Departmental investigation into an injury aboard the tug WAMBIRI at Fremantle WA on 13 April 1997

Report No. 114

Australia
Department of Workplace Relations and Small Business

Contents

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Navigation (Marine Casualty) Regulations

investigation into an injury aboard the tug

WAMBIRI

at Fremantle WA on 13 April 1997

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Summary

On the morning of 13 April 1997, the tug *Wambiri* was assisting in the departure of the Singaporean flag vehicle carrier *Salome* from berth No. 2 North Quay, in the port of Fremantle. *Wambiri* was made fast aft and was using its own, forward towline, the eye of which was placed over a bollard on *Salome's* poop. After *Salome* had been manoeuvred clear of the berth, *Wambiri* was instructed to accompany the vessel on a slack line until the Pilot was satisfied he had steerage way.

When the order was given to let go the tug, before *Salome's* crew could lift the eye off the bollard, weight quickly came on the towrope, the Tugmaster misinterpreting the signal to slack away as heave away. The towrope parted in the eye and, recoiling, struck one of the tug's integrated ratings, who suffered severe internal and external injuries.

Sources of Information

Tugmaster and crew, tug *Wambiri*

Pilot and Second Mate, *Salome*

UNIRIG (Aust) Pty Ltd

Fremantle Tug Operators

Howard Smith Towage & Salvage Ltd (Melbourne)

Acknowledgements

The AMSA Marine Manager and a Marine Surveyor (Engineer), Western Australia, were appointed to conduct the field investigation, while the AMSA Senior Marine Surveyor, Victoria, assisted in the investigation when *Salome* docked in Melbourne.

Portion of chart Aus 113 reproduced by permission of the Hydrographic Officer, RAN.

Narrative

The tug Wambiri

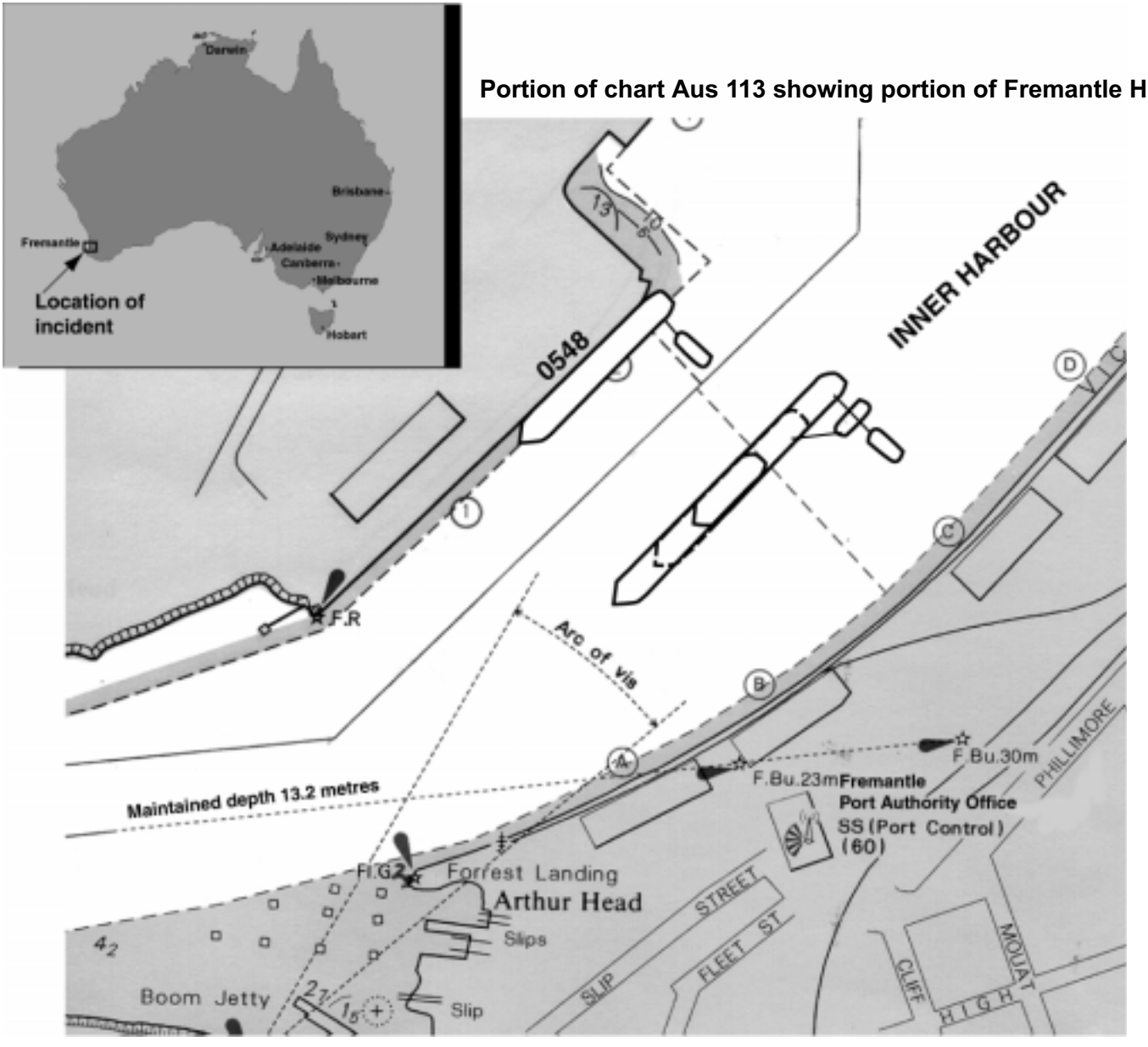
The tug *Wambiri* has a gross tonnage of 477 and was built as a harbour tug, with an ocean-going salvage tug capability, by the then Australian Shipbuilding Industry (ASI) in 1986. Equipped with two Niigata Z-pellers, driven by two 1760 kW Daihatsu diesel engines, the tug has a bollard pull of 61 tonnes.

