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Summary

At about 1836 on 26 March 1992, the Australian roll-on/roll-off vessel Searoad Mersey, was unberthing from Webb Dock, Melbourne to undertake its regular voyage from Melbourne to Devonport.

During the unberthing operation a stern rope, being retrieved very rapidly, swung and whipped as the eye of the rope neared the ship's side. The eye of the rope hit the Second Mate, who was leaning over the rail, and caught around his head and shoulders, The Second Mate was pulled over the ship's side and into the water. When he was recovered from the water, he was dead.

The Victorian Coroner, who held an inquest into the Second Mate's death on 4 and 5 April 1993, found the death had occurred from a combination of drowning and multiple injuries. In detailing the circumstances of the incident the Coroner stated, inter alia:

"The evidence is clear that it was the normal practice of the deceased to retrieve the mooring lines at maximum rate, even though he was aware of the danger of rope whip and had discussed the danger with colleagues. To this extent I am satisfied the deceased himself, contributed to the cause of death."

Sources of information

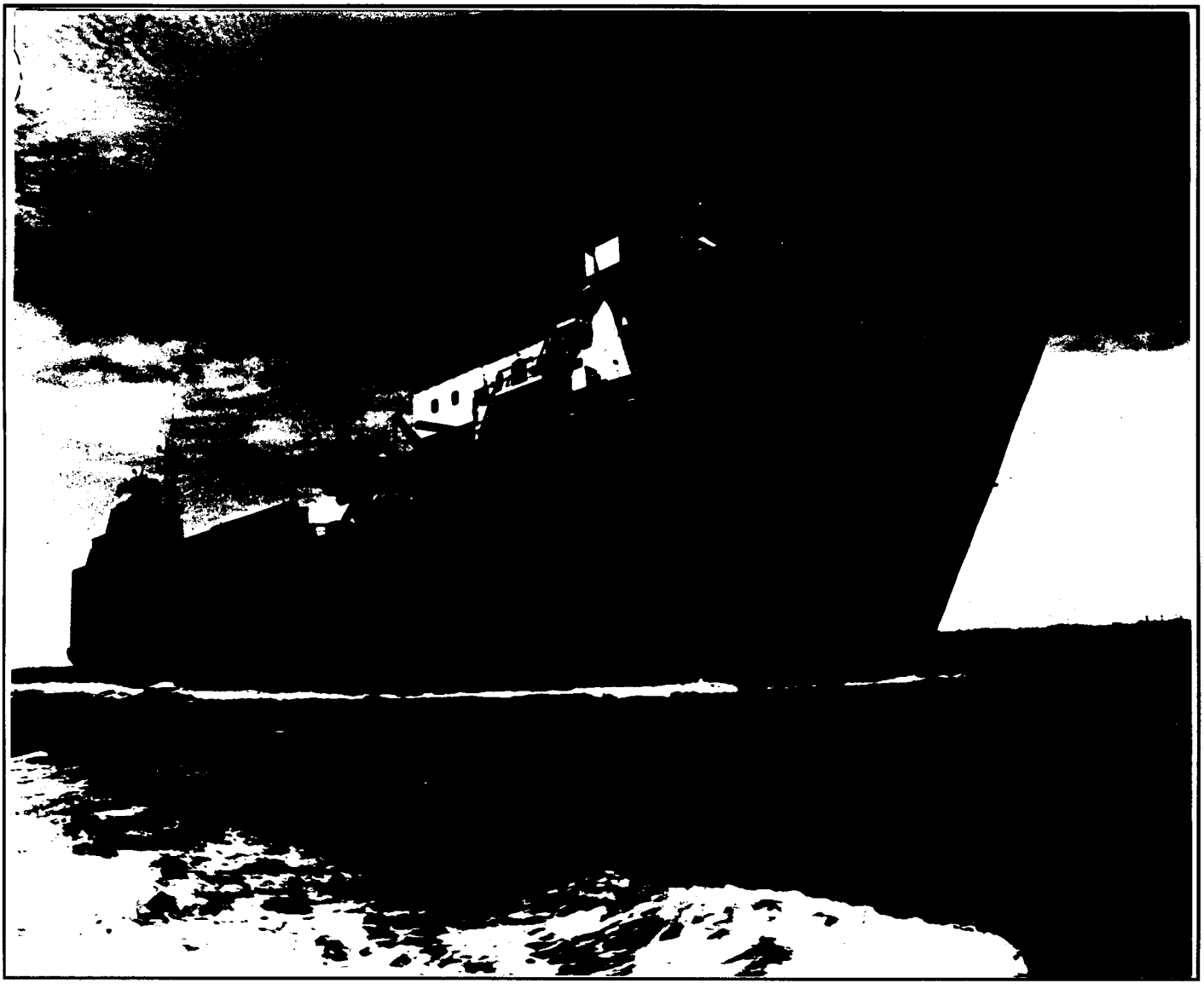
Information was obtained from:

The Master and crew of Searoad Mersey;
ASP Ship Management;
The Victorian Police;
The Alma Doppel;
Shipping Control Centre, Port of Melbourne;
Australian Maritime Safety Authority.

The Inspector was assisted in the investigation by Mr R.J. Timms B.App.Sci. (Marine Engineering), Engineer Class 1, Principal Marine Surveyor, Australian Maritime Safety Authority.

Time: The times used in this report are Australian Eastern Standard Time, Searoad Mersey was operating on Tasmanian Summer Tlme.

In comparing ship's time with Eastern Standard IIme, as recorded on the tape-monitoring system maintained by Harbour Control, there is a time difference of between 61.5 to 62 minutes between the times recorded by the ship and harbour control



Searoad Mersey

SEAROAD MERSEY

The ship

Searoad Mersey was registered on 27 March 1991, as an Australian registered roll-on/roll-off motor vessel, classed with Det norske Veritas. It was launched in November 1990, at the Singmarine Dockyard and Engineering (Pte) Ltd Singapore, as hull 178.

Searoad Mersey is a vessel of 5925 gross tonnage, with a capacity of 120 twenty-foot equivalent units carried on a main deck and an open upper deck. The ship is 91.5m in length overall (85.1 m registered length), has a beam of 18.5m and a moulded depth of 13.6m. It is a twin screw ship powered by two Wartsila 8R32E, eight-cylinder diesel engines, developing 5576kW at 75Orev/min on each engine and giving propeller shaft speeds of 174rev/min via a reduction gearbox.

Before the vessel was accepted by the owners, it underwent sea trials. These trials included various engine, machinery and manoeuvring operations, and included anchor trials which were conducted on 7 March 1991. The anchor trials did not extend to testing either the forward or after mooring winches.

Searoad Mersey arrived in Melbourne on the morning of 19 April 1991, after the delivery voyage from Singapore and took up its regular service that night.

The ship, specifically designed for the service between Melbourne, northern Tasmania, and King Island, is normally scheduled to undertake sea passages at night and to carry out cargo operations during the day.

