ATSB
Australian Transport Safety Bureau

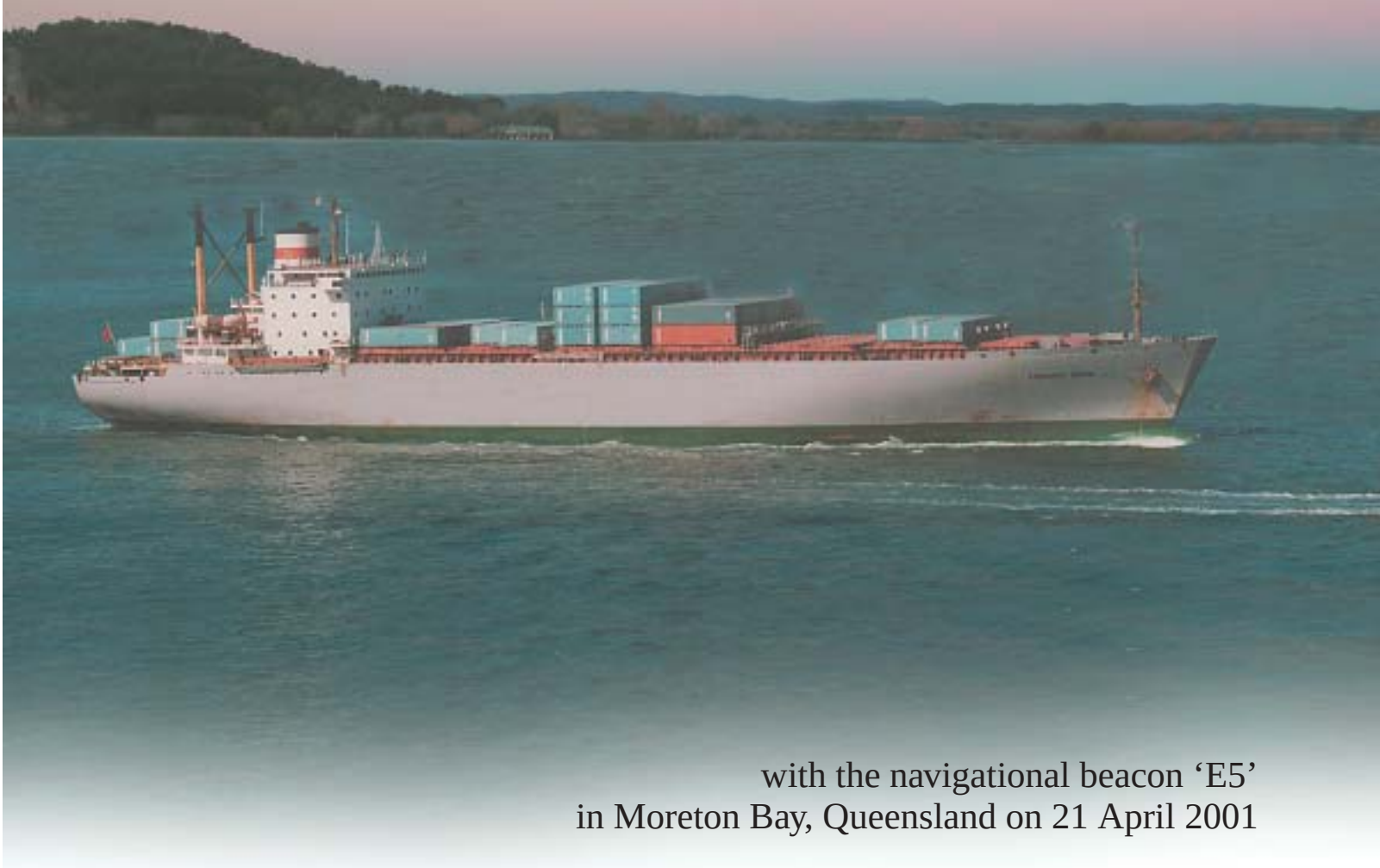
AUSTRALIAN TRANSPORT SAFETY BUREAU

MARINE SAFETY INVESTIGATION

REPORT 168

Independent investigation into the contact by
the Russian flag container ship

Maksim Mikhaylov



with the navigational beacon ‘E5’
in Moreton Bay, Queensland on 21 April 2001

COMMONWEALTH DEPARTMENT OF TRANSPORT AND REGIONAL SERVICES

Department of Transport and Regional Services
Australian Transport Safety Bureau

Navigation Act 1912
Navigation (Marine Casualty) Regulations
investigation into the contact by the Russian flag container ship *Maksim Mikhaylov* with the navigational beacon 'E5' in Moreton Bay on 21 April 2001

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Marine Incident Unit
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Civic Square 2608 ACT

Phone: 02 6274 6478
1800 621372
Fax: 02 6274 6699
Email: marine@atsb.gov.au
Internet address: www.atsb.gov.au

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FIGURE 1:
Maksim Mikhaylov

Summary

At about 2330 on 20 April 2001, a licensed pilot boarded the Russian flag container ship *Maksim Mikhaylov* in the port of Brisbane. The pilot exchanged the necessary pilotage information with the master. He then set up his electronic charting system (ECS) and differential global positioning system (DGPS) display on a bridge front window sill to the port side of the centre line in the wheelhouse. The vessel sailed from Fisherman Islands container berth at 0015 on 21 April.

The vessel cleared the berth without incident. The pilot noticed at this stage that, as the tugs took minimum weight on their lines, the vessel heeled 3° or 4° indicating that the ship had reduced residual stability, that is the ship appeared to be 'tender'. Once established in the Bar Cutting, the pilot requested that the ship's speed should be increased to full sea speed for the outward passage via East Channel. At about this time, the second mate took over as officer of the watch and a new helmsman took over the steering. The master remained on the bridge, mostly on the starboard bridge wing. The night was fine and clear with excellent visibility, there was little wind and a calm sea. The tide was on the last of the ebb.