Z-pellers, so called because of the configuration of the drive shaft, are capable of directing the thrust through a full 360º. Main engine speeds are controlled by two throttle levers, while directional, or steering control is by means of a uni-lever, the electronic control system adjusting the direction of thrust of the two Z-pellers to move the tug in the direction that the uni-lever is moved. With the uni-lever in the vertical, or neutral position, the thrust of the two Z-pellers is at right angles to the vessel's centre line, on each side, thus holding the vessel stationary.

Jointly owned by Adsteam Marine Limited and Howard Smith Industries, and operated by an Adsteam subsidiary company, Fremantle Tug Operators, *Wambiri* is mainly engaged in port operations, but is also operationally ready to carry out salvage work at short notice. For normal berthing and unberthing operations, the forward winch and towrope are used, enabling the tug to quickly change between pulling and pushing modes. However, the forward winch is not fitted with auto-spooling equipment, necessitating one of the crew members guiding the towrope onto the drum when it is being recovered.

The towrope is a Marlow 'Superline'* 72 mm diameter, 12x3 strand, circular, braided polyester rope, having a minimum breaking strength of 123 tonnes. To this is attached a sacrificial tail, made from a 24 m length of Marlow 'Superline' 52 mm diameter, 12x3 strand, circular, braided polyester rope, having a breaking strength of 65 tonnes. This tail is formed into a loop, providing a minimum breaking strength of 110 tonnes, and seized so as to form two, short soft eyes, one for attaching to the main towrope, the other for passing over bitts or bollards. To assist ships' crews in handling the towrope, there is a 20 m messenger rope attached to the end of the sacrificial tail.

Portion of chart Aus 113 showing portion of Fremantle Harbour



The tug is manned on a shift basis, each shift crew comprised of a tugmaster, a chief engineer and two integrated ratings. Each crew works a 12-hour shift on a schedule, starting on a Friday, of a week on dayshift (0700 – 1900), a week on nightshift (1900 – 0700) and a week off. The schedule provides a 24-hour break at the change from the day to the night shift and the third week of nightshift is followed by three weeks off.

