Australian Government

Australian Transport Safety Bureau

MARINE SAFETY INVESTIGATION REPORT
No. 200

Independent investigation into the grounding of
the Bahamas registered passenger ship

Astor

in Platypus Channel, Townsville, Queensland
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Released under the provisions of the *Transport Safety Investigation Act 2003*

ISSN 1447-087X
ISBN 1 877071 75 7 August 2004

This report was produced by the Australian Transport Safety Bureau (ATSB), PO Box 967, Civic Square ACT 2608.

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Media Release

Breakdown in communications and teamwork leads to grounding

The failure of officers to use modern navigation bridge management principles was the major factor in the grounding of the Bahamas registered passenger ship *Astor* during the ship's departure from Townsville at around 7 pm on 26 February 2004, according to an Australian Transport Safety Bureau (ATSB) investigation report released today.

The ATSB report into the *Astor* grounding released today states that the ship grounded on its port side as it was turning from Townsville harbour into Platypus Channel. The ship heeled about three degrees to starboard and, after about three minutes, slid clear of the bank without assistance and continued out of the channel. No injuries or pollution resulted from the grounding.

The report concludes that, after the *Astor* left its port berth, the ship's master did not accept the advice of the Townsville harbour pilot on board. By failing to take the pilot's advice, the master incorrectly positioned the ship for a turn to starboard into Platypus Channel, part of the approach channel to the port, resulting in the ship running aground during the turn. The report also concludes that the pilot was unable to understand the Ukrainian language of the officers and crew on the navigation bridge.

The ship's managers stated six days after the grounding that an onboard investigation had found a steering malfunction caused the grounding. This was the first time a steering gear malfunction had been mentioned by ship's staff or shore management to any Australian authorities or organisations.

The ATSB carried out a thorough examination of the ship's steering system and consulted with the manufacturers of the steering equipment. The investigation has been unable to determine the degree, if any, to which the reported malfunction contributed to the grounding.

The investigation was also complicated by the fact that information from the *Astor*'s 'black box' data recorder was not backed up immediately after the grounding and by the fact that company procedures were not followed with respect to the keeping of bridge records.

Copies of the report can be downloaded from the internet site at www.atsb.gov.au, or obtained from the ATSB by telephoning (02) 6274 6478 or 1800 020 616

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1 SUMMARY

At 1900 on 26 February 2004, the Bahamas registered passenger ship *Astor* let go its mooring lines and departed the Queensland port of Townsville.

The ship, equipped with twin rudders, controllable pitch main propellers and a single bow thruster, did not require a tug for the departure. The master, as is common practice on passenger ships, manoeuvred the ship clear of the berth and then, even though this was his first visit to Townsville, kept the conduct of the ship without consulting the harbour pilot. The pilot adopted an advisory role.

As the ship was turning from the harbour into Platypus Channel, part of the approach channel to the port, it grounded on its port side. The ship heeled three degrees to starboard and, after about three minutes, slid clear of the bank without assistance and continued out of the channel.

After it had cleared the channel, the ship stopped for about two hours to check that the hull was not breached and that all machinery was operating normally. Immediately upon notification of the grounding, the Australian Maritime Safety Authority (AMSA) placed a detention order on the ship until the ship's classification society was satisfied that *Astor* was seaworthy. When it was confirmed that the hull and machinery were in proper condition the detention order was lifted and the ship then proceeded to Cairns. At Cairns, an underwater survey of the hull was carried out to ascertain the extent of any damage.

Based on the available evidence the report concludes that:

- The investigation has been unable to determine the degree, if any, to which a reported steering malfunction contributed to the grounding.

The following factors, however, are considered to have contributed to the incident on 26 February 2004, independently from any steering malfunction:

- The master did not accept the pilot's advice after the ship left the berth.
- Communications on the bridge were in a language the pilot was not able to understand.
- The ship's master and bridge team members did not employ good Bridge Resource Management practices at any time leading up to the grounding.
- The master had not positioned the ship correctly for a turn to starboard into Platypus Channel.
- The master did not present an outward passage plan to any of those present on the bridge at the time of departure.

The investigation into the grounding of *Astor* was complicated by the fact that Voyage Data Recorder (VDR) data was not backed up in the time immediately after the grounding (highlighting a deficiency in crew training in this important facet of ship operations) and by the fact that company procedures were not followed with respect to the keeping of bridge records.

The investigation showed that crucial VDR information is easily lost by unintentional actions.

Of additional concern to the safety of navigation and the prevention of pollution on the Australian coast is that the master did not declare any steering defect to the Cairns pilot or port authority and *Astor* entered the Cairns Channel using only one steering motor on the port rudder without the pilot's knowledge.

This reports recommends that:

- Ship owners, managers, operators and masters of ships ensure that all bridge staff are fully trained in the correct operation of VDR data backup procedures for the particular ship on which they are serving.
- Manufacturers of VDR units should ensure that indicator lights are free of any possible ambiguity and that consideration be given to printing emergency backup instructions on VDR control panels on ships' bridges.
- Masters of vessels should not actively con the ship directly during pilotage unless they are familiar with the port and they do so in full agreement with any pilot.
- Ships' masters should ensure that all bridge orders in pilotage waters are in a language understood by pilots and ships' staff.
- Ship owners, managers and operators should instruct masters and ships' crews to use all elements of effective Bridge Resource Management at all times.

2 SOURCES OF INFORMATION

The master, officers and crew of *Astor*

Townsville pilot

Australian Maritime Safety Authority

Maritime Safety Queensland

Passat Shipmanagement, Cyprus

Great Barrier Reef pilot

Blohm and Voss Industrietechnik, steering gear manufacturers

Townsville Port Authority

References

International Convention for the Safety of Life at Sea, 1974, and its Protocol of 1988 (SOLAS), the International Maritime Organization.

The International Management Code for the Safe Operation of Ships and for Pollution Prevention [International Safety Management (ISM) Code] as adopted by the International Maritime Organization by Resolution A.741(18).

International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW Convention), 1978 and 1995 amendments, and the STCW Code, the International Maritime Organization.

IMO Assembly Resolution A.861(20).

MSC/Circ.1024, International Maritime Organization.

IMO Assembly Resolution A.893(21).

Bridge Procedures Guide, the International Chamber of Shipping.

Permanent International Association of Navigational Congresses, *Approach Channels, A guide to Design.*

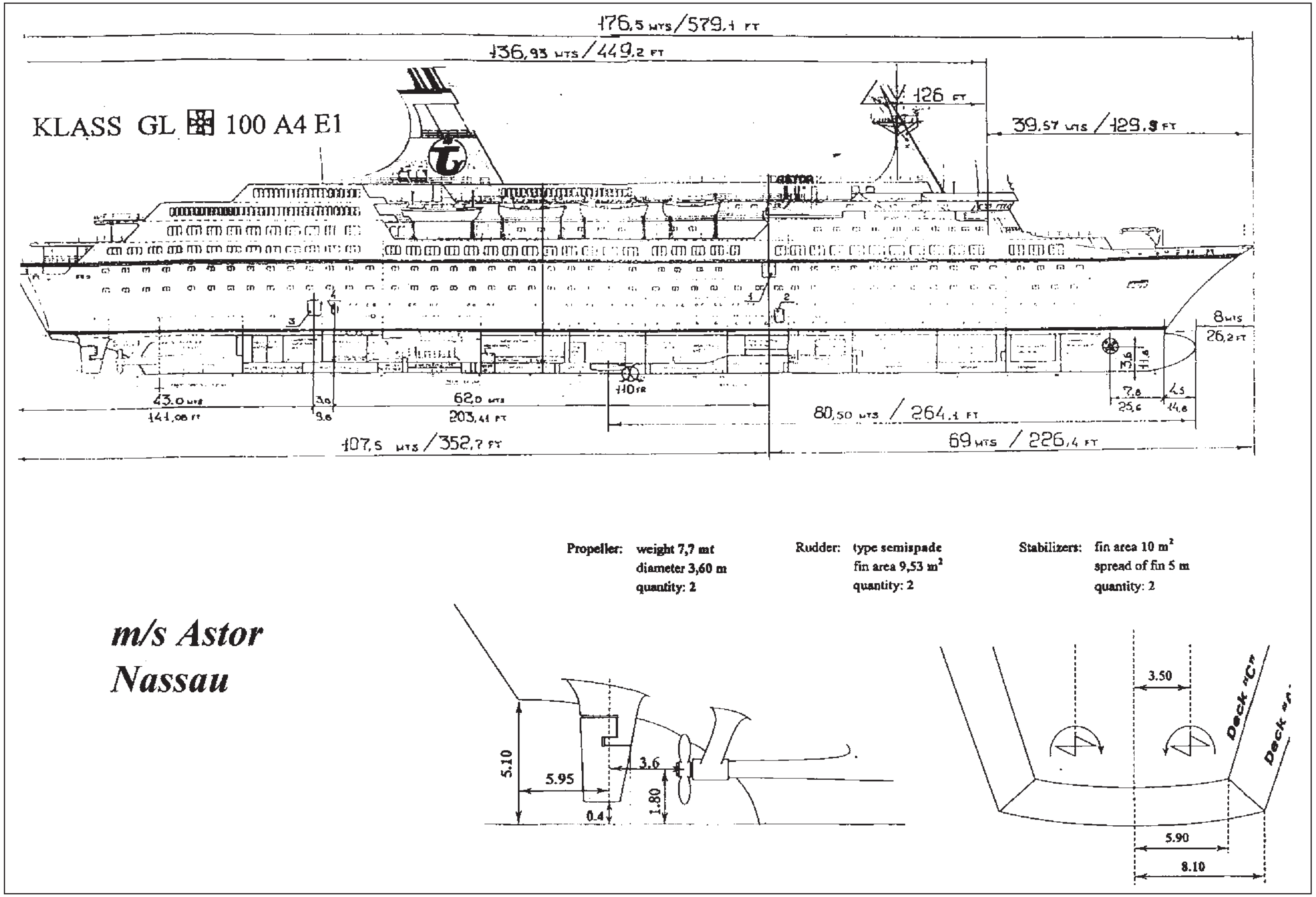
The United Kingdom Maritime and Coastguard Agency Maritime Guidance Notice 72 [MGN 72].