Clear of the Bar Cutting, the pilot ordered an alteration of course to 060° true. Ahead, the beacons marking East Channel could clearly be seen. The pilot alternated between the radar and his ECS display. The second mate fixed the ship's position at five minute intervals and the master remained on the starboard bridge wing. The helmsman steered a straight course and demonstrated that he understood helm orders.

At about 0114, the pilot ordered five degrees of port rudder to enter the East Channel. The ship's swing started to accelerate and the rudder was ordered to amidships. *Maksim Mikhaylov* contacted Beacon E5 at about 0115:30.

Other than superficial paint damage *Maksim Mikhaylov* sustained no damage, but the beacon suffered substantial damage. The pilot reported the incident at 0125.

The ship continued on passage, anchoring off Point Cartwright where the master and pilot provided a statement to an official of Queensland Transport and a preliminary assessment of any damage to the ship was made.

Sources of Information

The master and crew of *Maksim Mikhaylov*.

The pilot and Brisbane Marine Pilots Pty Ltd

Queensland Transport.

Acknowledgment

The Inspector is grateful to Interdynamics Pty Ltd (www.interdynamics.com) for the computer program, FAID 330E, which was used during the analysis of the fatigue factors.

Narrative

Maksim Mikhaylov

Maksim Mikhaylov is a Russian flag container vessel. The ship was built in 1979. It is 198.9 m in length, has a beam of 25.4 m and a moulded depth of 17.45 m, with seven cellular holds which, together with on-deck stowage, gives a capacity of 1254 TEU (twenty-foot equivalent units). The ship is powered by a 12 799 kW Sulzer engine giving a service speed of 20 knots.

The bridge is 149.9 m from the bow. It is equipped with a range of navigational aids including three radars, one of Russian manufacture and two Decca ARPA radars (10 and 3 cm). There are also two GPS receivers, one Navtrax and one Shipmate model. The ship has only one gyro repeater in the wheelhouse (other than those in the radars), which is in the steering stand. It has a single, deckhead mounted, centreline rudder angle repeater which has three displays within it. One display faces the helmsman and the other two face the port and starboard sides. All this equipment was operating normally.

In addition to the master, the ship's crew consisted of 22 Russian nationals. All the watchkeeping officers were appropriately qualified.

The master was a man of considerable experience having commanded container ships and a passenger cruise ship, including voyages on the Australian coast. He estimated that he would have made as many as eighty voyages to Brisbane.

Brisbane Marine Pilots

Brisbane Marine Pilots Pty Ltd is the pilot service provider company for the Port of Brisbane. This company's pilots operate on a cycle of sixteen days with ten days on duty followed by six days off.

To minimise the risk of pilots being affected by fatigue, Brisbane Marine Pilots operate a risk monitoring system based on a fatigue index program developed by the Centre for Sleep Research, University of South Australia. This document is supplemented by 'Pilot Job Allocation' guidelines, which are used by the pilot operations coordinators when assigning pilots to ships. These guidelines suggest a minimum period of eight hours between ships (one hour each way for travel plus a six hour break).

The number of pilots on duty rosters is based on normal traffic patterns, supported by a fatigue management policy. Pilots' duty hours are assessed including the hours involved in travel to or from duty and the hours of pilotage. These duty hours are entered into a fatigue computer program which returns a 'fatigue index score' for each pilot at any time. The pilotage company has set an index score of 80 as a warning to itself. Should pilots get above this score they are considered to be entering a risk zone for fatigue.

As a part of their normal shipboard operating procedures, pilots carry a portable electronic charting system (ECS) on a laptop computer, which also contains a differential global positioning system receiver. When pilots were first issued with these units, a number of routes were already entered into the program. This pilot had changed these to reflect the routes he normally used, others left them unchanged and used the routes in the program as only a rough check against the ship's actual track. The ship's real time position is plotted automatically every ten seconds, together with the course made good and the ship's speed, all of which is stored in a memory file.

The pilot

The pilot assigned to *Maksim Mikhaylov* on the 20 April 2001 joined Brisbane Marine Pilots in June 1999, gaining his initial licence on

5 August 1999. He holds a valid certificate as Master Class 1. He has had extensive experience at sea as well as in the Brisbane River as a tug master since 1991 and in passages through Moreton Bay to Point Cartwright.

Earlier on 20 April 2001, before joining *Maksim Mikhaylov* to conduct the ship to sea, he had undertaken an inward pilotage passage leaving home at 0620 but not actually boarding the ship until 1027 for the inward passage. The pilotage itself then took about four and a half hours, before he returned home at 1615 that day. On arrival at home he called the pilot operations centre and was told that he was to pilot the outbound *Maksim Mikhaylov*, sailing at 2300 from Fisherman Islands. He rested for an hour before a meal. He went to bed some time between 1930 and 2000. At about 2030 the pilot's wife took a phone call from the pilot company informing her that the sailing had been delayed until midnight. Unaware of this message, the pilot got up as scheduled at 2130 to be told of the delayed sailing. He went back to bed almost immediately and slept until 2230. At 2300 he left home and boarded *Maksim Mikhaylov* at 2330.

The incident

Maksim Mikhaylov arrived at berth number 6, Fisherman Islands on the morning of 20 April 2001, with a scheduled sailing time of 2300 that evening. The ship worked containers throughout the day. Sailing was postponed by one hour to midnight on 20 April.

At 2330 the pilot arrived on board *Maksim Mikhaylov*. He then briefed the master on the unberthing manoeuvre and the passage from the berth to the pilot ground off Point Cartwright. The plan, with the ship at a draught of 8.2 m forward and 8.5 m aft, was to depart via the East Channel. Predicted high water at Brisbane Bar was at 1952 at a height of 1.98 m and low water was predicted at 0158 at a height of 0.56 m above datum.

On board *Maksim Mikhaylov*, after the information exchange with the master, the pilot rigged the DGPS aerial and set up his laptop, with its electronic charting system on the port side of the wheelhouse, about 8 m from the centre line. He entered the position of the aerial relative to the bow, stern and sides of the ship. His preferred outward passage plan had already been set on the electronic chart.