On 26 March 1992, Searoad Mersey held all the statutory certificates required by Australian legislation. These included:

International Cargo Ship Safety Construction Certificate, valid to 26 March 1996.

International Cargo Ship Safety Equipment Certificate, valid to March 1993.

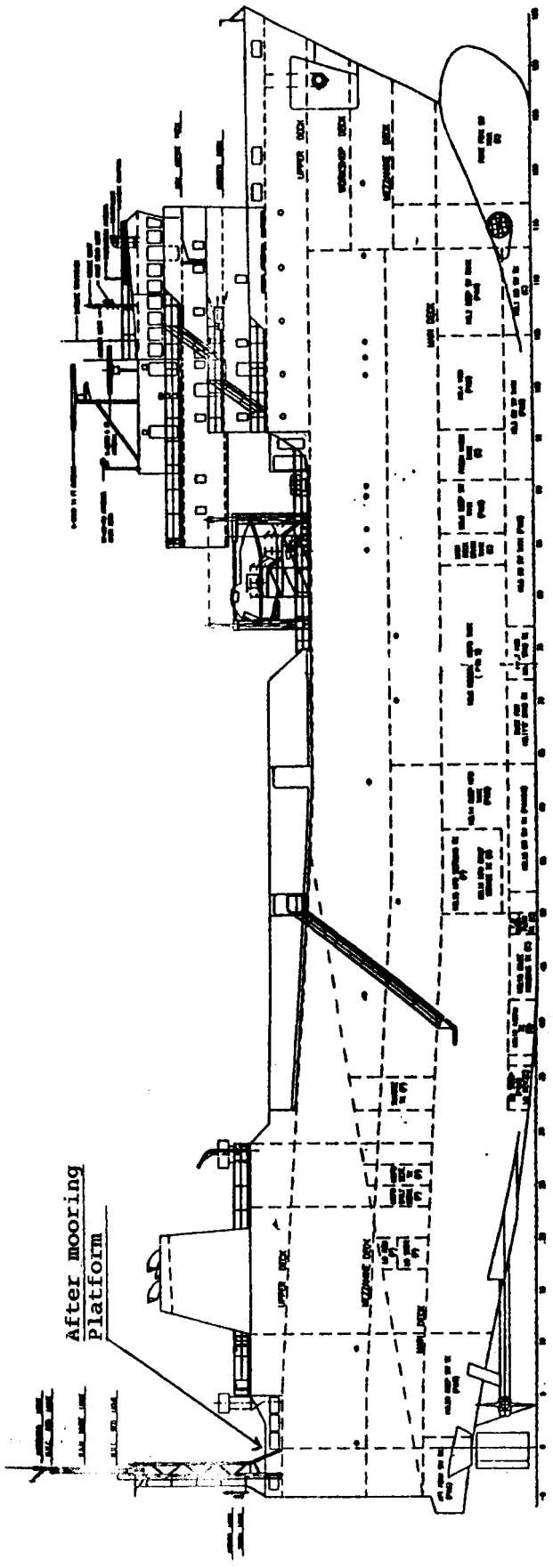
International Load Line Certificate (Interim), valid to August 1992.

International Oil Pollution Prevention Certificate, valid to 27 March 1996.

Ship's crew and organisatlon

The ship is normally manned by a crew of 14, consisting of the Master, three deck officers, three engineer officers, two catering ratings and five integrated ratings. The presence of a probationary integrated rating increases the crew to 15 when appropriate.

In applying for a "Category Certificate" under the Ship's (Capital Grants) Act 1987, the company made submission relating to the appropriate crew numbers to be carried stating:



Searoad Mersey Profile

"The engine room is classed for UMS (unattended machinery space) operation. There is a centralised control and approved automatic alarm system. "

and:

"A planned maintenance system will be provided for all hull and machiney items and appropriate shore assistance will be provided if the engineers are unable to maintain the program due to the schedule of the ship. "

and in relation to mooring they submitted:

"The mooring equipment is designed for efficient safe mooring operations with available crew. All ropes consist of Atlas ropes on drums. Automatic self tensioning devices are provided on all winches. "

The ship operates on a two "swing" system, with two two crews, each working approximately one month on the ship and one month off. The officers, employed by ASP Ship Management, had served on the ship since it entered service in April 1991.

The Master in command on 26 March, had first assumed command of Searoad Mersey on 7 May 1991 and had from that time alternated command on the two "swing" basis with another master. Both Masters held a Master Class One certificate of competency.

The Mate had been on Searoad Mersey as part of the two "swing" system since May 1991. He also held a Master Class One certificate of Competency, issued on 7 August 1987,

The Second Mate held a Second Mate Class One certificate of competency, issued on 23 August 1987. He had been a permanent member of the crew since 19 April 1991. He was born on 11 February 1965, was 198cm tall and is said to have been of a powerful build.

The Third Mate and all other crew members held appropriate qualifications.

During the ship's first year of service, the Integrated Ratings (ratings) tended to serve for limited periods only. Of the six ratings on board, only the Provisional Integrated Rating and one other had been employed on the ship on a previous "swing", two had been employed for the preceding month, one for nine days, and one rating joined on 26 March.

SEQUENCE OF EVENTS

The Second Mate returned to Searoad Mersey on 24 March, having been on leave since 22 February 1992, and took up duty relieving the deck officer who was second mate on the other "swing".

Searoad Mersey departed Devonport at 1548 Eastern Standard Time (1648 ship's time) on 25 March 1991, on the scheduled service to Melbourne. The Second Mate kept the midnight to 0400 watch, and when this was completed made a routine inspection of the cargo decks to ensure that the ro-ro units remained secure. He would have completed these duties and been able to go to bed at about 0500. As the ship approached Webb Dock, the Second Mate was on duty again at the after mooring platform during berthing to tie the ship up.

The ship arrived at Webb Dock, Melbourne at 0802 on 26 March. It moored, as usual, port side to the berth, with a stern rope from the "blue" winch, two breast ropes and a back-spring from the "red", "green" and "yellow" winches respectively.

The discharge and loading of units began at 0920 with the Third Mate as duty officer and the Mate with overall responsibility for the cargo operations. At 1200, the Second Mate relieved the Third Mate as duty officer. As roll-on/roll-off units were loaded, the integrated ratings on duty secured the trailers by chain lashings, to prevent them from moving in the seaway.

Cargo operations were completed at 1620 and the ship prepared for sea. The crew members were engaged in lashing the last of the trailers and cars put on board. A little after 1627, the Master requested clearance from the Port of Melbourne Shipping Control Centre. Clearance was given, with the instruction that Searoad Mersey was to follow the ship, City of Burnie.

The Master, Mate and an integrated rating went to the bridge; the Third Mate and the Chief Rating went to the forecastle. The Second Mate and a Rating went to the after mooring platform (Photo page 13). The Integrated Rating had been a crew member of Searoad Mersey for eight days, since 18 March and had not served on the ship previously. Two ratings remained in the vehicle spaces securing the final few units.

The Rating arrived at the after mooring platform before the Second Mate. The speed of the winch drum can be controlled by a "mooring valve". The Rating stated that he had set the "mooring valve" to the setting normally set by the officer who had left the ship on 24 March.