Nijjer, R. (2000) *Bridge Resource Management: The Missing Link*, Sea Australia 2000, Sydney

Maritime Safety Authority of New Zealand Shipping Notice 10/1997

Australian Maritime Safety Authority Marine Notice No. 34/2002 (superseding 7/1994)

FIGURE 1:
***Astor* plan**



3 NARRATIVE

Astor

Astor is an ice strengthened passenger cruise ship with a length of 176.50 m, a beam of 22.60 m and a summer draught of 6.10 m, giving it a displacement of 14 440 tonnes. Built in 1986 by Howaldtswerke-Deuthsche Werft AG in Kiel, Astor was sold to its present owners, Astor Shipping Company, in 1996. The ship is managed by Passat Shipmanagement of Cyprus and classed as a ✠100A5 E1 passenger ship with Germanischer Lloyd.

The vessel is powered by four Sulzer diesel engines in two pairs producing a total power output of 15 400 kW. Each pair of main engines is clutched into a reduction gearbox, which drives a single controllable pitch propeller. The ship is equipped with two 'semi-spade' rudders, which can be operated singly or together. The practice on the ship is to use both rudders together. Manoeuvring is conducted using direct bridge control of the main engines. The ship is also equipped with a bow thruster of 860 kW, which the ship's staff stated is effective up to a speed of seven knots.

The bridge is located about 37 m from the ship's stem, with the wheelhouse forward of the chartroom. A communications room aft of the bridge houses the Global Maritime Distress and Safety System (GMDSS) communication equipment and a Voyage Data Recorder (VDR). The vessel is equipped with a range of navigation equipment consistent with SOLAS[1] requirements, including a SAM Electronics Electronic Chart Display Information System (ECDIS). The VDR was manufactured by AVECS Bergen GmbH.

Bridge instrumentation includes propeller pitch and rudder indicators at the forward part of the bridge and on the bridge wings. A separate rudder angle indicator for each rudder is mounted on the steering console.

Astor is usually engaged in passenger cruises in the Mediterranean Sea and northern Europe. Every two years, the ship conducts a worldwide cruise. The total number of passengers that can be accommodated is 656 (in 295 cabins). On departure from Townsville on the day of the incident, there were 396 passengers on board and a crew of 294.

All bridge watchkeeping officers on *Astor* at the time of the incident were Ukrainian nationals. The master had joined the ship in Sydney on 20 February and took command in Brisbane on 23 February after a handover from the outgoing master. He first went to sea in 1980, gaining his unlimited foreign-going master's certificate in 1994. He has had command experience since that time and had been master of another passenger ship in 2002 and 2003. In August 2003 he joined Passat Shipmanagement and was appointed to *Astor*'s sister ship as master in September/October 2003, before going on leave. He had never been to the port of Townsville before the incident.

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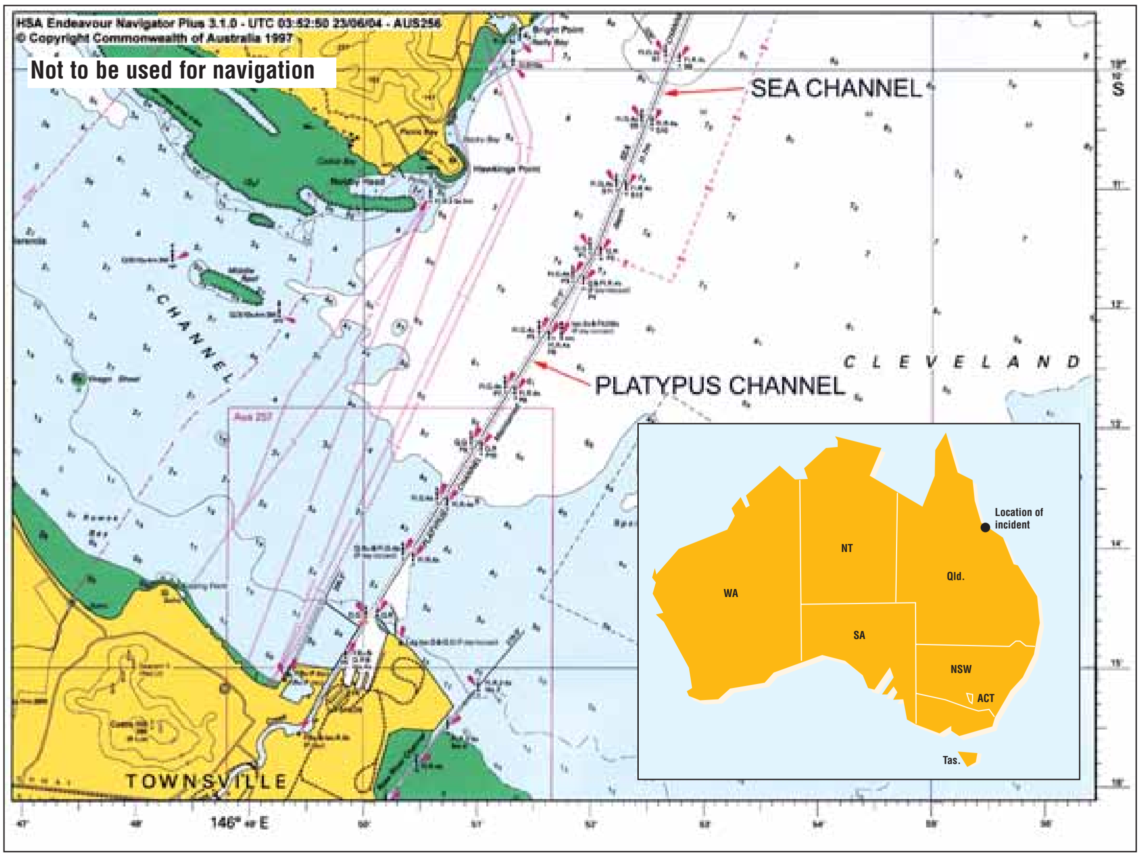
1 The International Convention for the Safety of Life at Sea 1974 as amended, Chapter V.

Townsville

Ships approaching the port of Townsville do so through Cleveland Bay, which is bound by Cape Cleveland to the east and Magnetic Island to the west. Entrance to, and departure from, the port is by a single channel about seven miles long. The outer section of this channel, the Sea Channel, is about 3.5 miles in length on a true heading of 021.5°/201.5°. The inner section of this channel, Platypus Channel, is 3.5 miles in length on a true heading of 031.5°/211.5° (see Fig. 2). The approach channel is dredged to a width of 92 m and the channel markers in Platypus Channel are set 44.0 m outside the toe line.[2]

The minimum maintained depth within the approach channel and the harbour is 11.7 m.

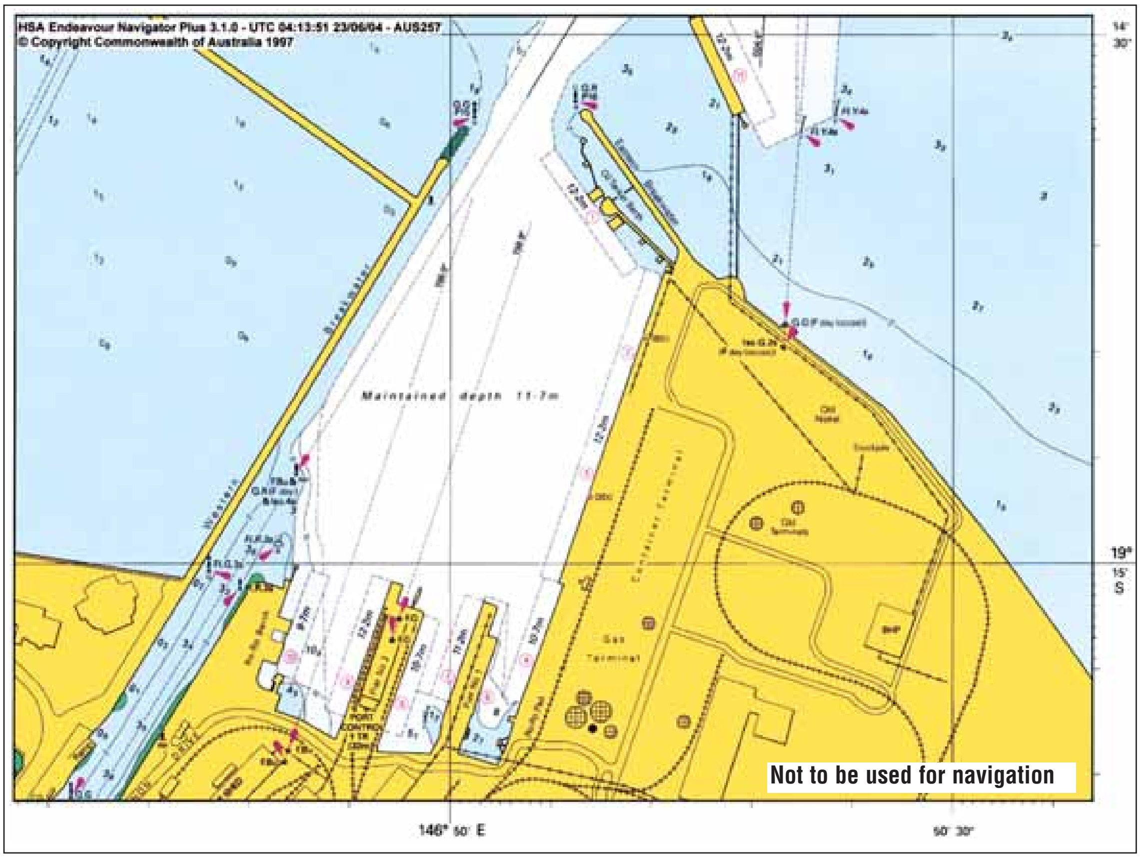
FIGURE 2:
Portion of chart Aus 256 showing the approaches to Townsville



Townsville Harbour is based on Ross Creek, which runs through the southern part of the city. Two breakwaters, the Eastern and Western Breakwaters, form the seaward limits of the harbour to the west and northeast and a substantial landfill area forms the eastern limits (see Fig. 3). There are nine berths in the inner harbour grouped around the swinging basin. There is one berth located in the outer harbour, about 230 m northeast of the Eastern Breakwater. The depth alongside the container, general bulk and tanker berths is maintained at 12.2 m.