Under the Fremantle Tug Operators' company operational procedures and guidelines the dayshift crews attend on board from 0700 to 1500 Monday to Friday, and are then on stand-by at home for the remaining four hours of shift and for the full shift on Saturdays and Sundays. The crews on nightshift remain at home on stand-by, turning-out for work as necessary.

Two tugs are on call, although both may not always be used. To distribute the workload, a system is operated such that on any one day, one tug will attend all towage jobs, while the other attends only the two tug jobs. The system rotates on a daily basis.

The incident

Following normal operational procedures, on Saturday 12 April 1997, the crew evening shift change took place aboard *Wambiri* at 1900. The first job for the night shift was at 1940, and was to assist in the departure of the container ship OOCL Assurance from No. 4 berth, North Quay. This was immediately followed by the berthing of the container ship Contship Action at the same berth, which was completed at 2115.

The crew then stood by until required to assist with the berthing of the car carrier *Salome* at No. 2 berth North Quay, between 2330 and 0155.

At 0530, the Tugmaster received a call for *Wambiri* to assist with the departure of *Salome* and the tug moved back to No. 2 berth, where the Pilot gave instructions to make the tug fast on the port quarter of the vessel. The tug's forward towrope was passed to *Salome*, where the ship's crew took the tail through a Panama lead at the lower mooring station and placed the eye over the bollard. Dawn was approaching, nautical twilight occurring at 0543.

When discussing the departure procedures with the Master of *Salome*, the Pilot had informed him that after letting go, he would manoeuvre the vessel into mid-channel, using the thruster forward and the tug pulling aft. After gaining mid-channel, he would retain the tug until such time as he was satisfied that he had steerage and full control of the vessel. However, the Master did not relay this information to the 2nd Mate.

Salome's mooring lines were let go at 0548 and, using the working VHF channel 06, the Pilot instructed *Wambiri* to lift off, but because a problem was experienced with Salome's bridge wing bow thruster control, this was amended to "pull minimum". Full control of the bow thruster was restored, using the control in the wheelhouse, and *Salome* was manoeuvred to a position in mid channel, slightly eastwards of the berth. The Pilot instructed *Wambiri* to stop pulling and to accompany *Salome* on a slack line and, at 0554, the Pilot gave the order for Salome's engine to be put to slow ahead. *Wambiri* dropped astern and took up station slightly on the port quarter.

The 2nd Mate, at stations aft on *Salome*, saw the tug's line become slack and took this to mean the tug wanted to let go, so he called the bridge and asked if he could, in fact, let go the tug. The Master relayed this query to the Pilot, who was taken somewhat by surprise, as the order to let go the tug normally originated from him, but he agreed that the tug could be let go.

The Master confirmed to the 2nd Mate that he could let go the tug and the Pilot contacted *Wambiri* and informed the Tugmaster that the tug was to be let go.

The 2nd Mate instructed the crew to let go the tug and the crew moved toward the bollard to carry out the order. However, there was too much weight on the line for the crew to be able to lift the eye of the towline off the bollard, so the 2nd Mate signalled to the tug, waving his arm downwards, to slacken off the line. However, more weight started to come on the line and the 2nd Mate ordered the crew to move clear.

Receiving the order to let go from the Pilot, the Tugmaster, using the deck hailer system, passed the information to his two ratings, who were standing in the shelter of the port side of the deckhouse. The two ratings moved forward, one to the winch controls and the other to forward of the winch, to guide the towline on to the drum. The Tugmaster then saw the crew of *Salome* signalling to him, which he interpreted to mean "heave away". He therefore pulled the uni-lever control back, to bring *Wambiri* to a stop, so as to

Forward towing winch

Failed grommet

Photograph of bollard, piece of grommet and messenger

prevent the tug from running over its own towrope. The towrope, however, instead of pulling clear of Salome's Panama lead, as he expected, became taut and parted.

The rating at the winch controls had seen the weight coming on the towrope and had moved back to safety, at the port side of the deckhouse, calling to the other rating to move clear as he did so. The other rating had turned and started to follow, but was caught by the recoiling towrope, lifted off his feet and thrown to the deck, his right arm almost severed from his body.