The weather at the time, as recorded by the Port of Melbourne Authority's Shipping Control Centre, was fine, partly cloudy, with good visibility, and the wind from the north at 15 knots. The after mooring platform was dry and free from oil and grease. The Second Mate was dressed in a white boiler suit and a day-glow orange safety vest and wore substantial elastic-sided working boots. He had been in charge of mooring at the after mooring platform in excess of 140 occasions.

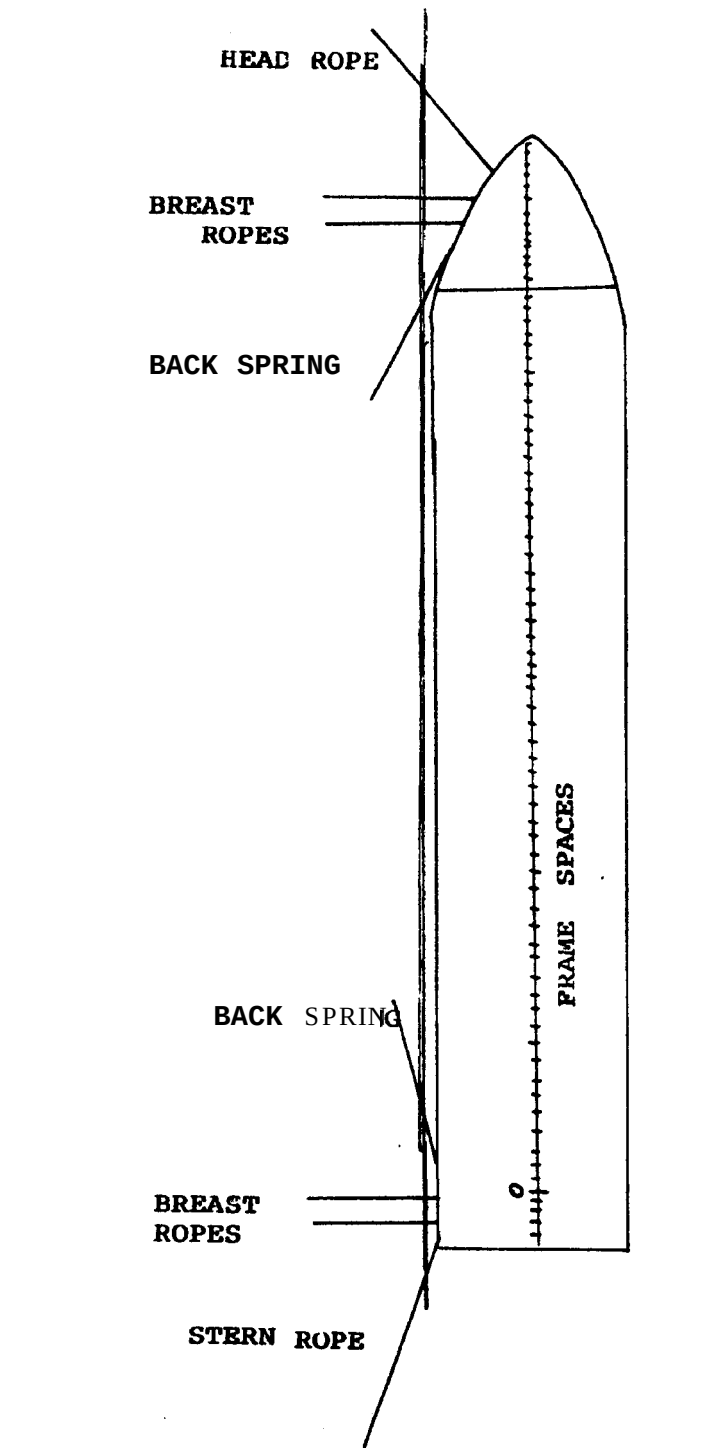


DIAGRAM OF TYPICAL MOORING PATTERN

- "Frames" refer to the transverse girders forming the ribs of the hull. They are conventionally used as a point of reference when referring to position of structures, equipment, or areas of damage to a ship. Frames are numbered from the rudder post forward as positive numbers and from the rudder post aft as negative numbers (or sometimes letters).

The Master ordered all ropes to be "let go". At the after mooring platform, the two mooring ropes from the "green" and "red" winches were released first. According to the Rating, the Second Mate controlled the recovery of the two ropes by the two centre ("green" and "red") levers. The stern rope to the "blue" winch and the back spring to the "yellow" winch, were then released. The Rating volunteered to operate the blue lever and the Second Mate agreed.

Both the Second Mate and the Rating were at the shipside controls, the Second Mate was standing at the after end of the control box, between it and the after fairlead. The Rating was at the forward end, standing between the control box and the fairlead in way of frame 1. The rope to the "yellow" winch was led through the fairlead immediately forward of the control box, directing the Second Mate's attention in that direction. The Rating at the forward end of the control box, operated the forward of the four levers ("blue" lever) controlling the stern rope, which was led through the fairlead immediately on the Second Mate's left side. With the release of the moorings the ship's stern began to drift slowly off the wharf in the northerly wind.

The following sequence of events occupied between four and five seconds.

The stern rope had been dropped on the quay, clear of the bollard and was being recovered. It dropped clear of the quay and swung parallel with the ship's side without hitting the water or the square stern section of the ship.

According to a statement made by the Rating, he thought the stern mooring rope was coming in "too fast" and turned around to make sure that the rope was stowing on the drum correctly. He turned back to see the eye of the stern mooring rope rotating rapidly above the Second Mate's head. He shouted a warning, released the blue winch control and tried to pull the Second Mate back from the bulwark. At the time, the Second Mate was leaning over the bulwark looking forward along the ship side watching the "yellow" mooring rope. The eye of the "blue" mooring rope became entangled with the Second Mate's upper body, pulling him over the side of the ship. The Rating looked over the side and saw Second Mate floating face down in the water with blood coming from his head.

The Rating also stated that, although he had released the mooring winch control, the winch did not stop but continued to haul in the rope at maximum speed.

Both the Master, Mate and helmsman were on the bridge. The Master and Mate were looking aft, watching the ship's stern clear the ramp area. At a time put at 1633, both men, with the helmsman, saw the Second Mate fall into the water. The Master immediately went to the wheel house and pushed the main engine emergency stop buttons.

Based on the times taken from the Harbour Control's tape monitoting system the following sequence of events occurred after the Second Mate fell to the water.

At 1631.20 the Master called the Shipping Control Centre on VHF channel 12:

"Harbour Control, Harbour Control this is Searoad Mersey. Could you get the port emergency services round to Webb Dock. I've got a man fallen in the water."

The Shipping Control immediately alerted the mobile first-aid units and acknowledged the message from the ship.

On the ship, the Mate rushed aft, joined by the Chief Integrated Rating and the Probationary Integrated Rating, who was alerted by the engine stopping. The Probationary Rating stated that the "blue" winch rope drum was rotating slowly when he arrived at the mooring position. He went to the winch and moved the manual control lever on the winch to the stop position and the drum ceased turning. He saw the mooring control was set to maximum speed.