The master provided him with a pilot card providing some details of the ship's manoeuvring characteristics. This included information that it took 60 minutes to increase from manoeuvring full ahead to full sea speed of 16 knots. The deck was stacked predominantly with one tier only of containers and forward vision was not impaired.

At 0010 the ship commenced letting go its mooring lines. The tugs lifted *Maksim Mikhaylov* clear of the berth under the pilot's direction and the ship started its outward passage. The pilot noticed at this time that, as the tugs took minimum weight on their lines, the vessel heeled 3° or 4° indicating that the ship had reduced residual stability, that is, it was considered to be 'tender'. He commented on this to the attending tugs. The master, the mate and the radio officer were on the bridge together with a seaman at the wheel. As the ship transited the Inner Bar Cutting, the pilot asked for full sea speed. At about this time the second mate relieved the mate and the helmsman was relieved by another seaman.

The ship cleared the entrance beacon at 0044, steering 032°(T). Five minutes later, at 0049, the pilot ordered an alteration of course to 060°(T) towards the entrance to the East Channel. There was no gyro compass repeater visible to the pilot and the helmsman called the heading every five degrees to the heading of 060°(T) during this alteration.

The tide was in the last stage of the ebb. The weather was fine with good visibility and there was a calm to slight sea.

The second mate fixed the ship's positions at five-minute intervals using the radar and ship's

GPS. Soon after clearing the Entrance Beacons, the second mate offered the pilot use of the coffee making facilities, which the pilot accepted. He was also offered the pilot chair to sit in, which the pilot declined. The second mate stated that when offering the pilot a cup of coffee and the pilot chair to sit in, the pilot had indicated that he was tired and declined the use of the chair. The pilot had no recall of such a conversation and stated that it was his practice never to sit while conducting a pilotage. No other person heard this alleged conversation.

The helmsman saw the pilot and second mate in occasional conversation but was not aware of what they were talking about. The pilot, for the most part, remained at the port side of the wheelhouse close to his ECS display and the port radar. The master remained mostly on the starboard bridge wing, but occasionally entered the wheelhouse briefly.

At interview the pilot stated that he could not see the rudder indicator until he had moved from his position to about 5 m to port of the centre line. This rudder angle indicator was of a type that is mounted on the deckhead. It is of circular construction showing the rudder angle on the port and starboard sides of the wheelhouse and also to a person, such as the helmsman, standing on or near the centre line.

As the second mate was plotting the ship's position at 0115, the pilot ordered 5° port rudder to bring the ship into the East Channel. From this time the accounts of the following five minutes differ to a material degree.

The pilot's account

The vessel was approaching beacon E5 at this time. The pilot recalled that the beacon was about 3 to 4 points (33-45°) on the port bow and he now gave the order to apply 5° port rudder. As the vessel turned, the helmsman called the heading at five-degree intervals, as he had done when altering course previously off the Entrance Beacons. At a heading of 050°(T) the pilot was concerned that the ship was turning too rapidly and ordered the rudder amidships, an order that was repeated by the helmsman. When the helmsman confirmed that the wheel was amidships the pilot ordered 10° of starboard rudder to check the ship's rate of turn. This order was also repeated by the helmsman.

However, the rate of turn did not slow and, if anything, increased. The pilot moved towards the helmsman's position and ordered 20° starboard helm. As he moved towards the centre line the pilot saw that the rudder indicator was indicating 20° of port rudder. He immediately told the helmsman that the rudder was the wrong way and to go hard to starboard.

At this point the master came rapidly towards the centre of the wheelhouse from the bridge wing saying he was unhappy about the rate of turn to port. The pilot told the master that the helmsman had put the wheel the wrong way and that the rudder should be put hard to starboard. At this point the master spoke in Russian to the helmsman. The rudder was put hard to starboard and, with beacon E5 about one ship's length ahead, the turn to port stopped. However, this was not in time to prevent the ship hitting the beacon.

The master went to the port bridge wing and watched the beacon pass down the port side. As the vessel turned back into the channel the pilot ordered the ship to steady on a heading in the vicinity of 020°(T) or 025°(T), before setting course on 015°(T) and continuing the pilotage.

The ship's account

At 0115 the master was on the starboard bridge wing and the second mate and helmsman were inside the wheelhouse. The master stated that his habit was to spend most of his time on the bridge wing and to come to the wheelhouse just before any alteration of course. He was able to monitor both the engine revolutions and the rudder angle from a tachometer and rudder angle indicator mounted above the forward side wheelhouse window, facing outward onto the bridge wing.

The second mate was fixing the ship's position at five-minute intervals, moving from the radar to the ship's GPS display behind the chart console. At 0115 he had just taken the ship's position as 048°(T) x 0.82 miles to beacon E5. He could also clearly see beacon E5.

The helmsman was steering a course of 060°(T). He could clearly see beacons E5 and E4 almost in line, fine to port. He recalled that the pilot ordered 5° of port rudder with beacon E5 still seen over the outboard foremost container, an angle of about 5°. He turned the wheel to apply 5° port rudder and called the heading as it passed 055° and 050°.

The master had not anticipated that the course would be altered at this time and was concerned that the ship was turning too soon and too rapidly. He entered the wheelhouse and, simultaneously with the pilot, ordered starboard rudder. He then went quickly to the chart table to see if it was possible, at their particular draught, to leave beacon E5 to starboard. It was not.

The ship's staff on the bridge stated that the pilot seemed frozen for a few moments and disorientated. The pilot ordered port rudder but this was countermanded by the master. From this time the helmsman disregarded the pilot's helm orders and obeyed only the master's instructions.

The second mate plotted a position at 0118, putting the ship alongside beacon E5.

Contact

Based on the timing taken from the pilot's electronic chart, initial contact was made between beacon E5 and the break of the forecastle at 0115:30 at a speed of 14.5 knots on a heading of 038° (from the course recorder trace). The ECS does not record ship's heading information but it showed a course made good at this time of 000°. The ship cleared the beacon, which passed down the ship's side, clearing the ship some 26 seconds later.