Informed by the Chief Engineer that the rating appeared to be badly hurt, the Tugmaster immediately contacted the signal station on VHF channel 12, at the approximate time of 0555. He informed them about what had happened and requested that an ambulance be arranged to rendezvous with *Wambiri* at "A" berth, Victoria Quay. While the Chief Engineer and the other rating attended to the injured crewman, the Tugmaster took the tug to "A" berth, where the ambulance arrived at 0613.

As soon as the towrope parted, the 2nd Mate reported the fact to the bridge, and that a crewman had been injured. The Pilot's initial understanding was that it was one of the *Salome* crew members that had been injured, however, confirmation came from the poop that the tug was clear and that it was one of the tug crew that was injured. As *Salome* was still only moving very slowly, the Pilot ordered full ahead, at 0556, in order to improve control.

The Pilot called *Wambiri* on VHF channel 06, but received no reply, however the pilot aboard another vessel informed him that *Wambiri* was well clear, over towards Victoria Quay. The Pilot then changed to VHF channel 12, heard *Wambiri* talking to the signal station, so concentrated on taking *Salome* to sea.

The ambulance took the injured rating to Fremantle hospital, where the medical staff ascertained that, in addition to the injuries to his arm, he had also suffered broken ribs and extensive injuries to internal organs.

Comment and Analysis

Failure of the towrope

The sacrificial tails of towropes are normally used for between 1000 and 1500 operations, unless physical damage dictates earlier disposal. The tail that parted on *Salome* had been used for just over 200 operations and had shown no indications of damage during routine inspections prior to the incident.

The broken tail, which had been cut into two pieces by the crew of *Wambiri*, was examined and tested by Universal Testing Services (Australia) Pty Ltd (UTS), at Henderson, Western Australia. The tail was found to be in a malleable state with no visual signs of localised stiffening and, apart from the ends at the break, there was no significant damage to the body of the rope. The rope was considered to be in good condition and UTS concluded that the tail had apparently been subjected to some form of occurrence during its operational use which had impacted on is performance.

The longer length of the tail was tested to destruction by UTS and failed under a load of 35.53 tonnes, 59% of the certified minimum breaking strength. However, the test was considered inconclusive as the length of rope available for testing (3.5 m between the formed end splices, needed to set it up on the test rig) was less than half the standard length used for test purposes.

The tail had parted where it passed around the bollard and a short length of the protective sheath, with the messenger attached to it, remained by the bollard. The 6.5 cm circumference messenger was attached to the tail by means of a soft eye splice, the eye being passed around the rope of the tail twice, so that there were four parts fitting firmly around the tail. Because it fitted firmly, the messenger could not be moved easily around the eye of the tail and so would be left trapped between the eye and the bollard. The possibilty was explored that it might create an irregularity in the strain within the eye, as it was in that area that the towrope failed. However, expert opinion provided to the Unit is that whereas this might be the case with cable, or multiplate “square” laid ropes, it was not so with Marlow ‘Superline’ ropes.

At the time of the incident, *Salome* was accelerating under slow ahead, from a virtual standing start and was considered to be moving at between two and two and a half knots, with *Wambiri* instructed to maintain station on a slack line. Although the times of the 2nd Mate asking if he could let go the tug, the order to let go and the line parting are not recorded, it is apparent that the time frame was quite short, within one minute, and that the weight came on the towrope quite rapidly. It is therefore considered that a shock loading was placed upon the towrope by the Tugmaster bringing *Wambiri* to a stop before the towrope was let go.

Information provided to the investigating officers variously described the Tugmaster's actions as, starting to bring the tug to a stop and, commencing going astern from the ship. In his submission, the Tugmaster stated that he put the uni-lever to the neutral position. With the uni-lever in this position, the nozzles are directed at 90°, directly outboard, to the tug's fore and aft line and the thrusts, so directed, have a braking effect. At a speed of about two knots the tug would have been brought up within its own length, sufficient to provide considerable shock loading on the towrope.