The Master, meanwhile, had returned to the bridge wing where he saw the Second Mate face down in the water, and there appeared to be a lot of blood.

At 1632.06 the Master radioed Shipping Control again:

"Harbour Control this is Searoad Mersey. We do need an ambulance and port emergency. I've got a man fallen from the ship in the water and looks injured."

Shipping Control confirmed the message and confirmed that first-aid units were already on their way The Master stated that he was unable to render assistance and that the ship was drifting in Webb Dock and was about "to sort myself out".

The sail training vessel Alma Doppel was on passage down river and had been cleared by Shipping Control to follow Searoad Mersey after the ro-ro vessel had left its berth. The Alma Doppel's Master monitored the radio conversation and offered assistance immediately, launching the vessels rubber dinghy with some crew members a little after 1630. However they were unable to reach the Second Mate. The Alma Doppel subsequently anchored and helped in the rescue attempt until 1815, when the dinghy returned to the training vessel.

At 1634.26 the Master told Shipping Control that he planned to moor at No 4 Webb Dock and asked for linesmen to attend.

At 1637.38 he repeated his request for linesmen and, after the message had been acknowledged, the Shipping Control Centre asked whether he still had the man in sight. He replied:

"No. He's gone under the wharf with the tide. Appears to be very serious - I'd say fatal just looking at it."

At 1717 the Master confirmed that Searoad Mersey was all fast at No 4 Webb Dock.

At about 1747, the Ship's Manager from ASP Ship Management, arrived at Webb Dock and coordinated communications between the ship, the company, State and harbour officials

and the next of kin. Police, ambulance and a surveyor from the Australian Maritime Safety Authority attended the ship. The Second Mate was recovered from the water and a registered medical practitioner pronounced him dead.

The ship remained in Melbourne until the afternoon of 27 March, when it resumed its passage to Devonport.

The vessel returned to Melbourne on 31 March. The Inspector of Marine Accidents boarded the vessel to interview the Master and certain of the crew, and to examine the unberthing procedure.

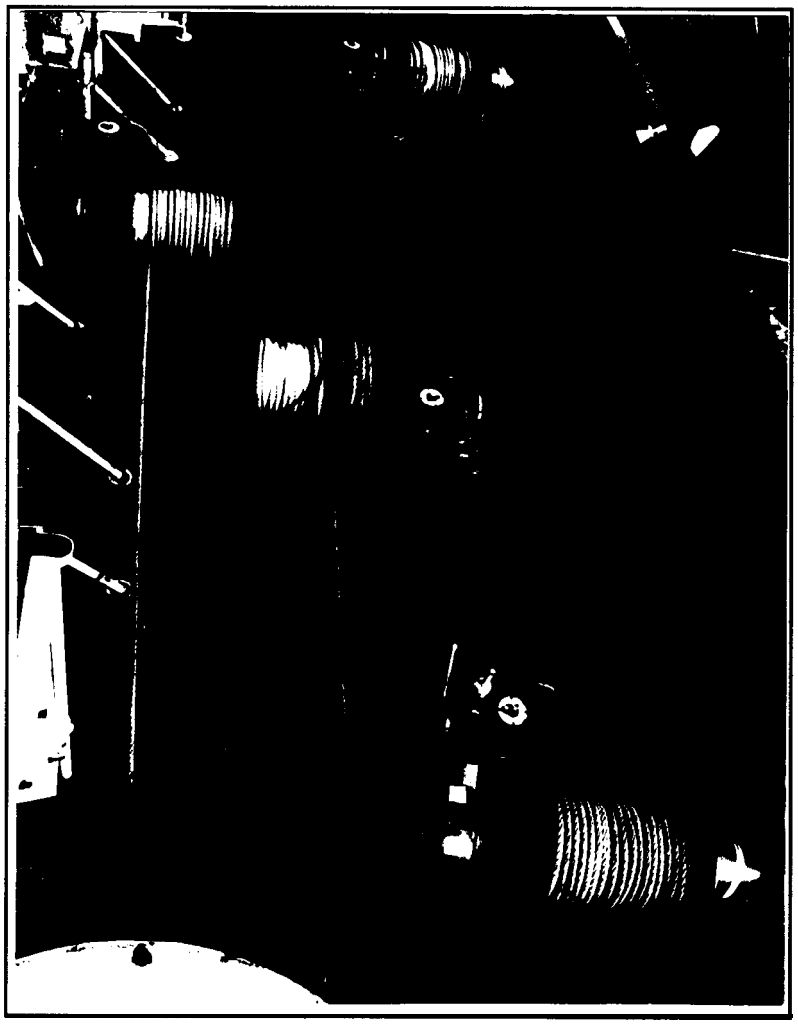
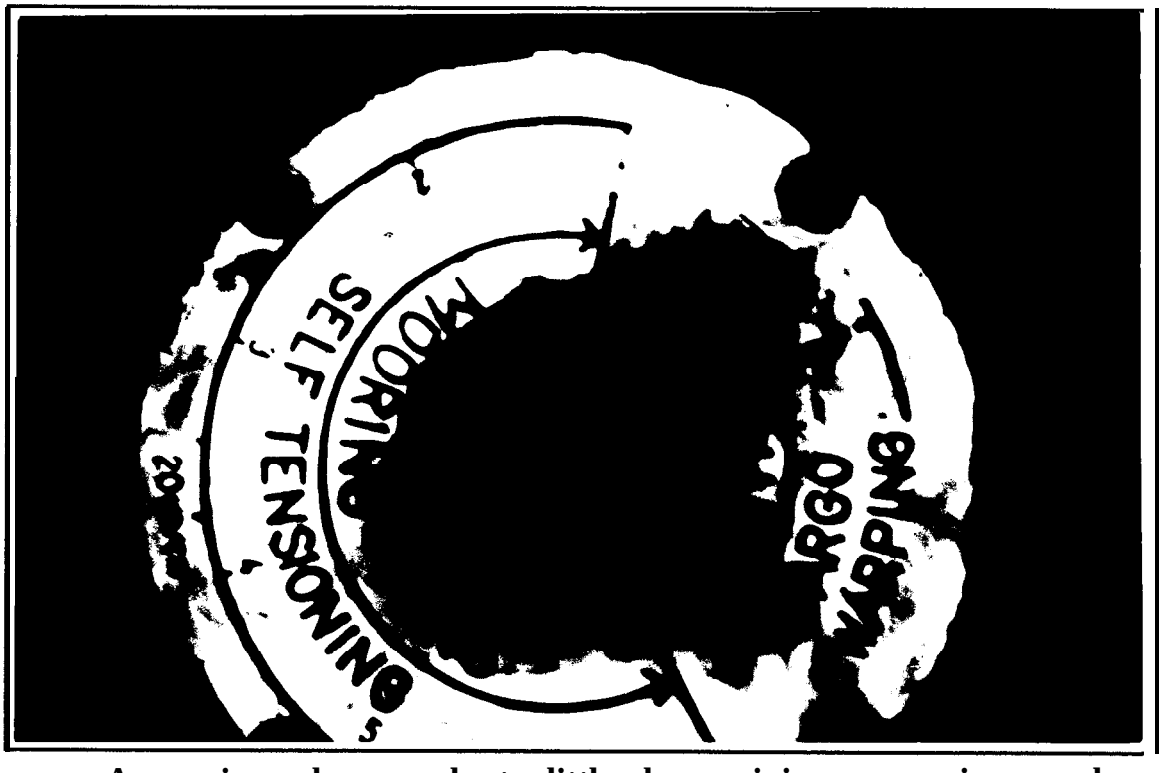