2 A toe line is the transition line between the charted depth of a channel and the bank.

FIGURE 3:
Portion of chart Aus 257 showing Townsville harbour



Pilotage is compulsory for the port of Townsville, unless a ship's master holds a pilotage exemption for the port. For vessels drawing less than 8.0 m, the pilot boarding ground is three miles ESE of Cape Bremner on the eastern side of Magnetic Island. Vessels drawing more than 8.0 m take a pilot on board at the outer boarding ground, about one mile east of Orchard Rocks, off the northeastern part of Magnetic Island.

Pilotage

A pilot is engaged as a 'specialist advisor' to a ship's owner to advise the master on the conduct of the ship in waters in which the pilot has local knowledge of tides, conditions, channels and port operations. The time-honoured notation entered in ships' deck logbooks and bridge movement books when a pilot is on board is TMO/TPA ('to master's orders and to pilot's advice'). The master maintains overall command and responsibility for the ship, but the pilot has conduct of the ship. In a compulsory pilotage area, a person must not navigate a ship unless the services of a pilot are utilised.

The presence of a properly qualified pilot enhances the safety of a ship and reduces the risk of an adverse outcome that could affect the port or the environment. A ship involved in an accident in a port, or its approaches, has the potential to seriously disrupt port operations and threaten the local environment with consequential costs and damage.

Pilots utilise their ship handling skills, local knowledge of the port, tide and weather conditions, language skills for that country and bridge team support to safely con the ship and ensure that any risk to both the ship and the port is minimalised.

The pilot

The pilot assigned to *Astor* on the ship's outward passage from Townsville began his seagoing career in 1963. He gained initial pilotage experience in Papua New Guinea, between 1973 and 1983. At the time of the incident, he had been a pilot at Townsville for five years. He had experience on all types of ship, mostly bulk carriers and tankers with the accommodation and bridge aft, but also with passenger cruise ships with bridges at or near the pivot point[3] when the ship is moving ahead.

On 25 February he piloted two ships, one at 1600 and the other at 2200. He completed his shift at 0100 on the morning of 26 February, after which he returned to his home and went to bed. He awoke at about 0900 that morning, and reported for the afternoon shift at 1400. He was assigned three ships that shift, including *Astor* which was due to depart at 1900.

During the afternoon the pilot berthed a bulk carrier at number two berth. He went immediately to the bulk oil berth and piloted a tanker to sea, disembarking at 1740 and arriving back in Townsville at 1815. At 1830 he boarded *Astor*.

Steering gear

Astor is fitted with two sets of Simplex-Compact rotary vane steering gear, manufactured by Ross Industrie GmbH of Hamburg (now Blohm and Voss Industrietechnik), Germany. Each set operates one of the vessel's two rudders by means of a rotary vane hydraulic unit mounted on the rudder stock. Rudder movement is possible to a maximum of 35 degrees either side of the midships position.

Hydraulic actuating oil is supplied to the two rotary vane units by four steering pumps, two to each unit. Each unit can be operated with either a single pump or both pumps. In restricted waters, all four steering pumps are operated as standard procedure. The use of two pumps per rotary vane unit allows for continued operation in the event of a single pump/component failure, and it also halves rudder response times.

Hydraulic circuits

On each steering gear, the two electrically-driven gear pumps supply hydraulic oil through two separate systems (see Fig. 13). The direction of oil flow in each system is controlled by two control units, each arranged as a block containing passages through which the working chambers of the rotary vane unit connect with its respective pump. The hydraulic circuits are semi-closed, that is the pumps remain in operation

[3] The itinerant vertical axis about which a ship rotates during a turn.

and maintain a pressure in the system while part of the oil is returned to an oil reservoir.

With no signal from the telemotor system, a control valve remains in the mid-position 'short circuiting' the oil flow which is spilled to the return line. When a rudder movement signal is received from the telemotor system, the control valve shuttle is moved (by solenoids) allowing oil to flow through a stop valve to the relevant working chamber within the rotary vane unit. Oil under pressure will be supplied to this chamber until such time as the control signal from the telemotor is removed.

During rotation of the rotary vane hub, oil is displaced from the non-pressurised, or opposite, working chambers. Automatic stop valves restrict the flow of oil out of each of these chambers (depending on the load applied), thus eliminating rudder slamming. Another function of the automatic stop valves is to shut off in the case of a sudden loss of hydraulic pressure, stopping the rudder in its set position.

In the case of telemotor system failure, the steering gear can be operated from the steering gear compartment by manual operation of the control solenoids.

The incident

On 26 February 2004, *Astor* was berthed starboard-side to at number four berth on the eastern side of Townsville harbour. There were two vessels ahead of *Astor* on berths two and three. Berth number six, on *Astor*'s port quarter, was not occupied (see Fig. 3).

Preparations for sailing started at 1800. The pre-sailing bridge checklist was completed and signed by the staff captain and countersigned by the relevant navigating officer. This checklist indicated that all equipment, including the steering gear, had been tested and found to be working and all procedures, including the passage plan checklist, had been completed.

When the pilot boarded at 1830, he discussed his outward pilotage plan with the staff captain. The pilot's plan was to clear the berth and to head for the point near where the yacht marina breakwater joins the Western Breakwater. When the space between the two inner, easterly dolphins of the tanker berth was abeam the ship's bridge, the pilot planned a routine turn to starboard. This would then align *Astor* with the centreline of the Platypus Channel while still well inside the harbour.

Astor's master came to the bridge at about 1850. He shook hands with the pilot and immediately went to the starboard bridge wing. He did not consult the pilot's passage plan, or discuss the outward passage with either the pilot or the staff captain. The pilot followed the master out to the bridge wing with the passage plan and handed it to him. The master then gave it, at best, a cursory examination before handing it back without comment.

The master, the staff captain, a helmsman and the pilot were on the bridge at sailing time. The staff captain operated the propeller pitch controls and the bow thruster controls. A Great Barrier Reef (GBR) pilot and the ship's security officer were standing on the port bridge wing, where the GBR pilot had set up his electronic chart system, ready for the passage from Townsville to Cairns. The ship had about 770 m to negotiate before reaching the harbour entrance. The weather conditions were good, with clear visibility and an eight knot northerly wind. The sun had set about 20 minutes before sailing.

Shortly after 1900, the vessel cleared the berth using both rudders, the twin propellers and the bow thruster. All four steering motors were running, two on each rudder. On sailing, the master exercised his prerogative to maintain the conduct[4] of the ship and make the necessary helm and engine orders. This is a practice common on passenger ships. He gave all his orders to the staff captain and helmsman in Ukrainian. It was apparent that, once clear of the berth, the master had no intention of handing the con of the ship to the pilot. No formal discussion took place between the master and harbour pilot as to which of them would con the ship once it had left the berth. The pilot, therefore, adopted a purely advisory role.

Prior to boarding *Astor*, the pilot had discussed the ship with his manager. During these discussions, he was told that the pilot who had brought the ship into the port on the morning of 26 February had encountered difficulty while communicating with the master. The pilot's manager had then instructed the pilot to contact the port control tower if he experienced any difficulty with the master.

After the ship left the berth, the accounts of the master and the pilot regarding the events which preceded the grounding differ.

The master

The master stated that, after leaving the berth, he ordered a heading to leave beacon number 15 fine on the port bow. This beacon marks the end of the Western Breakwater and the entrance to the harbour. Beacon number 16 was on the starboard bow. As *Astor* approached the position off beacon number 16, at which the master judged the starboard turn should be made, the helmsman reported that the port rudder indicator at the steering console showed about 20 degrees to port. The wheel was still in the midships position. The starboard rudder indicator showed the rudder as being at amidships. The master stated that he then ordered 'hard a starboard', a command he repeated several times, but the ship maintained its heading and did not respond. He then ordered the starboard engine to zero pitch. He stated that the port rudder indicator showed full port rudder and the starboard rudder indicator showed full starboard rudder. He ordered the port propeller on zero pitch and applied full starboard thrust on the bow thruster. The vessel had slowed from about five knots to three knots when the port side touched the ground on the western side of Platypus Channel to seaward of beacon number 15.

4 To direct the movement or passage of the ship (commonly referred to as 'having the con').

The pilot

The pilot stated that, once clear of the berth, he advised the master to steer towards the Marina Breakwater, a breakwater which joins the Western Breakwater about 150 metres from its end. The master responded in Ukrainian, but did not follow the pilot's advice, instead putting beacon number 15 fine on the port bow on a course made good of 353°(T). The pilot was again ignored when he advised the master to apply starboard rudder at the point where the ship's bridge was about abeam of the inner eastern mooring dolphin of the tanker berth. As the bridge came abeam the tanker berth cargo arms, the pilot again advised a rudder angle of 20 degrees to starboard. Again this advice appeared to have been ignored.