Following the contact with the beacon, *Maksim Mikhaylov* regained the mid-channel and the situation returned to normal. The master ordered the second mate to check for damage inside the hull. Another seaman relieved the helmsman.

At 0125 the pilot notified Brisbane Port Control of the incident, reporting that the ship had collided with the beacon and that the light on the beacon was extinguished. The master reported the incident to his company contacts and the ship's Brisbane agent.

At 0225 the pilot reported that 'all tanks have been sounded and appear to be sound, the vessel will be going to Point Cartwright for further inspection.'

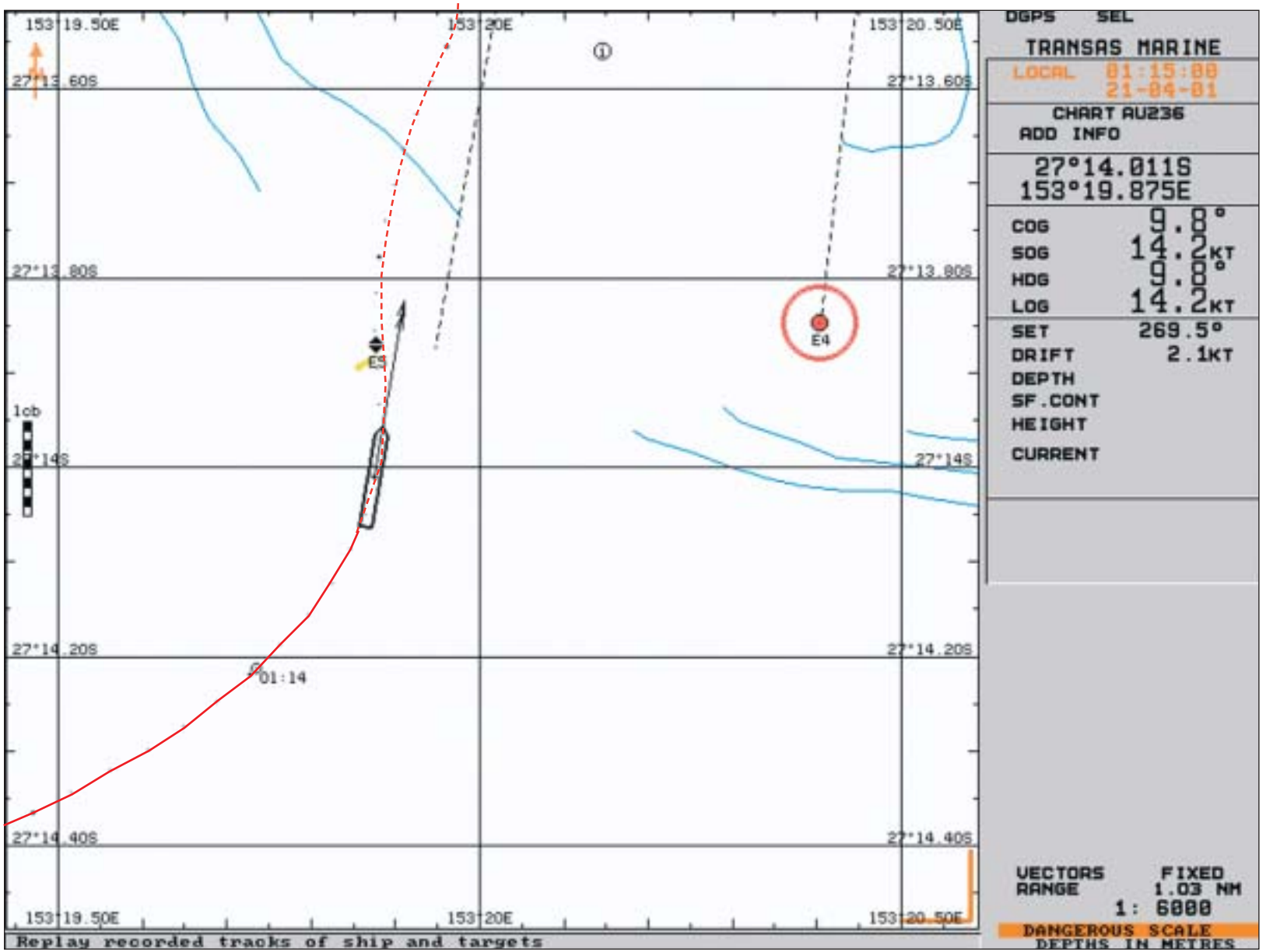
The ship continued on, anchoring off Point Cartwright at 0345. An inspection of the ship showed two areas of contact and hull paint damage on the port side. A 300 mm wide strip extended aft from the ship's name on the bow for about 30 m. A further strip of paint was missing from the hull in way of the superstructure towards the stern. Further checks on the fuel and ballast tanks and void spaces were carried out. Other than the stripped paint no other damage was detected.

E5 beacon had been damaged by the contact. The beacon was at an angle of about 35° from the upright and its light was extinguished.

At 0450 the pilot disembarked from *Maksim Mikhaylov*. At 0550 a director of Brisbane Marine Pilots Pty Ltd boarded the container ship, at the request of the harbour master, to talk to the master and conduct an assessment of the incident. The senior pilot disembarked at about 0735 and the ship resumed its passage for Manila.

FIGURE 2:
Wheelhouse from port side

FIGURE 3:
Replay recorded track of *Maksim Mikhaylov*



Comment and analysis

Evidence

Interviews were conducted with the master, second mate and helmsman on 23 May 2001. Ship's documents including photocopies of the Russian chart of Moreton Bay (Chart 56334, equivalent to Aus 236), the pilot card, procedures and the course recorder trace were provided by the ship and Queensland Transport.