Photo showing general arrangement of platform, note colour coding of winches



A mooring valve- speed set a little above minimum wraping speed

ANALYSIS

The investigation examined relevant aspects of the ship operation which might have affected the performance of the crew undertaking mooring operations, and those elements of the ship management that might have affected the proper maintenance of the ship machinery, particularly the after mooring winches and associated hydraulic system.

Based on the evidence obtained, the ship operated under recognised management procedures with a representative shipboard Management and Safety Committee meeting regularly. The ship's operation was based on an interim operations manual, which appeared to fulfil the requirements of an operating manual The interim manual was in the process of amendment, based on the experience of the first year of operation of the ship, when it was to be issued in a more final form.

The officers, including the Second Mate, were experienced in the operation of the ship and had been involved in the berthing and unberthing of the ship since it entered service.

Although the engineer officers were involved in a significant volume of unscheduled maintenance, they were supported by shore contractors engaged by ASP Ship Management. There is no evidence that the engineer officers failed to meet the maintenance schedule or that any of the ship's machinery was not maintained as required. The Inspector is, therefore, satisfied that the over-all maintenance regime on board the ship was not a factor in the accident.

The mooring winches were used every day of the week for mooring and unmooring and were in constant use, in the automatic mode, when berthed. Faults were repaired by the ship's staff or shore contractors as reported.

The inspector is satisfied that there were no other factors, outside the actual mooring equipment and operation, that could be considered significant elements in the accident.

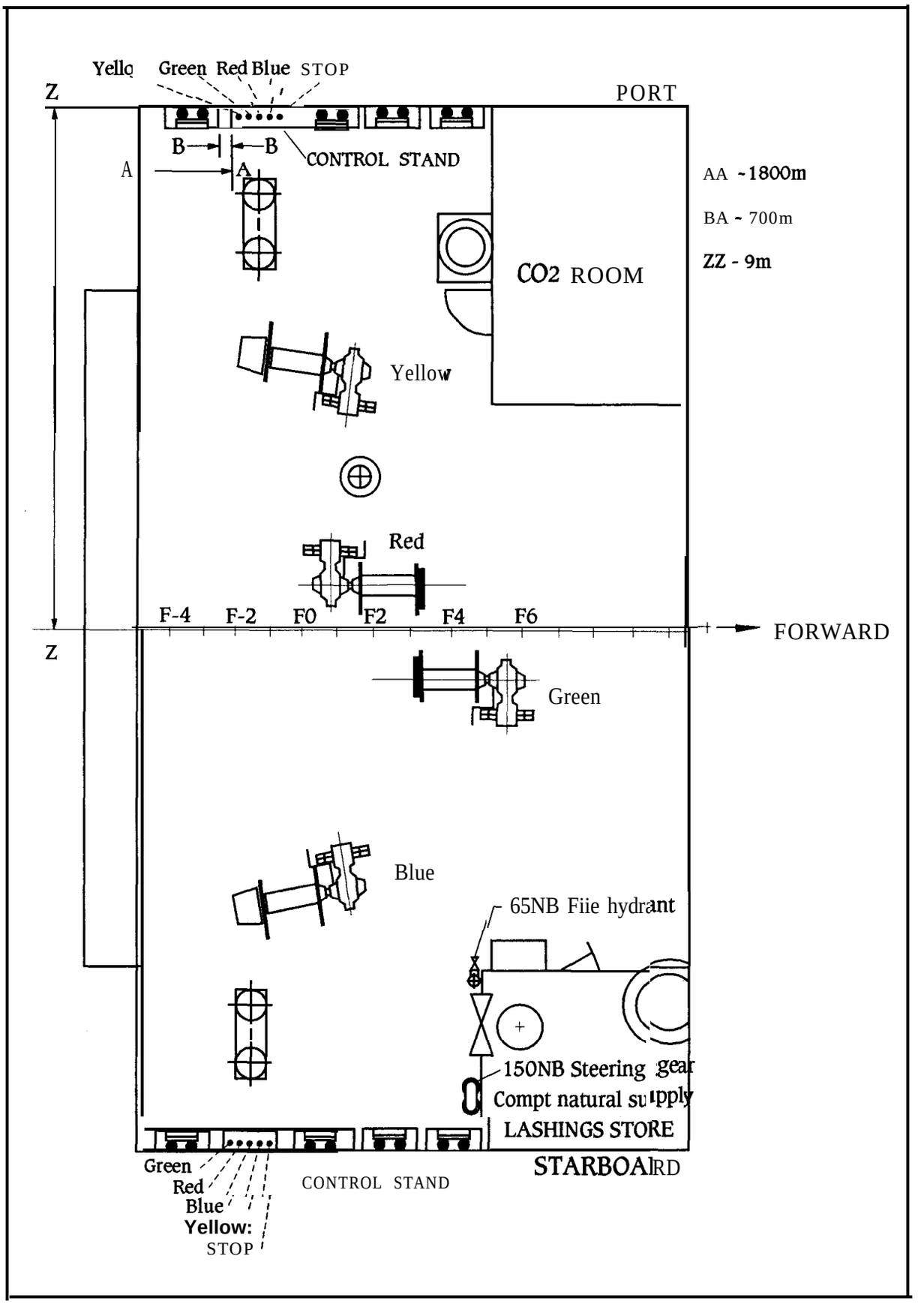
The mooring platform and operation of the mooring equipment.

The owners submission regarding the mooring and unmooring operations states:

> *"The mooring equipment is designed for efficient safe mooring operations with available crew. All ropes consist of Atlas ropes on drums. Automatic self tensioning devices are provided on all winches."*

The after mooring platform is a space on the upper deck at the stern of the ship, aft of the port and starboard casings, about 6.2m (five frame spaces either side of the rudder post), by 18m breadth. On 26 March, the weather was fine and the decks were dry and free from grease or oil. The Second Mate was wearing appropriate clothes and footwear. The after mooring platform, therefore, provided safe footing for those unberthing the ship.

A bulwark (a solid vertical guard fence) of 1000mm in height protects the crew at the ship side. Four sets of



Mooring Arrangement
Diagram of after mooring platform as at 26 March 1991

fairleads are set in to both the port and starboard side bulwarks, each with an upper and lower horizontal roller and two vertical rollers, to allow the ropes to be led in any direction.