All communication between the master, staff captain and helmsman was conducted in Ukrainian. No confirmation or dialogue was conducted in English between any of the ship's staff and the pilot. The vessel remained steady on a heading of about 353°(T).

The pilot stated that he pointed out to the master that the line of red (eastern) beacons of Platypus Channel were coming into line and advised that the rudders should be put to starboard 20 degrees. He also pointed out Platypus Channel itself, which was beginning to open to starboard. Again the master gave no response. The pilot then went to the VHF radio and called the tower at 19:05:26 on channel 16:

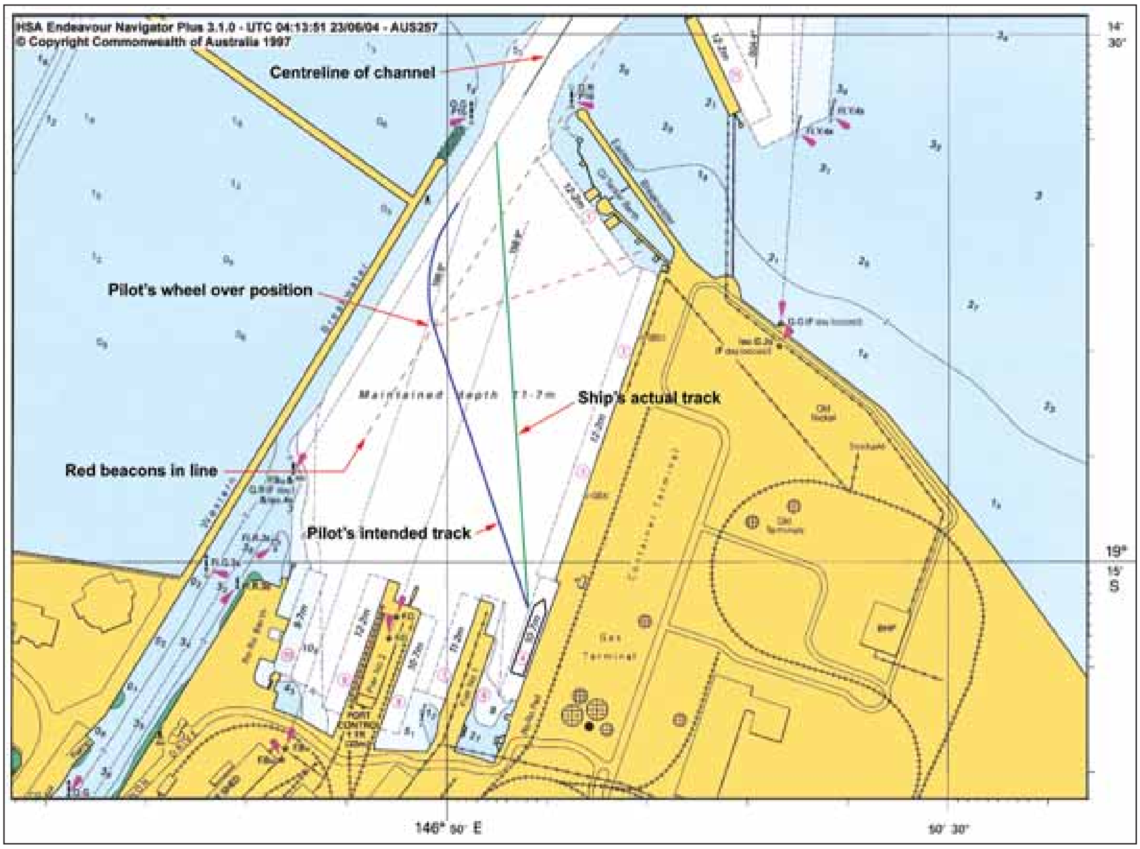
> Tower – this is the pilot on board the *Astor*. The master has got command and ah, we are too far over on the port side of the channel – umm – we're at this moment in time trying to square up – and he's speaking in Russian. I can't hear what he's doing. (Transmission ends at 19:05:40)

The pilot stated that he then returned to the master's side. He did not look at any rudder indicator to see whether any starboard helm had been applied. Platypus Channel was opening rapidly to starboard and the pilot realised that urgent action was required. The pilot advised 'hard a starboard' repeating the advice urgently four times. He then advised 'stop starboard engine, full astern starboard engine'. The master appeared to respond, issuing orders in Ukrainian. The pilot noted that the helmsman also seemed to be complying with the master's directions.

The pilot stated that he went to the port bridge wing to look astern at the leading lights. The vessel was turning to starboard, but looking astern he could see that Platypus Channel leading lights had closed and the ship had only swung through 15 degrees of the 35 degrees required to align the ship with the centreline of the channel.

The pilot realised that the ship would shortly ground and action was needed to minimise the swing to starboard and any impact with the channel bank. He urgently advised that the starboard propeller pitch should be put to zero, the rudders 'hard a port' and then the starboard pitch to slow ahead. Again the master did not respond and no acknowledgment was made in English, though the corrective action was apparently taken.

FIGURE 4:
Portion of chart Aus 257 showing the pilot's intended track and ship's actual track



Astor turned to starboard to enter Platypus Channel, but the ship was to the west of the centreline. The ship subsequently grounded on the western side of the channel at 1908, about 135 m northeast of beacon number 15 (see Fig. 5). The ship heeled about three degrees to starboard and, during the time it was in contact with the bottom, its speed was reduced.

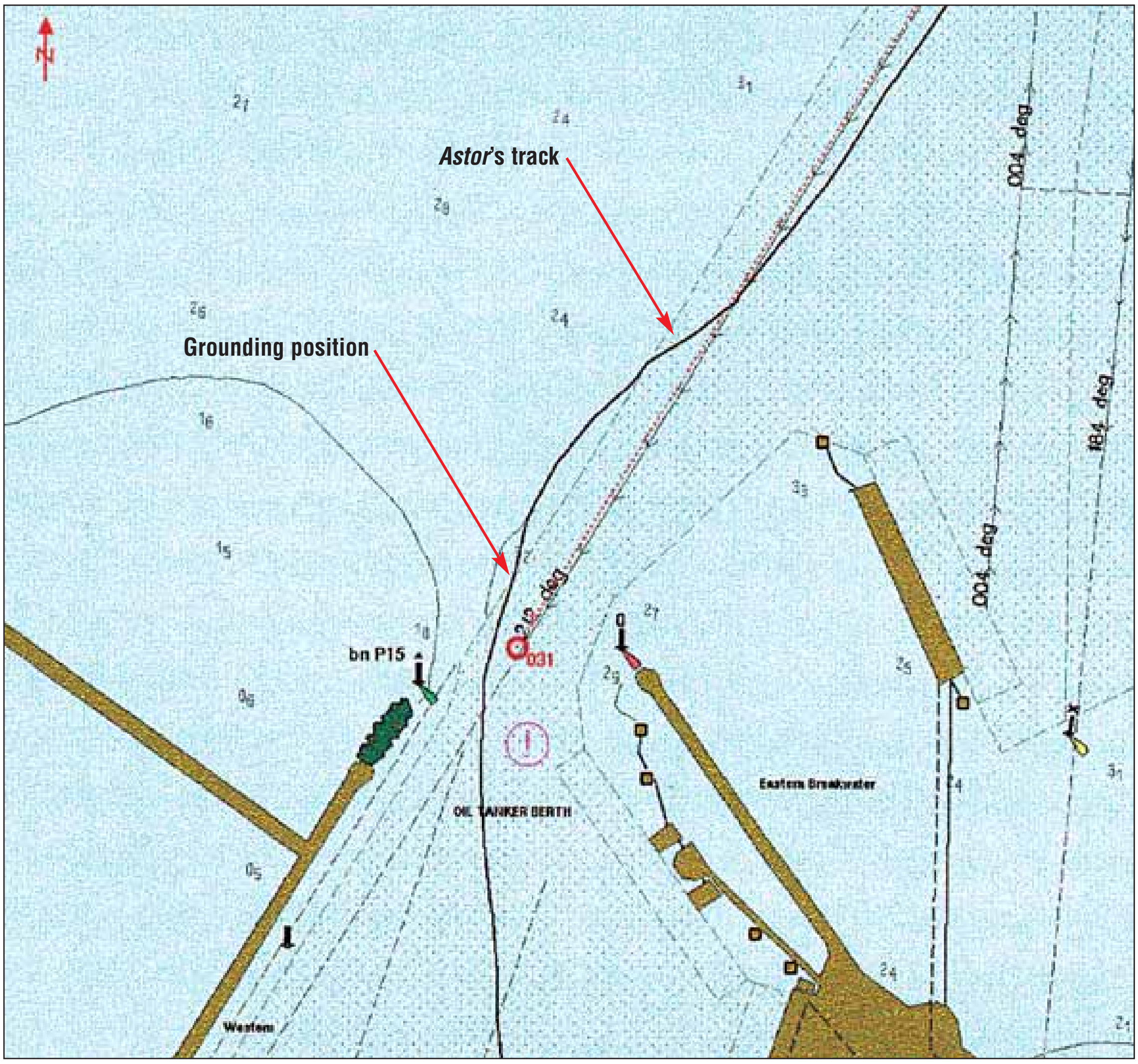
After the grounding

After sliding along the bank, the ship came clear at about 1911. It then continued on its outward passage. As it came off the bank, it was almost aligned with the centreline of Platypus Channel.

Once the ship was under control within the channel, the pilot advised the master of the various authorities that should be informed of *Astor*'s grounding. Once clear of Platypus Channel, the ship was allowed to drift clear of shoal water while the various authorities were notified.

