to be run at the slower and less efficient speed of 1600 RPM.

2.21 The bridge of the *Milford Mariner* was well designed for one-man operation, with a good centralised console. However, such a layout did make it more difficult for someone not seated at the helm station to assume control. Consequently, it would have been awkward for the Chef to reach the engine controls, making it less likely for him to get the starting sequence correct.

2.22 The seasonal nature of the tourist industry usually resulted in many new staff starting work each season. Consequently, the operator held training periods before the start of the season and promoted ADH training by the staff. Overall the training system was reasonable, but due to the nature of the tourism industry, it was heavily weighted towards the hospitality part of the operation.

2.23 Following the grounding, the Master acted competently, keeping the vessel aground until a full damage assessment had been made and its watertight integrity ensured. The crew put into place the emergency plan to ensure the passengers' safety.

2.24 The damage resulting from the grounding was largely superficial due to a combination of a slow grounding speed, the clement weather conditions and the ship being strongly constructed, particularly around the underwater areas of the bow. However, it should be noted that a ship drifting, out of control, in Milford Sound does pose a real hazard and this could easily have developed into a more serious situation.

2.25 The designed FW system on the ship had been altered such that it defeated the purpose of having 2 separate systems. It would have been preferable to address the problems of filling the potable FW tanks directly rather than make alterations that compromised the system and necessitated the Master's attention during the voyage. The malfunction of the sensor necessitated the Master leaving the bridge and this contributed to the failure sequence.

3 Findings

Findings and safety recommendations are listed in order of development, not in order of priority.

3.1 The engines stalled when an inexperienced trainee helmsman, who was unfamiliar with the engine control system, put the main propulsion engines astern, probably unwittingly.

3.2 The Master left the bridge to attend to a basic task, which resulted in the trainee helmsman being supervised by the Chef who, although ADH qualified, was not familiar with the control systems of the ship.

3.3 The Chef did not remind the Master that he was unfamiliar with the ship's operation when he agreed to oversee the trainee helmsman.

3.4 The actions of the Master and crew following the grounding were appropriate.

3.5 Real Journeys management was aware of the tendency of the ships' engines to stall, but had allowed the ships to continue operating without fully investigating the cause or taking remedial action other than the installation of the hot keys to minimise the effect of a stall.

3.6 There were informal practices in place among the masters to minimise the possibility of the engines stalling, but no formal procedures had been established.

3.7 The engine trials and commissioning of the ship were not fully completed so no baseline was available to calculate the optimum propeller size for the ship and its engines.

3.8 The engine control system had not been customised for this particular ship. Consequently the engines tried to respond immediately to engine commands, increasing the potential for the engines to be overloaded and stall.

3.9 The reason why the engines stalled could not be established, but it was probably a combination of several factors including the momentum of the ship, the size of the propeller, the power of the engine and the immediate response of the engines.

3.10 When the engine stalled, the ship turned towards the shore. Whether the turn was due to residual applied rudder or the effect of the wind, or a combination of both could not be determined.

3.11 The slow speed of the ship when it grounded and its strongly constructed hull helped to minimise the damage to the ship.

3.12 The starting procedure for the engines was not unduly complicated, but it did require several distinct actions to be undertaken in the correct order for it to be successful.

3.13 In the urgent situation in which they found themselves, the crewmembers were unable to restart the engines, probably because an incorrect starting sequence was used.

3.14 There were sufficient properly qualified personnel on board the ship to meet the requirements of the minimum crewing document and the ship was correctly certified.

3.15 The number of crew required by the minimum crewing document would have been insufficient to operate the vessel safely with a full complement of passengers in the event of an emergency.

3.16 The Master had extensive responsibilities and tasks to perform in the normal operation of the ship, including engineering. None of the crew was specifically assigned to assist the Master so he was exposed to being overburdened.

3.17 The sensitive nature of the Milford Sound environment and the economic significance of the tourist industry increase the potential impact of any accident in the area. Fortunately, this grounding did not result in any injuries or environmental pollution, but should serve as a warning to all operators in, and administrators of, the area of the extreme care and prudence that need to be exercised to preserve that situation.

4 Safety Actions

4.1 Following the accident the Safe Ship Management Manager of Real Journeys issued a memorandum to the masters on the overnight boats and copied it to the masters throughout the fleet. The memorandum included the following instructions:

- All Skippers should familiarise themselves with procedures to restart after an engine stall. This has recently been added to the Mariner and Navigator Procedures Manuals, as these vessels are the ones prone to stalling.

- All watchkeeping crew should be fully familiar with restarting stalled engines. This should come under training in the vessel handling section of the crew training forms.

- Crew members under supervision on the helm as part of their "Vessel handling" training should be specifically under the *Skipper's* supervision.