The platform is equipped with four hydraulic self-tensioning winches manufactured by Hydraulik Bratvaag, Norway, with a break holding capacity of 30 tonnes.

Each winch, colour coded for control purposes, is fitted with a 44mm diameter polyamide mooring rope attached to the winch drum. In the free end of each mooring rope, a 2m "eye" is spliced to facilitate mooring, the splice length being OSm. The total weight of each rope is approximately 276kg, or 1.254kg per metre, making the weight of the eye and splice about 6kg.

Each winch is driven by a separate triplex motor, operated through a servo-slide control mechanism on each winch. The servo mechanism acts as an amplifier to assist the operation of the controls, and diverts oil to the appropriate number of pump chambers to obtain the required power on the winch. The motors are supplied from a common hydraulic oil reservoir in the starboard side funnel casing. The hydraulic oil return line is common to all four winches and incorporates a full flow filter. This filter comprises a 0.44mm mesh supported by a stainless-steel perforated cylinder, inside which is positioned a strong magnetic bar for picking up the finer ferrous particles.

Each winch operates in automatic mode as a self tensioning winch to maintain a steady weight on the mooring ropes so as to keep the ship in position in a berth without having to be tended due to the rise and fall of tide, increase in wind strength, and with the constant movement of units on and off the ship. This means that the winch motors are constantly operating in automatic mode when the ship is moored.

With the winches under constant use in port, the hydraulic motors and system in general generate heat. Temperatures of between 52.4 degrees Centigrade and 55.6 degrees Centigrade were recorded after 48 hours of continuous running. These temperatures are not considered significant in terms of the accident and are within the normal working temperatures for the machinery.

Specifications provided to ASP Ship Management by the manufacturers claim that each mooring winch has:

A brake holding load of 30 tonnes

6.6 tonnes pull at 0 - 15m/min

3.3 tonnes pull at 0 - 23m/min

Slack rope at 0 - 55m/min.

This specifies that the slack rope recovery rate is a maximum of 55m/min.

The winch torque is controlled by a "mooring" valve which is operated by a hand wheel or disk. Marked on the disk are a series of numbers, one to six, and a section marked cargo warping. The disk is moved as appropriate, relative to a fmed pointer

at the centre.(Photo page 25) The graduation one to six is selected when the winches are in automatic tensioning mode and relate to the load on the winch before it automatically slacks the line to prevent over tensioning. When off load, the lower the figure set against the pointer, the slower the winch drum turned. When set to cargo warping the disk engaged a switch that allowed for fast retrieval of the rope up to a maximum speed of 55rpm. This effectively sets the maximum speed at which the winch will recover the rope when not under tension.

The speed of recovery of the mooring rope depends on the speed of rotation of the winch drum and the drum diameter. Searoad Mersey was fitted with winches and 325mm diameter drums by lm in length. To recover the complete 220m of mooring line at least six layers of rope are wound on to the drum. With each turn of the empty winch drum, 1.02m of the 44mm diameter rope would be recovered. As each layer formed, the effective diameter of the drum would be increased by 88mm. By the time five layers of rope had been recovered the drum diameter had increased to 0.677mm and 2.13m was recovered with each revolution, or more than twice the speed of recovery for the first layer of rope. From photographs the number of turns each layer appears to vary from 18 to 22. The 220m of mooring rope would take at least six layers to stow on the drum, and given the imperfect formation of layers, there can be as many as eight to 10 layers. The rate of recovery of the rope given the constant speed of 55rev/min would increase to more than 130m/min (over 2m per second) at the sixth layer.

At certain ports and under certain weather conditions, the ship cannot unberth safely unless the ends of the mooring ropes are hoisted clear of the water very rapidly, so as not to risk fouling either the bow-thruster forward or the main engine propellers aft

To drive the winches from the ship side controls, the operator may stand directly behind the panel in use, or on either side of it. (Photo page 25)

On 26 March, the forward of the four winches between frames 3 and 6 in a fore and aft plane, just to the starboard side of the centre line, was designated the “green” winch. It was arranged so that its mooring rope was led through the forward roller fairlead in way of frame 4 when the ship was moored either port or starboard side to a berth. On the 26 March 1992, the ship side control lever for the “green” winch was positioned third from forward in the control box.

The “red” winch was between frame 0 and frame 3 in a fore and aft plane, marginally to the port side of the centre line. Its mooring rope was led through the fairlead between frame spaces 2 and 3 for either port side or starboard side berthing. The shipside control lever was second from forward in the port side control box.

The “yellow” winch was between frames -2 to +2 about 4.5m off the centre line on the port side. It was slightly angled to the fore and aft line so that when mooring port side to a berth its mooring rope was led through the port fairlead in way of frame 1 and when moored starboard side to the berth the rope was led through the aftermost fairlead in way of frame -3. The port side control lever was placed at the after end of all the control levers.

The "blue" winch was between frames -2 to +2, about 4.5m to starboard of the centre line. It was also angled to the fore and ah line to lead its mooring rope through the fairlead in way of frame 1 when moored starboard side to a berth and through the aftermost fairlead when berthed port side to a berth. The port side control lever for the "blue" winch was the forward most of the levers in the control box.

On 26 March, the Rating was operating the "blue" winch control (for the stem rope) from the forward end of the control box and the Second Mate the "yellow" winch (for the spring) from the after end, adjacent to the stern rope fairlead. The Rating was concerned with the speed at which the blue rope was being recovered and the Second Mate was looking forward watching the yellow rope. Neither were concentrating on the rope or fairlead immediately next to him.

The arrangement of the levers at the port side control panel did not equate with the arrangement of the winches and, most importantly, the way the ropes were led across the deck and through the fairleads. In the event, the arrangements of the levers increased the risk to the operators, and particularly to the person operating the "yellow" winch.

The fatality

The practice on board Searoad Mersey was for an officer and one rating to tend to each end of the ship during unberthing operations. The Second Mate, who had been a regular member of the ship's company, and the Rating, who had first joined the ship on 18 March, had only sailed together for two days.

The Rating was the only eye witness to the incident. He described how he had set the "mooring valves" at a position considered safe by the officer on the other swing, who had left the ship on 24 March, and with whom he had moored the ship before the Second Mate rejoined the ship. This setting was about at about the 6 tonne mark, just before warping speed was engaged.

From the evidence available, it is apparent that when the Second Mate arrived on the after mooring platform (after the rating) he reset the speed control on the blue winch, and possibly the other winches, to maximum speed. This action was apparently consistent with his normal practice and his reported nature of getting things done quickly and efficiently.

During the unberthing operation, the Second Mate stood at the ships side at the after end of the remote-control panel immediately adjacent to the stern rope fairlead. As the "blue" (stern) mooring rope and "yellow" rope were released, the Rating stood at the forward end of the control panel, adjacent to the fairlead in way of frame 1.

The mooring platform was about 9m above the quay level at Webb dock.