The master, assisted by the pilot, contacted the Townsville Harbour Master, the Australian Maritime Safety Authority (AMSA) and Germanischer Lloyd (GL). AMSA placed a detention order on the ship, requiring the master to maintain position clear of the Townsville approach channels until GL was satisfied that it was safe for the ship to proceed to its next port, Cairns.

FIGURE 5:
Printout from *Astor*'s ECDIS showing ship's track and position of grounding



While drifting, all spaces on the ship were sounded and monitored over the following two hours. The ship was manoeuvred at full speed and no unusual vibration was detected. The detention order was lifted at 2150 and permission was granted for the ship to proceed to Cairns. The master was told by AMSA that the detention order would be reimposed on arrival at Cairns until the results of an underwater survey were known.

The pilot prepared a brief incident report in the form of an AMSA 'Incident Alert'. The report stated that the master had not taken sufficient action to turn quickly to starboard. This 'Incident Alert' was countersigned by the master.

The master also sent an 'Incident Alert' to AMSA at about 0238 on the morning of 27 February. In the alert, the master wrote that as the bow passed the red beacons in line, he had intended to make a rapid alteration of course to starboard 'but actions and situation were some another and the ship was coming to port'.

Immediately following the incident, the Townsville Harbour Master closed Platypus Channel pending a survey of the channel to ensure that the channel depth had not been reduced as a result of the contact. The channel, and hence the port of Townsville, was reopened on the morning of 27 February.

After arriving in Cairns, an underwater survey of *Astor*'s hull was conducted to determine what damage, if any, had been caused by the grounding. The report noted that there were no deformities in the hull plating, but there was an area on the port side of the keel aft, between frame ten and frame thirty[5], where the paint had been removed and the area was bare steel.

There were other patches of missing paint at frame thirty. The tip of one of the port propeller blades was bent over about 15 mm over a span of 100 mm. Forward, there were some rub marks where anti-fouling paint had been removed around frame one hundred and twenty. Given that the ship had been in dry dock and completed its annual survey on 15/16 December 2003, it is probable that the grounding had resulted in the removal of paint and damage to the propeller blade.

5 Framing on merchant ships is numbered from aft to forward with the rudder stock marking frame zero.

5 COMMENT AND ANALYSIS

Evidence

The bulk of the evidence is taken from the interviews conducted with the master, the ship's officers and helmsman, together with the interviews of the two pilots. Information was also provided by GL, Maritime Safety Queensland (MSQ), AMSA, the ship managers and the pilots in previous and subsequent ports of call. Security TV footage and recordings of VHF channels 16 and 12 were provided by the Townsville Port Authority.

No evidence from the ship's VDR was available as ship's staff had not followed the correct 'emergency backup' procedures immediately after the grounding.

The only documentary evidence from *Astor* directly relating to its passage through the harbour and subsequent grounding is a copy of the ship's ECDIS chart from about 1906 to 1915. No other contemporaneous records from the ship were available to the ATSB investigators.

The GBR pilot supplied data from his electronic chart system on his laptop computer. The times in this analysis are based on the data recovered from the GBR pilot's electronic chart.

The ATSB was notified of the grounding while the ship was drifting off Townsville. The incident did not result in any serious damage to the ship or pollution and the ATSB investigators did not want to disrupt the ships schedule by detaining the ship in Cairns (where it was to be berthed for less than 24 hours). Therefore, the decision was made to visit the ship at its next scheduled Australian port of call, which was Darwin, on 3 March.

On the morning of 27 February, while in Cairns, the ATSB issued the ship with an 'evidence protection order' under Section 43 of the *Australian Transport Safety Investigation Act 2003*. The order directed that information from the VDR, charts, written or electronic documentation and any other physical evidence pertaining to the grounding was not to be interfered with or removed from the ship.

When ATSB investigators met the ship in Darwin, the ship's managers informed them by fax that an investigation into the grounding had been conducted onboard *Astor* and that the cause of the grounding had been established as a steering gear malfunction. This was the first time any mention of a steering gear malfunction had been made by ship's staff or shore management to any Australian authorities or organisations.

Voyage Data Recorders

Passenger ships built before 1 July 2002 are required to be fitted with a VDR at the first survey after that date.[6] *Astor* was fitted with a VDR in December 2003 while the ship was in dry dock.

6 The 2000 amendments to Chapter 5, Regulation 20 of the Safety of Life at Sea Convention 1974.

VDRs record critical ship's data including: date and time; sounds in and within the vicinity of the bridge; the ship's position; speed; heading; important alarms; rudder orders and response; engine orders and response (including bow thruster); radar information; watertight and fire door status; fire alarms and wind speed and direction. Data should not be overwritten for at least 12 hours and the unit should be entirely automatic in normal operation. Means should be provided whereby recorded data may be saved following an incident, with minimal interruption to the recording process.[7]

Regulation 20 of the amended SOLAS Convention 1974 provides that the purpose of the VDR is 'to assist in casualty investigations'.

The Maritime Safety Committee of the International Maritime Organization (IMO) issued guidelines on the ownership and recovery of data from VDRs in May 2002 (MSC/Circ.1024). The guidelines note:

> Recovery of the VDR information should be undertaken as soon as possible after an accident to best preserve the relevant evidence for use by both the investigator and ship owner. **As the investigator is very unlikely to be in a position to instigate this action soon enough after the accident, the owner must be responsible, through the on-board standing orders, for ensuring the timely preservation of this evidence.** (ATSB emphasis)

The loss of the VDR data and lack of records

The VDR unit fitted on *Astor* complied with IMO requirements. The VDRs wheelhouse control panel is located on the main bridge console, near the internal ship telephone handsets. To retain voyage information for this type of VDR, it is necessary to operate the 'emergency backup' system from the wheelhouse control panel. The 'emergency backup' actuating button is illuminated by a steady red lamp and is protected from inadvertent activation by a perspex cover. The level of illumination is controlled by a dimmer switch on the console. To retain existing information, and allow the recorder to continue recording, it is necessary to lift the perspex cover and hold down the 'emergency backup' actuating button until the data transfer process is initiated. This initiation is indicated when the red lamp turns from a steady light to a flashing light.

ATSB investigators examined the VDR control panel on the bridge console. They noted that the 'emergency backup' button lamp was permanently lit. If the lamp was dimmed (as it would be at night), an untrained operator could believe that the backup process had commenced if the dimmer control was adjusted to provide more illumination. This is what had happened in this incident.

7 IMO Assembly Resolution A.861(20) adopted 27 November 1997.

FIGURE 6:
VDR wheelhouse control panel

According to the master's evidence, when *Astor* had cleared Platypus Channel following the grounding, the staff captain was directed to save the VDR data. In his evidence, the staff captain stated that he lifted the cover and pressed the 'emergency backup' button. He saw that the light was illuminated and then released the button. He did not realise, and had not been instructed, that he was required to maintain pressure on the button until the light started to flash.

It became apparent to the investigators that none of the ship's officers interviewed knew how to correctly save the VDR data. This is a serious deficiency in the training of the ship's officers. There was no shipboard procedure to instruct the crew, other than the manufacturer's operational manual. It also demonstrated how easy it would be for a person to deliberately fail to back-up important navigational data and plead ignorance, if it was in their interest to do so.

ATSB investigators also found that the procedure for activating the emergency backup system, as contained in the instruction manual provided for the VDR unit by AVECS, was incorrect. AVECS have since amended this procedure to reflect the correct method of 'emergency backup' activation.

The loss of the VDR data is compounded by the lack of any other contemporaneous records other than the ship's ECDIS printout. This printout did not include any time reference points and, for this analysis, the GBR pilot's electronic charting system was used to verify the ship's data and provide time references.

Following the installation of the VDR in December 2003, a decision was made to remove both the engine data logger and the course recorder from *Astor*'s bridge. At the time it was also decided to dispense with the movement book when manoeuvring.

During the ship's dry docking in December 2003, the annual survey was carried out on behalf of the Commonwealth of the Bahamas Maritime Authority, and 'yes' was answered to the following questions:

- Is the vessel provided with Company policy statements, instructions & procedures with regard to bridge management and safe navigation?
- Is the course recorder in good working order?
- Is the engine movement recorder in good working order?

Additionally, the company policy on the bridge movement book (revised in December 2003), as contained in the safety management system (SMS) approved by the flag State, is:

> **Bridge movement book** is to be a hard backed book properly paginated. This log book can be of the utmost importance in the event of an accident. All notations must be made in pen. The Officer keeping the Bridge Movement book must sign it at the end of each watch or Bridge assignment.

Astor's previous master had dispensed with the use of the movement book. In doing so the operations of the bridge team during arrivals and departures were at odds with the published company safety policy. The previous master also had the course recorder and automatic engine data logger removed.

In respect of the course recorder and engine movement recorder, both were items subjected to survey by the Bahamas Maritime Authority. The authority had not received any request to remove the recorders and no approval had been given for any change to these two instruments.

The change in practices in record keeping on the bridge means that there is very limited objective evidence to reconcile the varying accounts of the grounding. The effective erasing of the VDR data and the absence of any independent data means there is no objective evidence from the ship for an incident which could have had major ramifications for the ship and the port.

Electronic chart data

The GBR pilot's electronic chart printouts (Figures 7 to 10) display the geographical position of its GPS aerial, the time and course and speed of the ship over the ground. The system uses a single GPS aerial, and thus no heading data is available from the pilot's electronic chart playbacks. The ship's track information is stored within the system at ten second intervals. The aerial was rigged on the port bridge wing, about 10 m from the centreline of the ship and just forward of the theoretical pivot point. (Note: The ship image on the printouts in the following figures should be disregarded as this is not an indication of ship type or dimensions. Interest should be directed to aerial location and the vector for the course made good).