The Tugmaster also submitted that stationed right astern of *Salome*, *Wambiri* was subjected to the propeller wash of *Salome*, and that this was the cause of *Wambiri* coming to a quick stop. Whereas such an effect would occur if the tug was stationed right astern, the towrope was passed through a lead about 20 m forward of Salome's transom stern, therefore, *Wambiri* was more likely to have been slightly on the port quarter and clear of the effects of propeller wash.

Human Physiology

The body's natural circadian rhythms are attuned to night time sleeping and daytime wakefulness, with the lowest level of alertness between 0500 and 0600. Although the body is able to adapt to shift work routines, it takes time for it to adjust to different sleep times, with poor quality of sleep immediately after the change, but improving with successive days. The second shift following a change to night shift has the lowest levels of alertness, again the lowest levels of alertness being between 0500 and 0600*.

At the time of the incident, the *Wambiri* crew was coming towards the end of a 12-hour shift, which was the second one on nightshift. From the physiological aspect, the *Salome* departure operation took place at the

worst possible time for the state of alertness of the *Wambiri* crew.

Fatigue

The Tugmaster had returned to rostered duty, after a period of 14 days of leave, on Friday 4 April, when he commenced one week on day shift, with work extending beyond 1730 on the first day only. After the week on day shift he had a period of 26½ hours off duty before reporting for the first job on night shift at 2130 on Friday 11 April. That night he carried out two towage jobs, finishing at 0355. On the Saturday night the first job commenced at 1900, and the job assisting in the departure of *Salome* from its berth on the Sunday morning was the fourth job for the shift that night.

As the Tugmaster had recently returned from a period of leave and as his workload had not been onerous since his return, it is unlikely that he would have been suffering from chronic fatigue. However, as a result of probable poor quality sleep following the shift change, he may have had a slight sleep debt and suffering to a certain degree, therefore, from acute fatigue.

Consideration of the Tugmaster's actions

The Tugmaster was well experienced, having spent 25 years handling offshore industry vessels and harbour tugs. He had been employed by Fremantle Tug Operators for three years.

Sunrise that morning was at 0636, with nautical twilight at 0543 and civil twilight at 0611, therefore, at 0555 it would have been about half light. However, the Tugmaster stated that he could see the towline and the crew on the poop of *Salome* quite clearly.

It is not clear just how slack the towrope became; normally it would be kept clear of the water, but one source indicated that it was in the water. If this was indeed the case, then it would explain why the Tugmaster thought the towrope had already been let go and why he acted to stop *Wambiri* before the towrope was seen to be clear of *Salome's* Panama lead. However, it would also indicate that he had either been distracted, or was no longer alert and had allowed *Wambiri* to accelerate at a faster rate than *Salome* when moving off from a virtual standing start to accompany the ship on a slack line.

There are no internationally prescribed signals for handling mooring ropes and towropes, such as there are for conveying signals to crane and derrick winch drivers. However, the generally accepted signal to indicate “slack away”, when dealing with mooring ropes and towropes, is the repeated waving of the arm in a downwards movement from the outstretched horizontal or raised position, with the palm facing downwards. The generally accepted signal to heave away is the waving of the forearm and hand in a circular motion. For the Tugmaster to have confused the former signal with the latter also indicates a low level of alertness.

That the Tugmaster acted to stop the tug and expected the towrope to pull clear from *Salome* was not good, safe practice. As this action was contrary to the normal practice of waiting until such time as the eye of the sacrificial grommet has passed outboard through the vessel’s lead, it indicates an impaired level of judgement.

The injured rating

The injured rating was 58 years of age and had only started employment with Fremantle Tug Operators nine days before the incident occurred. However, he had first gone to sea at the age of 18 and had served in the off-shore industry since 1971, so he had considerable experience of handling ropes and wires. Reports from the tug’s operators indicated that, even in the short space of time he had been in their employ, he had adapted to harbour tug work very well.