An interview with the pilot was conducted on 7 May 2001. The pilot provided the investigators with a copy of his ECS file for the night of the 20/21 April. This provided an accurate real-time display of the track and course made good by *Maksim Mikhaylov* from the berth to sea. A pilot is unable to alter or access the files recording the ship's track. Another file was also provided which overlaid the pilot's voyage plan on the above records.

The ship's course recorder trace was not synchronised with the bridge clocks. There was a notation on the course recorder chart roll '0000 210401' with a signature marked against the trace just about the time that the trace indicates that the ship's head started to alter. This is not consistent with known times of alteration of course. The course recorder chart is 4 hours 38½ minutes fast of the time shown on the pilot's ECS and it was reading one degree low.

In trying to reconcile the two accounts of the incident from about 0110 onwards, the ship's charted positions and course recorder trace were compared with the pilot's ECS plotter. The corrections between the datum for the chart (AHD66) and the pilot's electronic chart datum (WGS84) were applied.

The ship's charted positions at 0110 and 0115 were about 0.8 of a mile (1482 m) astern of the 0110 and 0115 positions taken from the pilot's ECS plot. At 0115 the ship's charted position was 1518 m from beacon E5. The evidence from the pilot's ECS plot is that the ship started to alter course for East Channel at 0114, 685 m from Beacon E5. To equate this to the ship's time keeping, given a speed of 16.6 knots, the course alteration therefore started about 1 minute 36 seconds after 0115 ship's time. Comparing the positions plotted by the second mate on the ship's paper chart with the equivalent positions from the ECS, including the time of contact with the beacon, the ship's time appears to be in advance of the pilot's time by about 2½ to 3 minutes.

For convenience the ship's times have been adjusted to the time shown on the pilot's ECS.

Charting

After the incident the master took information from the pilot's plot and compared it with the ship's own charted position. The pilot's positions were based on World Geodetic Survey 84 (WGS84) datum (from GPS), while the Russian chart was based on Australian Hydrographic Datum 66 (AHD66). Any direct transfer of positions, without correction, would have shown a position north and east of the ship's actual position relative to the charted position of beacon E5. This variation would have been compounded by the three minute difference in time.

The turn

The electronic chart record shows that the ship was consistently 370 m to the north of the pilot's planned track. This was not due to any set; there was little tidal effect during the passage across Moreton Bay. The pilot stated that he was aware that he was to the north of his proposed charted track but, given the shipping situation (no traffic in the area), the calm weather and clear night, he was not concerned.

He also felt that he didn't need to make any alteration to his plan for the ship's apparent tenderness. Even though this condition was not unusual for a container ship, he was aware that this tenderness would affect the ship's turning characteristics. His intention was to alter course when beacon E5 was about 45° on the bow at a distance of about 4 cables.

The second mate had also drawn a course line on the ship's paper chart, across Moreton Bay. When corrected for chart datum the ship was at all times to the south of the ship's course line. These differences arose because the ship and the pilot were using slightly different waypoints for the turn position at beacon E5.

There is agreement by all parties that the initial helm order was for 5° port rudder. The ship's pilot card shows that to maintain a steady course the ship carried 2° starboard rudder. The net effect of the initial rudder angle was 7° to port. The master also stated that the ship turned at a quicker rate to port than starboard.

Even when dimmed, the rudder angle appeared easy to see on the rudder angle indicator.

The pilot stated that he planned to ease the ship round the beacon and, when the ship started to turn, he was not concerned initially and ordered amidships. The master stated that he had countermanded a pilot's order of 15° port helm. Which version, if either, is correct, cannot be determined with any certainty. There are a number of inconsistencies in the accounts.

Inconsistencies

There is an inconsistency between the two accounts as to the position at which the pilot initiated the alteration of course to enter East Channel.

The alteration of course from the line of the Entrance Channel leading lights was started at 0048 (about 0527 by course recorder). The ship altered its heading through some 29° and settled on a course of 060°(T) at 0051. The ship remained on this course for 23½ minutes, as confirmed by both the course recorder and the pilot's ECS plot. At 0114, with beacon E5 bearing 021.2° on the port bow at 0.37 miles, the ship started to alter course to enter the East Channel. The ship had effectively followed the pilot's planned track even though the ship was offset to the north. The pilot did not initiate the alteration of course with beacon E5 at 5° on the port bow, as recalled by the ship's personnel. The evidence available supports the pilot's account in relation to the initial alteration position.

There is also an inconsistency in the master's description of the turn. The master stated that his practice was to enter the wheelhouse to monitor alterations of course, but on this occasion the pilot altered course prematurely. The master did not anticipate the alteration for another two minutes. The evidence, based on the ship's position from the pilot's electronic chart, is that, had the master waited a further two minutes, *Maksim Mikhaylov* would have been more than midway across East Channel and only 185 m from beacon E4.

The 0115 position (ship's time), as plotted by the second mate, was 0.82 miles (1518 m) from beacon E5. At 16.6 knots the ship would have taken fractionally less than 3 minutes to cover the distance and contact beacon E5. However, the pilot's ECS shows that from the time the ship started to turn to port off beacon E5 until the initial contact, about 75 seconds had elapsed.

In an attempt to reconcile the differing accounts of the ship's staff and the pilot in relation to the rudder orders, the course recorder trace from 0114 to 0120 was enlarged and examined. There is agreement that the initial order was for 5° port rudder.

The course recorder indicates that the ship altered its heading through 60 degrees in 2½ minutes, reaching a heading of 000°(T) at 0116:30. (The course recorder shows a very brief excursion into the 270°–360° quadrant.) The ship's heading then returned to a heading of about 025°(T) at 0118, before steadying on a course of 020° at 0119:30.

The rate of turn was calculated from the slope angle of the recorder trace. The results are approximate, as there is inevitably some pen vibration. There appear to be four distinct components to the curve:

- for the first minute (0114 to 0115) the rate of turn was 21°/min;
- for the next minute (0115 to 0116) the rate of turn increased to 33°/min;
- for the next 30 seconds (0116 to 0116:30) the rate slowed to about 10°/min;
- then returning to a heading of 025°(T) at a rate of 15°/min.