FIGURE 7:
GBR pilot's plot 1907 hours

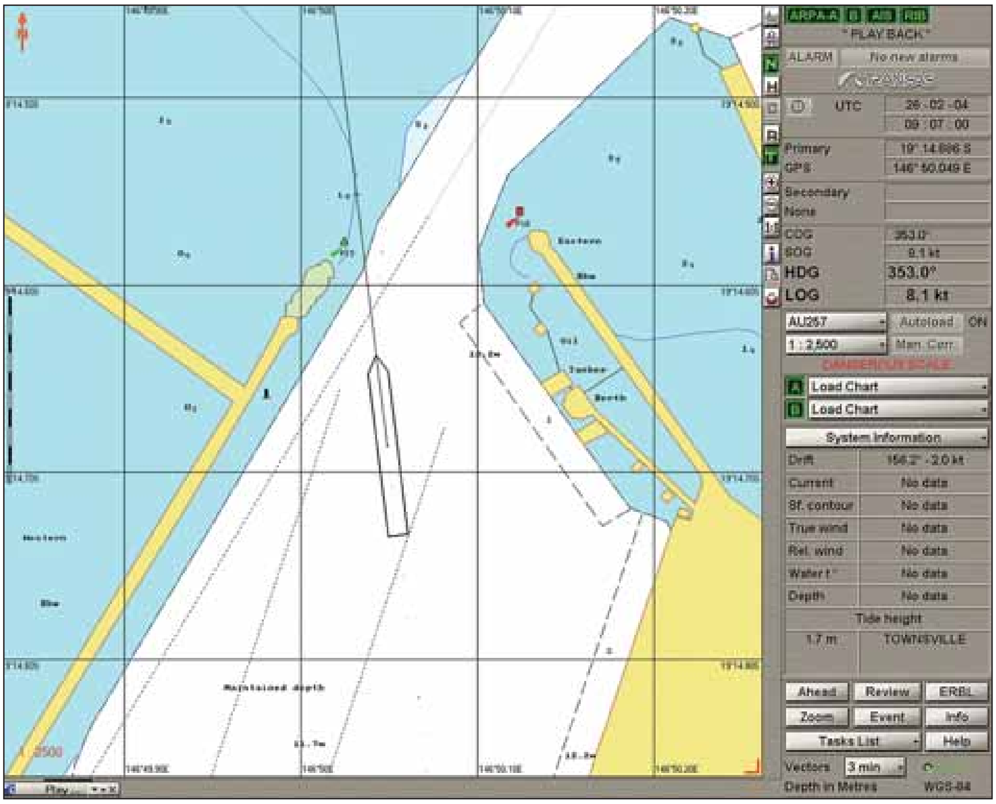


FIGURE 8:
GBR pilot's plot 1908 hours

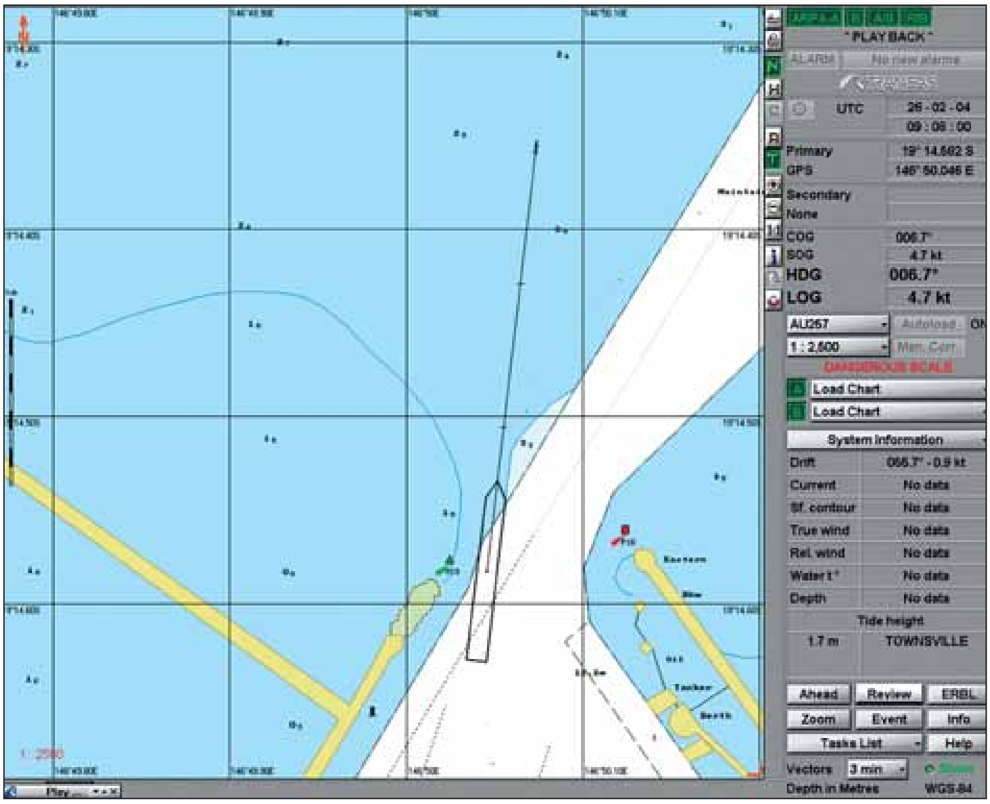


FIGURE 9:
GBR pilot's plot 1909 hours

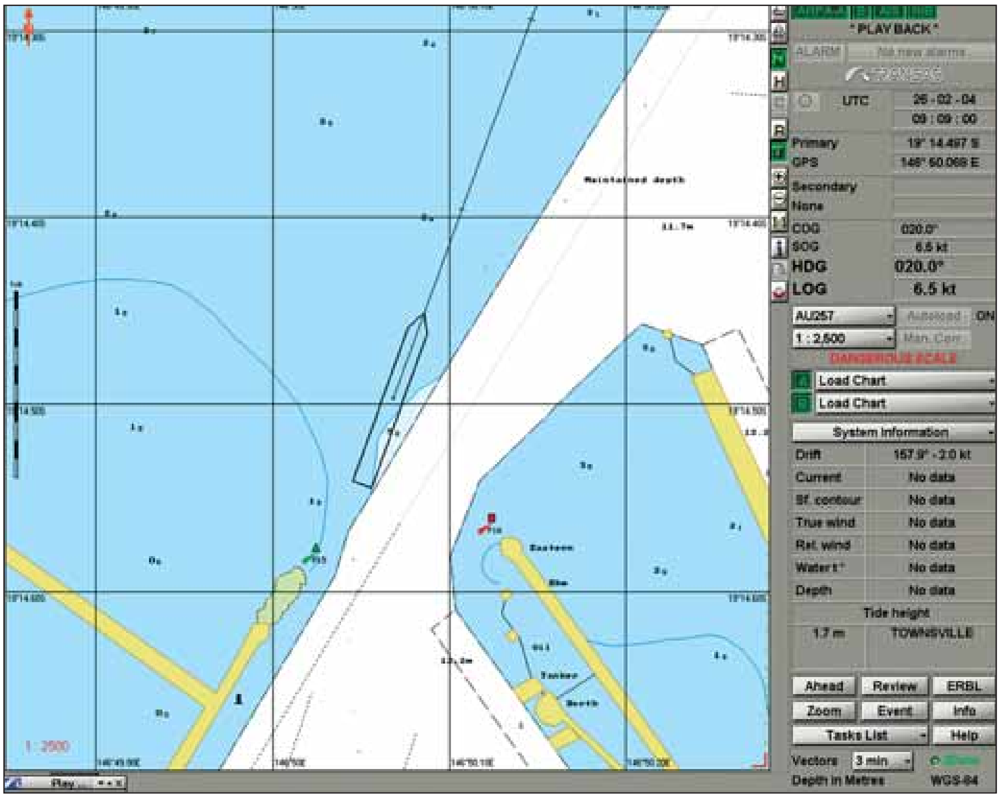
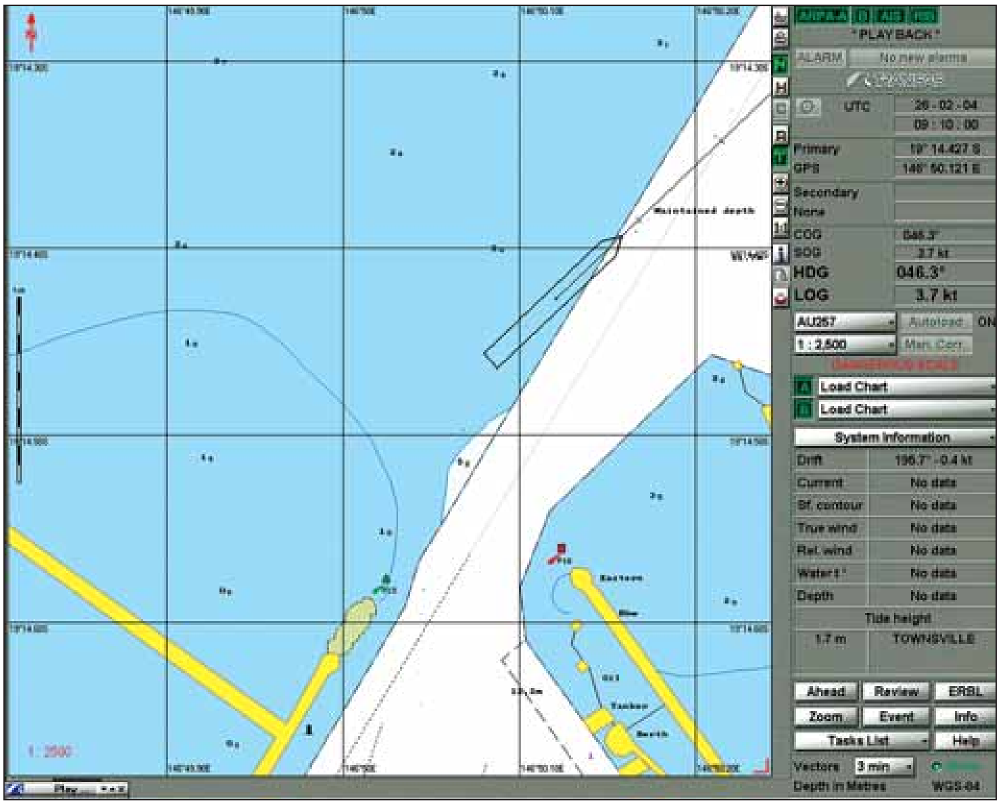


FIGURE 10:
GBR pilot's plot 1910 hours



The ship's ECDIS printout was compared with the GBR pilot's chart printout by overlaying the two. The two courses were identical; however, the GBR pilot's trace of the ship's route was offset to port from the ship's trace by about 18 m. This is accounted for by *Astor*'s GPS aerial, which is used for the radars and chart GPS receiver, being offset some nine metres to starboard of the ship's centreline.