While *Salome* was being pulled from the berth, he had stood well clear of the danger area and had only ventured onto the forecastle when informed by the Tugmaster that the vessel was letting go. He had gone to the very exposed position, forward of the winch, in order to guide the towrope on to the drum, at a time when the towrope was slack. To guide the towrope onto the winch drum, he would have to stand with his back to *Salome* and so would not be aware that weight was coming onto the towrope. Although he was warned by a shout from the other rating, due to the rapidity with which the weight came on the towrope, he did not have time to move clear before the towrope parted.

Procedures on board *Salome*

When the Pilot boarded *Salome*, he discussed with the Master his plans for departure, which included the retention of the tug until he was satisfied that *Salome* had sufficient steerage way. However, the Master did not pass this information to the 2nd Mate, who, being unaware of the plan, mistook the slackening towrope to mean the tug wanted to let go.

In his submission, the Pilot commented that he had never heard a Master specifically tell deck officers that a tug would be retained until a certain point. However, for Bridge Resource Management principles to be effective, not only on the bridge but in all areas aboard a ship, all persons need to be informed of the intended plan of operation.

Conclusions

These conclusions identify the factors contributing to the incident and should not be taken as apportioning either blame or liability.

The towrope, which injured the rating aboard the tug *Wambiri*, parted at the bollard aboard *Salome*, after the Tugmaster quickly took the way off the tug before it had been let go.

The following factors are considered to have contributed to the incident:

- Low level of alertness, and possible acute fatigue, of the Tugmaster, caused by the recent shift change.
- The misinterpretation of the signals made by the crew on the poop of *Salome*.
- The act of placing the uni-lever in the neutral position, to slow the tug down, expecting the towrope to pull clear, before the eye was seen to be clear of the Panama lead on the vessel, which resulted in:
- The rapid stopping of *Wambiri* before the towrope had been removed from the bollard on *Salome* and a consequent shock loading of the towrope.
- Possible unidentifiable damage to the eye of the towrope, sustained on some earlier occasion, which resulted in the towrope being less resilient to shock loading.

Also of relevance is the lack of Bridge Resource Management procedures and communication aboard *Salome*, in that:

- The 2nd Mate was unaware of the Pilot's intended retention of the tug and misinterpreted the slack line to mean the tug wanted to let go.

Submissions

Under sub-regulation 16(3) of the Navigation (Marine Casualty) Regulations, if a report, or part of a report, relates to a person's affairs to a material extent, the Inspector must, if it is reasonable to do so, give that person a copy of the report or the relevant part of the report. Sub-regulation 16(4) provides that such a person may provide written comments or information relating to the report.

The final draft of the report was sent to the following:

The Tugmaster and integrated ratings, *Wambiri*

The Pilot and 2nd Mate, *Salome*

Fremantle Tug Operators

Written submissions were received from the Tugmaster, Adsteam Marine, on behalf of Fremantle Tug Operators and the Pilot. The text of the report was amended as appropriate, to reflect the additional information provided.

The Pilot's submission included, in part:

"I can also understand the Tug Master's desire to clear the vessel … He also knew that shortly after the vessel commenced moving ahead that a starboard turn of some 40° would be initiated which would throw the stern towards the tug."

The Tug Master's submission included, in part:

"I as the tug's Master was not informed of the Pilot's intention (to retain the tug until he had steerage). If I had been, I would have made fast to the centre lead aft, not on the quarter.

"…if the Pilot had informed me of all his intentions, this incident would have been most unlikely to have happened."

Details of Wambiri

IMO No.	8515518
Flag	Australian
Classification Society	Lloyd’s Register of Shipping
Ship type	Tug
Joint Owners	Adsteam Marine Limited and Howard Smith Industries
Manager	Fremantle Tug Operators
Year of build	1986
Builder	Australian Shipbuilding Industries (WA) Pty Ltd, Fremantle
Gross tonnage	477
Net tonnage	141
Length overall	34.8 m
Beam	11.43 m
Draught	4.923 m
Engine	2 x 8 cylinder Daihatsu Diesels
Engine power	2 x 1760 kW
Bollard pull	61 tonnes
Crew	4 Australian