From analysis of the slope of the course recorder trace there is no indication that the ship significantly slowed its rate of change of heading over the first two minutes of the turn into the East Channel. This suggests that there was no early intervention with counter rudder to support the ship's account. However, given the limitations of the course recorder trace, the analysis cannot be taken as positive support for the pilot's account.

What is plain, however, is that bridge management and the checking of both the pilot's orders and the helmsman's response were absent. There was no consistent third party monitoring of the agreed passage plan.

For the pilot, this was exacerbated by the fact that the only gyro repeater in the wheelhouse, other than those on the radar displays, was on the steering column. When the ship was turning, the pilot could not monitor the turn at his preferred conning position. He relied on the helmsman to relay the ship's heading.

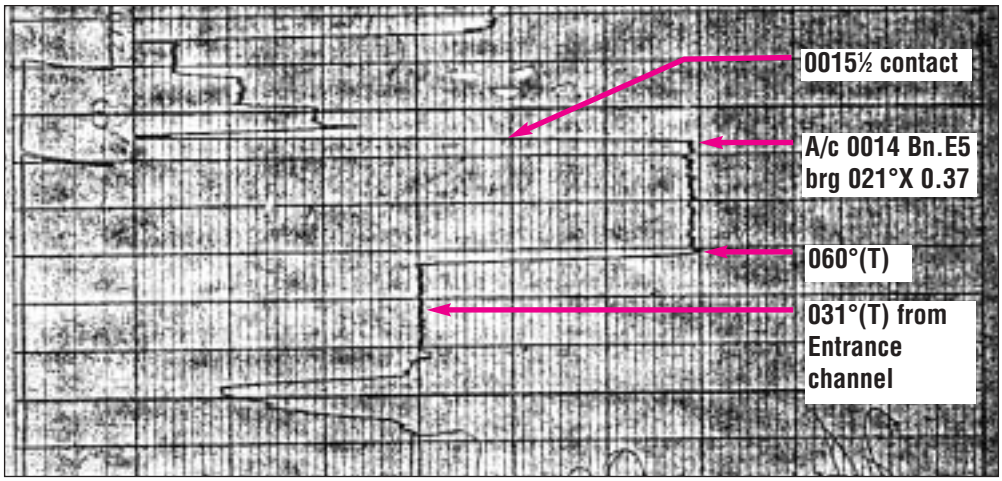
The helmsman was an experienced seaman and highly rated by the master. It was clear at interview that he had no difficulty in understanding helm orders or basic marine English. The pilot reported that he steered well.

Performance and fatigue

The ship did not keep a record of actual hours worked, but only a record of who kept which bridge watch. As a result of this, a full analysis of the fatigue levels for the ship's master and crew was not possible. Given the long hours and the times of working experienced by the master and crew of *Maksim Mikhaylov* from the time of approaching the pilotage early on 20 April, through to the early morning of 21 April, some decrement in performance was almost certainly present in some, if not all, the ship's bridge personnel.

The Port of Brisbane experienced 25 ship movements on 20 April, including 11 inward and 10 outward passages. On 21 April the total was 21 movements, 18 of which were either

FIGURE 4:
Course recorder trace *Maksim Mikhaylov*



inward or outward passages. This necessitated a more intense program of duty for some pilots.

The pilot assigned to *Maksim Mikhaylov* had slept from about 2100 on 19 April to 0500 on the 20 April and left home at 0620 for the pilot station at Mooloolaba. He arrived home at 1615 the same day having piloted an inward bound tanker.

He then rang the office at 1620 and was assigned, for an anticipated period of six hours, to the *Maksim Mikhaylov*, sailing at 2300. For this job he required about 30 minutes travelling time so he would have a maximum rest period of about 6 hours. While the pilot was asleep this period was extended by one hour. The pilot woke briefly in line with his original schedule before sleeping again for less than one hour.

A number of factors point to a possible significant level of fatigue on the part of the pilot, leading to a decrement in performance and hence further examination of the pilot's fatigue status:

- he went to sleep quickly when he went to bed at 2000 on 20 April and having been wakened and got out of bed at 2130, he went straight back to sleep;
- evidence from the second mate indicated that the pilot expressed a degree of tiredness (this was refuted by the pilot);
- the fact that the wheelhouse rudder indicator did not register with the pilot when the turn into East Channel was established at about 0115, or that he could not see it clearly.
- the ship's staff on the bridge stated that the pilot seemed frozen for a few moments and disorientated.
- the pilot allowed the vessel to continue to track to the north of his chosen route even though there was no traffic in the area and this direction would have resulted in the need for a quicker turn or less distance (and time) to steady the heading after arriving at the next course. The pilot was aware that the ship was tender and so he would need to take more care during shiphandling.

To assess the pilot's possible exposure to fatigue the simple test of 'sleep credit/deficit' was applied to the pilot's work hours. The system credits sleep hours with a credit of two points for every hour of sleep and one point debit for every hour awake. The system makes no allowance for physical or mental effort or for circadian rhythms. A negative score only indicates that the work hours warrant greater examination.