At 1900 on 26 February, there were eleven GPS satellites visible above an elevation of ten degrees above the horizon at Townsville Harbour.[8] The GPS record may therefore be taken as accurate.

The electronic chart data shows that:

- At 1901:00 *Astor* left the berth, initially making good a course of about 001°(T), gradually increasing speed.
- At 1905:00 *Astor* was making good a course of 353°(T) at a speed of 3.3 knots.
- At 0906:00 the cargo oil booms of the tanker berth were abeam the bridge, the ship had maintained its course of 353°(T) and had accelerated to 7.1 knots. It was at about this point that, according to the pilot, he advised the master to apply 20 degrees of starboard rudder.
- At 0907:00 the ship was still maintaining a course over the ground of 353°(T).
- At 1907:05 *Astor*'s bridge crossed the line of the red channel markers in Platypus Channel at a speed over the ground of 8.1 knots (4.1 m/s). (At this time, there was only 148 m (0.8 cables[9]) to run before the ship crossed the centreline of the channel, and 185 m (1.0 cable) in total before it ran aground if it did not alter course.)
- At 1907:40 *Astor*'s bridge crossed the centreline of the channel.
- Between 1907:10 and 1907:20 the ship covered about 37 m. Over the next ten seconds the ship covered 33.3 m (at 6.4 knots) and the ship had apparently started to move to starboard.
- At 1907:40 the speed appeared to drop further to about 5.75 knots and the move to starboard was a little more pronounced.
- At 1907:50 the speed had dropped to 5.3 knots and the course made good continued to change to starboard.
- At 1908:00 the course made good altered to 007°(T) and the speed dropped to 4.7 knots.

The ship's bridge was about 37 m from the stem. With headway on, the ship would have pivoted at a position between 44 m and 59 m from the stem, or between seven and twenty metres aft of the position from which the ship was being conned by the master.

From the electronic charts, it would appear that an effective course alteration was initiated between 1907:10 and 1907:20. In the absence of any other evidence, it is not possible to state whether this was through the application of the rudder, through altering the pitch of one or both of the propellers or a combination of both.

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8 Source, Trimble Navigation Limited.

9 A cable is one tenth of a nautical mile.

Reported steering gear failure

ATSB investigators were first advised of the steering failure by the ship's managers in Darwin, who stated:

> In-depth investigations of the reason for this incident has shown that the steering gear had a malfunction. The reason for this was a defect of one control valve of the portside steering gear.

This control valve affects the flow of hydraulic actuating oil to and from the rotary vane units' steering pumps.

According to the master and helmsman, as the ship's bridge reached the position at which the master was to make the alteration of course to starboard into Platypus Channel, and with the helm in the midships position, the port rudder indicator on the bridge console moved to port. The staff captain then reportedly contacted the engine room on the 'talk-back' system. The chief engineer stated that he had seen the rudder indicators showing opposite rudder angles and that he advised the bridge to switch off number two port steering motor. This motor had given some trouble, apparently about eight months before the grounding. With number two port steering motor switched off, the port rudder indicator slowly returned to amidships and then indicated the same angle as the starboard rudder indicator.

Examination of number two port steering motor by ship's staff, and the subsequent replacement of a broken valve, was not undertaken until after the ship had sailed from Cairns. The question of why the steering motor was not examined in Cairns (where the ship had a full day alongside), and the problem rectified as soon as it could have been after the grounding, must be asked.

ATSB investigators found no record of a steering gear malfunction when they examined the ship's deck logbook. Evidence of a malfunction was found in the engine room logbook for the evening of 26 February, though there is no way of determining whether or not this was a contemporaneous entry. A ship's SMS report dated 26 February signed by the master, chief engineer and the helmsman was also presented to the investigators. Again, the lack of any supporting data makes authentication of this evidence difficult.

AMSA was not informed of the steering malfunction, despite the master making out an 'Incident Alert' form and being interviewed the following day by an AMSA surveyor and a MSQ officer in Cairns. GL was not informed, despite the fact that the steering motors are under class survey.

The Townsville pilot was not told of the malfunction at any time while he was on the ship. This was despite the fact that he was on the bridge at the time and it was on his advice that the master was supposedly operating. He left the ship at about 2200, under the impression that the grounding had been as a result of the master delaying the turn to align *Astor* with the centre of Platypus Channel.

In submission, the Townsville pilot wrote:

> As far as the reported steering gear failure is concerned – prior to my communicating with the tower I had looked to see what the helmsman was doing, there was more than one person close to the helm position and they were looking enquiringly in the direction of the master, but there was no urgent notification (as one might expect) had a steering malfunction occurred. The master had still not said a word, and I had the feeling that the helmsman and others were expectantly awaiting his

> order to turn to starboard, the entry to Platypus Channel being patently obvious to all on the bridge.

When the ship arrived off Cairns, the inward pilot asked the master if any engine or steering faults were present. No faults were reported to the pilot, despite the fact that the master stated that number two port steering motor was not being used, and was possibly implicated in the previous nights incident.

ATSB investigators are unable to say why there was such apparent reluctance to report the steering gear malfunction. The master may have feared that *Astor* would be detained. A Port State Control inspection by AMSA in Port Adelaide on 17 February 2004 resulted in the ship being officially detained for two hours while the reserve power for the automatic operation of the GMDSS equipment was repaired. Two other deficiencies, relating to the rescue boat and three engine room fire dampers, were required to be rectified before departure Adelaide.

The failure of the ship's staff to notify any Australian marine authorities, the pilot or the classification society about the steering malfunction raises issues about the credibility of the claim. The handling of this entire matter points to lack of professionalism on the part of the ship's staff.

Stop valve failure

On 3 March, a broken valve insert (as shown in Fig. 11) was provided to the investigators. Ship's staff stated that this was the part that had failed, causing the steering malfunction and that the failure of this valve had been the cause of the 'hard to port' movement of the port rudder moments before the grounding. The effect of the failure of this valve must have been to over-ride the port steering gear number one pump, which was operating correctly.