The Rating described how, as the two final moorings were being recovered, the end of the stern rope to the "blue" winch, which was under his control,"whipped" as the eye came close to the fairlead. He stated that he released the spring loaded control lever, but the winch did not stop, or even slow down.

When the stern rope was released the vessel drifted clear of the quay, due to the effect of the northerly wind. The stern rope fell from the side of the quay,

but due to the rate of recovery it did not fall in the water; instead it swung clear of the water and in a pendulum motion.

During an inspection of the ship on 31 March 1992, this operation was simulated while the ship was alongside Webb dock. The eye of the mooring rope was released from a position between 8 and 10m astern of the after fairlead. The stern rope was recovered with the "blue" winch running at maximum speed. The length of the rope from the end of the eye to the fairlead was approximately 12 to 14m long. When released the rope swung as a pendulum in an arc, which rapidly shortened in radius as it was recovered, decreasing the period of the swing. The rope completed one single cycle in less than four seconds, at which stage the energy stored in the remaining 3 to 4m of rope caused it to rotate rapidly and with great energy in an anti-clockwise motion as the rope continued to be recovered. The simulation was repeated at least nine times and on each occasion, the eye of the rope was recovered to the fairlead in four to five seconds.

The increasing energy in the rope pendulum is generated by the speed of retrieval of the rope. This can be explained in terms of basic physical properties. Although there are other physical factors involved, in simple terms, when the rope is released at the dock-side, the potential energy of the rope is converted to kinetic energy, causing the rope to act as a pendulum. Simultaneously, the length of the pendulum is shortened, increasing the speed of the pendulum's swing which in turn increases the kinetic energy of the rope by a function of the square of the increasing speed of the pendulum. By the time that only the last 3m of mooring rope are left outside the fair lead, the energy in the remaining rope length has increased considerably, causing the rope end to rotate violently.

Simulation of the rope retrieval demonstrated that if the winch were stopped the rope would continue to rotate. However, it is apparent that the force of the rope dissipated rapidly.

The simulation demonstrated that, with the mooring winches operating at maximum speed, under certain, quite common circumstances, the last few metres of a mooring rope will rotate rapidly and with great energy, with a resulting risk to any person leaning over the ship's side within the scope of the rope end.

The Second Mate, 198cm tall, was leaning over the bulwark 100cm in height, looking away from the danger. The eye of the rope acted as a guillotine, which would have made heavy contact with anything or anybody proud of the ship's side in the immediate area of the fairlead. It caught the Second Mate around the head and shoulders, pulling him overboard, against the ship's side and into the water.

The basic issue is, therefore, related to the speed of the retrevial of the mooring ropes, particularly the stern rope, which can be released in such a way as to initiate the pendulum action, and to the response of the winch to the remote-controls.

In addition to the mooring platform and the operation of the mooring winches two other major factors are relevant:

1 The human factors present during the unmooring operation.

2 The apparent failure of the "blue" winch to stop when the shipside control was released.

Human factors

There was a suggestion that some members of the crew had seen the rope rotate, as simulated, under certain conditions on other occasions. This was not reported to either the ship's safety or management committee and it seems that nobody understood the potential danger.

A full appreciation of the time frame of events is necessary, to understand the rapidity with which the accident developed. From the time the rope cleared the wharf to the time it struck the Second Mate, only about four seconds elapsed.

The Second Mate was the officer responsible to the Master for the recovery of the after moorings. The Rating was under the Second Mate's direction.

The Second Mate had the option of setting the mooring controls to give the retrieval rate he required. Discussions with certain crew members suggest that the Second Mate always placed this control at maximum speed.

The Rating realised that the rope was being retrived at a very fast rate and checked that the rope was stowing on the drum correctly. He only realised that the danger existed when he saw the rope above the Second Mate, at which time he released the control lever. In the opinion of the Inspector, given that the rope was being retrieved at a rate estimated to be between 2m and 2.5m per second, the Rating could have done nothing at that time to prevent the rope striking the Second Mate. Even if it had occured to him to press the emergency stop button, the rope would still have struck the Second Mate.

The Rating stated that the winch maintained maximum drum speed after he had released the control lever. Other statements suggest that the controls were not instantaneous and were slow to respond. It is, therefore, probable that the winch did slow, but not signihcantly until after the rope had struck the Second Mate and the eye had passed through the fairlead.

Notwithstanding the maximum speed set on the mooring valve by the Second Mate, the shipside controls are designed to allow full proportional control over the speed of the winch drum.

Proportional control of the winch drum is achieved by holding the control lever at the maximum angle until the winch reaches the speed required, when the control lever is then moved to a position midway between the maximum angle and the stop position, which then maintains the speed of recovery.

However, crew members stated that they had understood that the shipside controls worked on a stop/go principle and that the speed of recovery could only be set at the winch itself. None of the ratings seem to have been correctly instructed in the use of the shipside controls.

Instructions for the operation of the winches and the shipside controls were contained in the provisional ship operations manual. The instructions were fairly basic and the arrangement of the shipside control was shown with a simple explanation.

It is not possible to say what the outcome may have been if the winch had stopped as soon as the shipside remote-control was released. From simulations it seems probable that the rope would have struck the Second Mate a very heavy blow, the weight of rope's eye being about 6kg and the force applied unknown. Whether the rope would have stopped in time to prevent the Second Mate being pulled over the ship side is problematic.

If, however, the Rating had fully understood the operation of the shipside valves, he would have been in a position to control the speed of the rope. The first days of his limited experience in unmooring operations, on board Searoad Mersey, had been under the officer who had left the ship at Devonport on 24 March. It was this officer's practice to set a slower, safer recovery speed, where the ability to control the speed of recovery would not have been as critical. There does not seem to be any evidence that at the time of the accident the Rating considered that the speed of the winch might have been dangerous, only that the rope was being retrieved very rapidly.

There is an issue as to whether the mooring operation was safe with one officer and one rating, where the attention of the officer in charge of the operation can be diverted from the over-all operation.

It would be difficult to substantiate with any certainty, the view that the accident would have been avoided if an extra crew member had been employed at the after mooring platform, rather than securing the vehicles. Other factors such as the speed of the rope recovery, the predisposition of the people involved, the position of the control handles, and the operation of the control levers must be taken into account.

The winch

During the course of the Inspector's investigation, the minutes of both the Management Committee and the Safety Committee were examined and no reference was found to deficiencies or concerns with the mooring winches before 26 March 1992. Since that date, a meeting on 29 March discussed the accident and the procedures, and on 4 April the minutes note that "a broad overview regarding the recent accident was made and a general discussion followed".

The hydraulic winches are subject to a routine inspection under a "Planned Maintenance" regime. The "Detailed Equipment History Report" from 27 March 1991 to 27 March 1992 indicates that the mooring winches were checked, at least each month, as a matter of routine. Each winch was subject to a general greasing and checked for hydraulic leaks, the proper operation of the control station, the condition of the brakes, and the securing devices; the electrical cable and electrical junction boxes had also been examined. The winches were scheduled for a major maintenance each year; the forward hydraulic winches had undergone this major

annual overhaul a few days before the accident, and the after winches were due to be overhauled before the end of March.