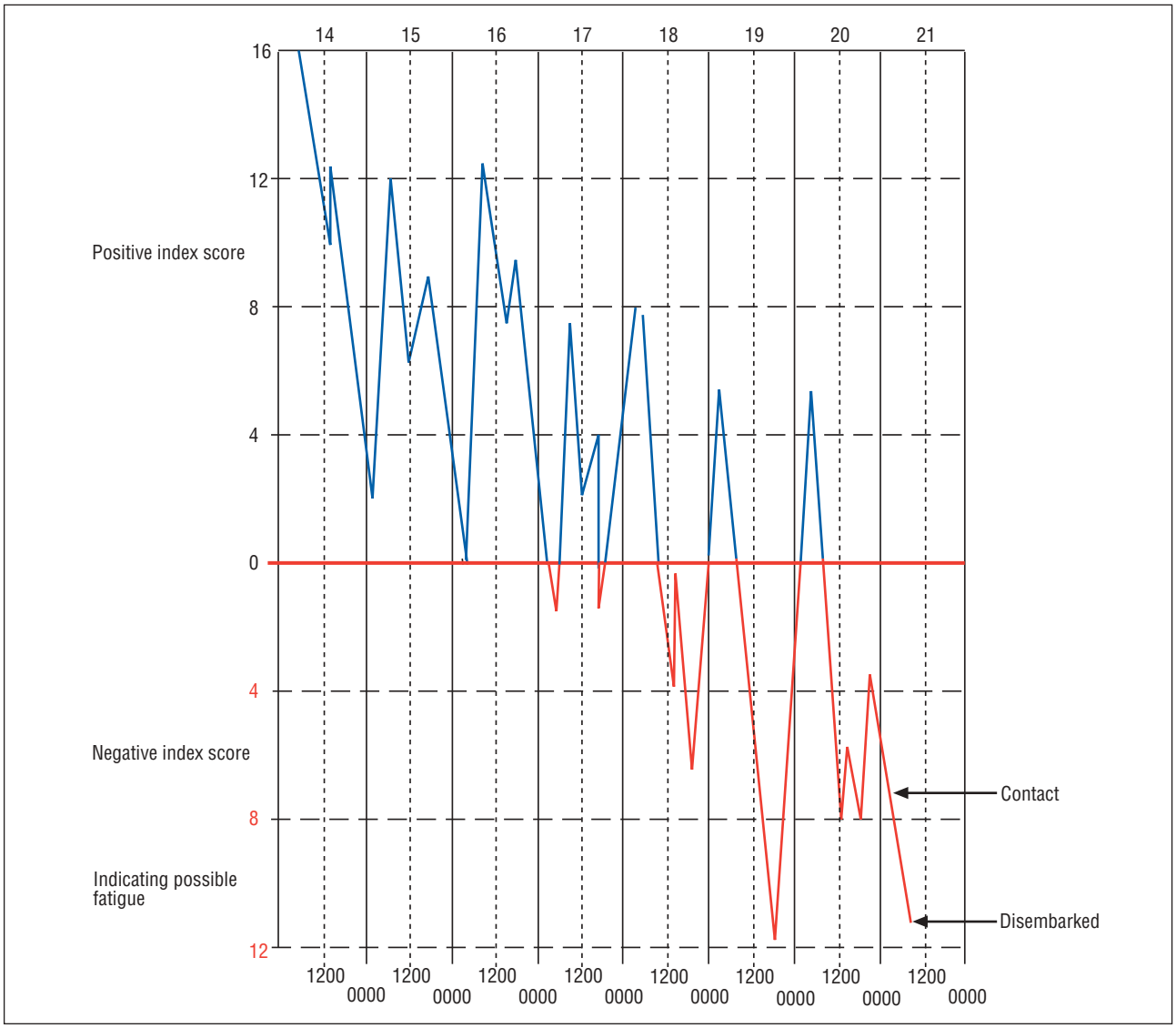
The pilot had returned from a period of leave, starting the ten day roster on 12 April. Examination of the roster hours show that on the morning of 14 April the pilot started the day with a full credit of 16 points.

Except for two minor incursions into the negative, his score remained positive until 18 April, after which the scores were generally negative. At the time of the contact with beacon E5 the pilot's work schedule indicated that he was some 7 points into the negative side of the equation.

To more thoroughly examine the pilot's possible exposure to fatigue, his program from 12 April was analysed using the Interdynamics Pty Ltd, FAID 330E fatigue program. Two scenarios were modelled, one using the total hours awake throughout his duty period, and the second using the most conservative estimate of hours actually involved in travel to and from duty and his periods of actual pilotage. The two sets of figures and graphs provided a 'high' and 'low' fatigue estimate.

The pilot company's computer program generated a fatigue index score of 75 at 0115 on 21 April. This was nearly the same score as generated by the FAID 330E fatigue program, based on the conservative, 'low' duty hour estimates. Using the total hours awake, the

FIGURE 5:
Pilot's work hours showing sleep credit/deficit analysis



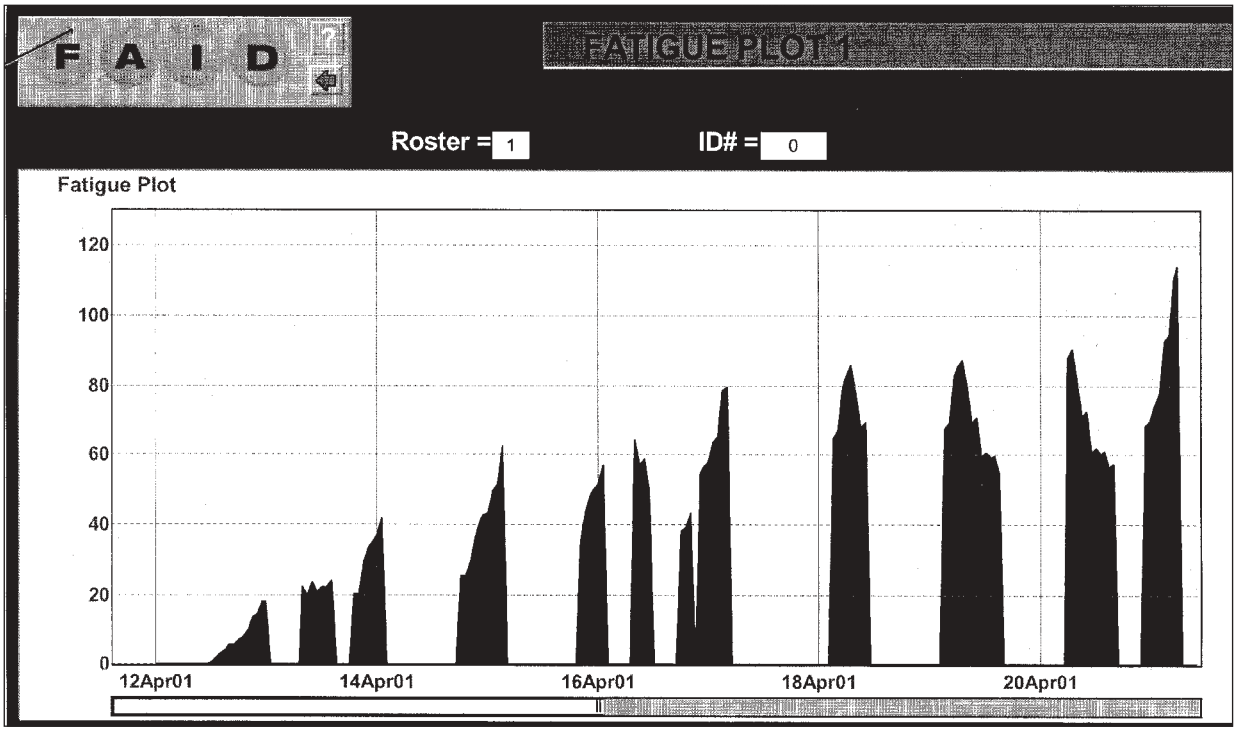
FAID 330E fatigue program gave a fatigue index score of 120 at 0115. This reflects a degree of subjectivity in assessing the input hours.