- Skippers should let their nature guides know if they are going to be off the bridge while cruising (recommend UHF contact). This will make the guide aware that he/she shouldn't create any passenger expectations of complicated manoeuvring while the skipper is away.

- Procedures required for valve changeovers etc which can be delegated to crew, should be.

4.2 Real Journeys employed an independent consultant to carry out a company-wide risk assessment of masters' workloads. This work was in progress at the time that this report was published.

4.3 Real Journeys has engaged the engine control manufacturer to visit the entire Real Journeys fleet to check and adjust each ship's engine control for optimum operation. This work was in progress at the time that this report was published.

5 Safety Recommendations

5.1 On 5 April 2006, the Commission recommended to the Chief Executive Officer of Real Journeys that he:

011/06 Establish quality assurance procedures within Real Journeys to ensure safety critical operational defects are properly addressed.

012/06 In conjunction with the engine control manufacturer, ensure that each of the company's vessels is configured for optimum operation by checking its engine control systems.

013/06 Carry out a full engine trial on the *Milford Mariner,* and any other of the company's vessels for which full engine trial data is not available or where the engine and propeller configuration has changed, to determine the optimal configuration of the engines and propellers.

014/06 After the engine controls and the engines and propellers are set for optimum performance, should the engines on any of the company's vessels continue to be susceptible to stalling, determine the course of action that might best prevent further incidences of stalling.

015/06 Carry out a risk assessment of the Master's workload on each of the company's vessels with a view to reviewing the minimum crewing documents to ensure that adequate support is provided for the Master.

016/06 Establish a policy that all staff undergoing training are properly supervised.

017/06 Formulate checklists for important procedures such as, but not limited to, starting the engine, changing the steering and engines between consoles, and operating on one engine. Include as part of the crew training sessions, exercises that practise the use of these checklists.

5.2 On 12 April 2006 the Chief Executive Officer of Real Journeys replied in part:

> 011/06 We believe that we have established quality assurance procedures under our Safe Ship Management System which is independently audited by Telarc and approved by the Director of Maritime New Zealand. This system has been in place for many years and on 3-4 May will be audited by the MNZ audit team. When this audit report is produced by MNZ it will be forwarded to TAIC.
>
> 012/06 This is in the process of being completed and a report will be forthcoming by the end of May 2006.
>
> 013/06 We accept this recommendation and will undertake this by the end of July.
>
> 014/06 This has been actioned by memo and we will follow up by training and recording in each ships operating manual. This will be completed by the end of April.
>
> 015/06 We would like to make the following comments.
>
> (a) All real Journeys vessels comply with Maritime New Zealand requirements as a minimum.
>
> (b) The Milford Mariner's minimum manning requirements were assessed [by MNZ] on 28 March and we are awaiting their final their final confirmation of their findings.

(c) On the company's larger vessels we are proposing to introduce the role of "mate" to assist the Master.

016/06 A memo has been sent to all skippers confirming their responsibility that training is part of their responsibility as per Section 3.5.5 of our Safe Ship Management Manual.

017/06 Current procedure manuals will be reviewed as per this recommendation by the end of May 2006.

5.3 On 5 April 2006, the Commission recommended to the Director of Maritime New Zealand that he:

018/06 Review Maritime New Zealand's internal practices and procedures for assessing and approving applications for the issuance or renewal of minimum crewing documents for restricted limit passenger ships to ensure that appropriate, consistent and realistic levels of properly qualified personnel are assigned to a vessel to fulfil all the provisions of Maritime Rule Parts 31B.7 and 31B.8. Particular consideration should be given, but not limited, to the following:

- the size and complexity of the vessel
- the environment in which the vessel operates
- the provision of support where a Master is allowed to perform the duties of both the Master and engineer
- the allowance of dual roles should be clearly and unambiguously stated on the minimum crewing document.

As part of the review, assess the feasibility of the minimum crewing document identifying the baseline number of crew dedicated to operating the vessel without passengers onboard. Additional staff to tend the passengers and provide coverage for emergency situations could then be identified to supplement the baseline group.

5.4 On 12 April 2006 the Acting Director of Maritime New Zealand replied that:

This recommendation is acceptable and work is currently underway to review our procedures and practices for the issue or renewal of minimum crewing documents for restricted limit passenger ships.

Maritime NZ has also attended the *Milford Mariner* and reviewed this ship's minimum crewing document in conjunction with management and the vessel's crew.

Approved on 27 April 2006 for publication

Ho W P Jeffries
Chief Commissioner

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Transport Accident Investigation Commission
P O Box 10-323, Wellington, New Zealand
Phone: +64-4-473 3112 Fax: +64-4-499 1510
E-mail: reports@taic.org.nz Website: www.taic.org.nz

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