The Chief Engineer stated that a certain amount of work had been undertaken to eliminate moisture from the electrical control boxes on the hydraulic winch system. An inspection of the electrical control mechanism and the subsequent operation of the winches showed no electrical fault.

According to statements volunteered by crew members and former crew members, the winches were slow to respond when the shipside controls were released. This can be explained by the inertia the servo-slide had to overcome to return to the stop position. Within limits, some delay had to be expected.

From statements by crew members, it seems that when faults in the mooring winches were reported to the ship's officers they were followed up by the engineers on board. One specific problem reported earlier in the year, related to the shipside controls - where the control lever is connected to an internal cam mechanism (and so to the electrical circuit) by means of an extruded aluminium pin. The extruded aluminium pin connecting the "blue" lever was found to be distorted, so that the cam would not follow the control lever. This problem was rectified by the Third Engineer.

None of the reported defects appear to have caused any significant concern.

The Rating, on duty at the after mooring platform 26 March, stated that the "blue" winch continued to rotate at full speed after he had released the ship side control. Neither he, nor the Mate when he arrived from the bridge, operated the shipside control lever, or returned the control handle at the winch, to the stop position. When the Provisional Eating arrived on the after mooring platform, a matter of moments after the Mate, the "blue" winch was rotating slowly. The local manual control lever at the winch was nearly at the stop position and when he moved it to stop, the drum ceased to rotate. This indicates that the blue winch did slow, but did not completely stop.

On 27 March, the Mate demonstrated the operation of the winch to the Police. On that occasion he noticed that the local manual control lever on the winch was not following the shipside controls and was sticking before the manual lever reached the stop position, allowing the drum to rotate slowly.

On 26 March, there seems to have been neither a malfunction of the mechanical control direct to the servo motor at the "blue" winch itself, nor evidence of an electrical fault. The extruded aluminium pin connecting the "blue" lever to the electric signal system was intact. There was no part of the electrical system which could account for the winch failing to stop.

The continued rotation of the "blue" winch would suggest that a fault lay in the hydraulic system, probably in the servo-slide valve.

A report by an engineer sent from Norway by the manufacturers, Hydraulik Brattvaag, noted that when the "blue" winch was operated on board on 7 April:

"The control lever did not return to the stop position after Hoist. The control cylinder was removed and the manoeuvre handle would go back to Stop after Hoist."

According to the Norwegian engineer's report:

"We checked the filter at 7A on the return line and there was a lot of hard particles in the basket plus on the magnetic, It was mainly steel coming from the pipework plus as already mentioned welded particles. The filters had not been opened since they had been painted."

According to records held on board Searoad Mersey, the hydraulic oil had been subject to periodic testing by the Mobil Oil Australia Laboratory, Melbourne. Samples had been taken in July and August 1991 and again on 30 March 1992, when a sample was taken from each of three points in the system. According to the analysis sheet, the oil had not degraded and remained within the recommended quality parameters for this particular hydraulic system. It is of note that the viscosity of the oil sample in column 1 was 88cSt, compared with a norm of 96cSt.

The ship's managers stated that the mesh filter, which is on the common return line from all four winches, had about a tablespoon full of particles, and the magnetic filter had a similar amount of debris attached to it.

An oil analysis of "black sludge" from the filters by Mobil Oil Australia Ltd, Melbourne Laboratory, found it to be mainly metallic and magnetic in nature. "The large amount of metal was seen to range in size from fine metallic shavings to chunks of metal ranging up to 10mm".

The ship's managers provided documented procedures to Singmarine Engineering and Dockyard and the owner's engineer (standing by the vessel during building), which stipulated how the hydraulic system should be flushed through to ensure clean lines of the system. There is no evidence that this was not completed as required.

There is some difference of opinion as to whether the amount of metallic waste recovered from the filters was consistent with debris from a new system after one year of service. If the flushing of the lines was carried out as stated, it does seem, given the particle size and quantity of the particles in the strainer, that some sections of the piping were not properly prepared and treated before fitting.

The other winches seem to have functioned properly when operated from the remote controls.

Also, given that the vessel had been in service for almost 12 months and that the filter is common to all four winches, it seems unlikely that any defect in the "blue" winch on 26 March could be attributed to the condition of the filters, hydraulic oil, or debris in the form of metallic particles in the hydraulic system.

The engineer's report continued:

"The piston, where the stuffing box mantle rings sits, shows wearing and also signs of being out alignment."

COMMENT

The ship's operators, Master and crew took immediate steps to address the hazard posed by the retrieval of the after moorings.

All mooring ropes have been marked about 10m from the end, to act as a warning, and operational procedures to govern the speed of the winches were put in place immediately after the accident. Large danger notices have been placed on the bulwark and in the ship side remote-control boxes. The position of the levers within the control boxes have been altered to reflect the relative positions of the winches.

The possibility of moving the shipside remote-control boxes was considered, but in view of the space available, the need for good visibility, the requirement to accurately judge distances between the ship and the quay, and the noise generated in the area of the alternative positions, the control boxes were left in their positions at the ship side.

The Victorian Coroner recommended that:

> *"Consideration be given to the design and installation of an appropriate form of protective structure for the operators, given the obvious danger of rope whipping, recoil on breaking, during berthing and unberthing procedure."*

CONCLUSION

The Inspector concludes:

1 The Second Mate was effectively lassoed by the eye of the mooring rope and thrown over and against the side of the ship.

2 The accident was caused by the setting of the winches to maximum speed.

3 Other factors relating to the accident involve the unmooring operation and include:

(a) the position of the remote-controls at the shipside bulwark

(b) the position of the winch control switches within the remote-control box,relative to the ropes they controlled

(c) the failure of ship board staff to realise that the shipside controls allowed the speed of recovery to be controlled

(d) the failure of the ship's crew to report the potential danger when it was known that the mooring ropes were prone to whip.

4 The shipboard staff were not properly instructed in the operation of the shipside control valves, specifically the proportional speed control.

5 Given the rapidity with which the accident happened, the Inspector is unable to conclude that:

(a) the Integrated Rating assisting the Second Mate had time to operate the emergency stop

(b) the misalignment of the blue winch contributed towards the accident.

6 No responsibility can be attributed to the Integrated Rating on duty on the after mooring platform.

ATTACHMENT

Particulars of ship

Name	Searoad Mersey
Flag	Australian
Lloyd's Number	8914831
Call Sign	VJBA
Owners	ANL Limited
Managers	ASP Ship Management
Classification	Det norske Veritas
Type	Roll-on/roll-off cargo
Builder	Singmarine (Pte) Ltd
Length	91.5m
Breadth	18.52m
Depth	13.6m
Summer draught	5.712m
Gross tonnage	5925
Net tonnage	1778
Summer Deadweight	3287tonnes
Capacity	120 twenty foot equivalent units
Engine	2, Wartsila 8R32E, eight cylinder diesel
Engine power	5576kW
Propeller	2 controllable pitch
Crew	15