Fatigue programs are useful tools and demonstrate a responsible and professional approach to safety management. However, in marginal cases they can only be taken as a guide to fatigue factors. Neither the FAID 330E fatigue program, or its earlier version currently used by the Brisbane Pilots, make allowance for mode specific environmental factors, such as noise, motion, vibration and light.

Figure 6 is a copy of the output graph from the FAID 330E program. This shows the index score at any time and indicates the effects of circadian rhythms as well as the biological limits of recovery as time on duty progresses.

While the pilot was operating within the pilot company's guidelines, having analysed the pilot's routine over the preceding days and assessed the pilot's actions leading up to the contact with beacon E5, the Inspector is satisfied that some level of fatigue contributed to the incident.

FIGURE 6:
Output graph from FAID 330E program



Drugs and alcohol

The pilot was not on any medication. There is no evidence that any person involved in this incident was affected by either alcohol, drugs or medication.

Conclusions

These conclusions identify the different factors contributing to the incident and should not be read as apportioning blame or liability to any particular individual or organisation.

1. After the initial turn was established, the turn to port was maintained by mistaken application of port rudder as a result of either the pilot giving the wrong order, or the helmsman applying the wheel to port rather than starboard. The rate of turn was exacerbated by the ship's low level of reserve stability.

2. The lack of proper monitoring of either the pilot or the helmsman by the master and officer of the watch contributed to the contact with beacon E5.

3. The lack of proper monitoring of the helmsman by the pilot, whilst he was giving commands and they were being executed, contributed to the contact with beacon E5.

4. There was a demonstrated lack of Bridge Resource Management.

   - There was a lack of communication between the master and pilot. There was also a lack of oversight of the pilot by the master during the passage .

   - There was no 'shared mental model' with defined limits which could be challenged if exceeded. The ship followed closely neither the pilot's nor the ship's planned route. The ship was on the 'wrong' side of the pilot's proposed route and this was not challenged by the Officer of the Watch.

5. The pilot was affected by a measurable degree of fatigue. The volume of shipping at that time put an extra demand on pilotage services, resulting in shorter than normal breaks between duty periods. The pilot was at the end of his rostered-on period.

Although not contributing factors it is also considered that:

- The pilot gave the order to turn from the heading of about 060° to enter East Channel at the position he originally planned. The order was given neither too early nor too late.

- Language and a proper understanding of the orders given by the pilot were not causative issues in the contact with beacon E5.

Recommendations

1. Brisbane Marine Pilots Pty Ltd review its fatigue management procedures with a view to setting maximum scores allowable at the commencement of each duty including an allowance for the anticipated length of the proposed duty cycle.

2. Brisbane Marine Pilots Pty Ltd introduce some 'fine-tuning' to its current fatigue policy. An example of such fine-tuning is the '5/12 rule'. That is, if a pilot has had less than 5 hours sleep in the past 24 hours, or less than 12 hours sleep in the last 48 hours preceding the start of the shift, the pilot should notify the line manager and undertake a more detailed risk assessment.

3. Pilots and other conning officers should consider the use of hand signals to supplement verbal commands. This could help to reduce the possibility of misinterpretation of wheel orders during ship handling periods especially where language difficulties might be a problem.

4. Masters and pilots should review their information exchange process to include information of importance contained in the vessel's hydrostatic or manoeuvring data, particularly the zig-zag test, which gives pertinent information regarding the steering ability of the vessel. This is especially important where a vessel is known to have poor handling characteristics and/or suspect margins of dynamic stability.

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, or relevant parts thereof, was sent to the following:

The master *Maksim Mikhaylov*

The second mate *Maksim Mikhaylov*

Far Eastern Shipping Company

Brisbane Marine Pilots

The pilot of *Maksim Mikhaylov*

Australian Maritime Safety Authority

No submissions were received from the master, second mate or Far Eastern Shipping Company.

Submissions were received from Brisbane Marine Pilots and the pilot of *Maksim Mikhaylov.*

Where appropriate, the text has been changed to correct the draft or reflect the submission.

Maksim Mikhaylov

IMO Number	7614379
Port of Registry	Vladivostok
Flag	Russian
Classification Society	Russian Register
Ship Type	Cellular Container
Builder	Warnow Werft East Germany
Year Built	1979
Owner	Far Eastern Shipping Company
Gross Tonnage	22 369
Net Tonnage	12 882
Deadweight Summer	23 216 Tonnes
Length overall	198.90 m
Breadth (moulded)	25.40 m
Depth (moulded)	14.7 m
Summer Draught	9.202 m
Engine	Sulzer 6 RND90
Power	12 799 kW
Crew	23 (Russian)