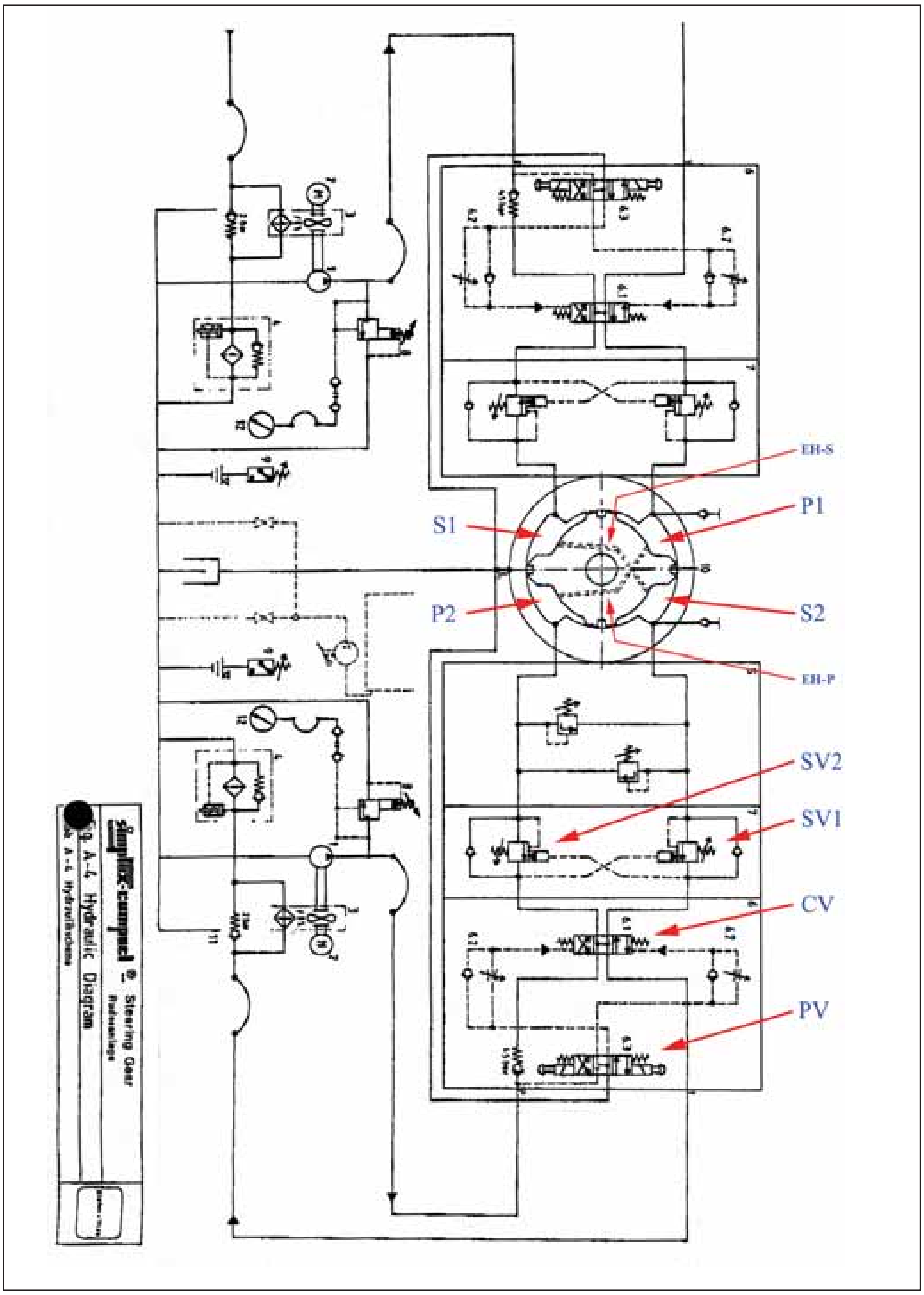
FIGURE 11:
Broken stop valve pieces

FIGURE 12:
Valve block arrangement

The fractured pieces of the component were reported as having been taken from an automatic stop valve on number two hydraulic system (SV1 in Fig. 13), which supplied the port steering rotary vane unit. However, the components, although similar, were not consistent with the drawing supplied to the vessel by the manufacturers in the steering gear operating manual. To be able to correctly analyse the hydraulic system, the ATSB obtained a more up-to-date hydraulic system drawing from the steering gear manufacturer.

With regard to the out-of-date hydraulic system drawings on board the ship, *Astor*'s managers, in submission, wrote that the manufacturers replaced the original stop valves and blocks in 1995 and the original diagrams were not replaced.

FIGURE 13:
Steering gear hydraulic arrangement diagram



Expert metallurgical examination shows that the fracture of one of the internal components was caused by crack growth over a period of time. The features of the fracture surfaces are consistent with crack growth by the mechanism of fatigue (the result of alternating stresses in the component).

Considering one hydraulic system in the schematic drawing (Fig. 13), assuming that a 'starboard' signal is received from the telemotor system, then:

- the control valve shuttle CV will move from left to right (as drawn) supplying oil under pressure to the stop valve SV1
- oil will flow through the non-return valve within SV1 thus pressurising the 'starboard movement' chamber S2 in the rotary vane unit and S1, via the equalising hole EH-S through the hub
- at the same time, pressure in the line between CV and SV1 will cause the pilot actuator on stop valve SV2 to move SV2 from right to left, thus opening the return line from the 'port movement' chamber P2 in the rotary vane unit, connecting it, through the restricting orifice in SV2, to the low pressure return line. Chamber P1 is thus also connected to the return line, via the equalising hole EH-P through the hub.

There are three possibilities regarding the outcome of a collapse of the valve into pieces. These are:

1. **The failed valve blocked the supply of oil to the rotary vane chamber**

   In this case, assuming that the failed valve could prevent oil flow to the 'starboard movement' chamber of the rotary vane unit, the opposite side would still be connected to the return line. Hence, the unit would be operating only under the influence of the one remaining pump, number one, (with some assistance from the oil which would flow through the equalising hole in the hub into the chamber S2). The result would be to aid correct operation, albeit more slowly.

2. **The failed valve partially blocked the supply of oil to the rotary vane chamber**

   In this case, with SV1 partially blocking the oil flow, the same events would occur, but there would be some build up of pressure from number two pump in the chamber S2, thus increasing the rate of correct operation, albeit still slower than normal.

3. **The failed valve allowed the free flow of oil to or from the chamber**

   In this case, there would be free flow of oil under pressure to the 'starboard movement' chamber S2 and, in the case of starboard helm being applied, the rudder would move to starboard as normal.

In each of the above instances, there appears no means by which the 'port movement' chamber P2 could become pressurised, with the 'starboard movement' chamber S2 connected to the return line, thus moving the rudder to port. In any of the failure modes above, the rudder should still move under the influence of number one pump.

If, however, a failure of the valve had allowed oil, with starboard helm applied, to reach the 'port movement' chamber P2 of the rotary vane unit, as well as the starboard chamber, it would flow through the equalisation hole through the hub to the un-pressurised chamber P1 which, together with the turning moment exerted by the correct operation of number one pump, would still result in a slow movement of the rudder to starboard.

In view of the above, it appears that movement of the port rudder to port, with starboard helm applied, is highly unlikely. At best, its operation would have become sluggish in comparison with the starboard rudder, at worst it would have 'failed set' with the rudder in whatever position it was in at the time of the failure.

If, however, in spite of the foregoing, the rudder had for some reason indeed moved to port, the chief engineer's advice to turn off number two pump was fortuitous. If the malfunction of the port rudder was due to a faulty hydraulic circuit, it could equally well have been number one system hydraulics. The chief engineer's decision was based on his recall of a previous problem, about eight months earlier, with number two pump. The only relevant maintenance record produced in evidence, however, related to May 2002, 18 months before the incident in Townsville. It would have been just as logical to assume that number one pump had failed as it had not been refurbished or had parts replaced as recently as number two pump.

Since 2001, the manufacturer had inspected the steering gear on *Astor* on three occasions. In December 2001, the port steering gear was overhauled, and in May 2002, one automatic stop valve was replaced on the port side steering gear. In September 2002, an inspection found no defects in machinery or operation.

An examination of drawings of the hydraulic system, together with consultation with the manufacturers of the steering gear, has failed to reveal any means by which the port rudder could have moved to the 'hard to port' position of its own accord after the failure of an automatic stop valve.

The grounding

The approach channels to Townsville are relatively narrow. In any narrow channel, it is imperative that a vessel, regardless of size, is positioned correctly prior to entering the channel. Vessels must be either on or close to the centreline, to minimise the bank effect[10] in the channel. They must also be on the correct heading when entering the channel.

At 1900 on 26 February 2004, the height of ebb tide was predicted to be 1.82 m. *Astor*, with a maximum draught of 6.2 m, had a minimum under-keel clearance (UKC) of over seven metres. With a beam of 22.6 m, the beam to channel ratio was 4:1. Providing the ship remained on or close to the centreline of Platypus Channel, its passage through the channel would present no particular challenge to an experienced ship handler.

Position of *Astor* within the harbour prior to grounding

When taking vessels out of the harbour, the usual practice for Townsville pilots is to have the ship lined up on the centreline of Platypus Channel as far inside the confines of the harbour as they can. This is done by visual reference of the channel itself ('boxing' the channel), and by referencing the leading lights astern. By doing this, they are assured of a uniform flow of water down each side of the ship's hull at beacons number 15 and 16.

10 A streamlining or venturi effect due to the restricted water on one side of the ship's hull increasing velocity, with a resultant drop in pressure, tending to attract the stern towards the near bank and repelling the bow (for a ship in forward motion).

The course the master followed differed significantly from the departure plan of the pilot. Evidence points to the fact that for leaving the harbour and entering the channel, the master intended the ship to turn into the channel at the entrance to the harbour. This is precisely what Townville pilots do not do and why *Astor*'s master needed to discuss the departure with the harbour pilot before the ship left the berth.

Any departure plan the master may have had appears to have been purely in his head, as no evidence exists to show that anyone on the bridge of the ship knew the detail of his intentions prior to the ship's departure.

At about 1907:15, *Astor*'s master ordered the starboard turn into Platypus Channel. According to the Townsville pilot, when the master first ordered the wheel to starboard, the pilot could see along the inside of the line of red (eastern) beacons. This is consistent with the analysis of the GPS plot.

At this stage, *Astor*'s pivot point was at best about 90 m from the centreline of the channel and the ship had to turn through 36 degrees. When fully operational with four pumps running, according to the ship's data, the rudder would take 5.5 seconds to reach the 'hard over' position from midships. Thereafter the ship would need to turn at about two degrees per second, to align with the centre of the channel.

When a ship alters course, there are effectively three major dynamic influences working on its hull. These are:

- the rate of change in heading about the pivot point
- the forward motion of the ship around the radius of the turn
- a hydrodynamic force, known as lateral resistance.

Lateral resistance works on the entire length of the body of the ship in opposition to the rudder. This results in the ship moving bodily sideways through the water and, to some degree, increases the turn radius. The rudder is the dominant turning force in a ship making headway, as the distance between the rudder stock and the pivot point forms a lever, which overcomes the lateral resistance as the ship moves forward.

In open sea, the effect of lateral resistance is not particularly noticeable, but in confined waters, it can be critical.

Astor is a ship with a high beam to length[11] ratio (1:6.7), making it a relatively narrow ship. As such, the ship is 'directionally stable'[12] (that is it has a resistance to turn), and consideration of this directional stability has to be taken into account when ship handling, especially in harbour waters.

By waiting until the bridge of the ship had passed the line of red beacons of the channel, the master did not fully allow for the turning ability of the ship and failed to allow sufficient sea room ahead of the ship for its advance[13] and turn.

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11 Length between perpendiculars.

12 Permanent International Association of Navigational Congresses, *Approach Channels, A guide to Design*, pp 22.

13 The distance travelled in the direction of the original heading measured from the point at which helm was applied.

In not heeding the pilot's advice, the master, apparently in the absence of any plan of his own, trusted in his 'seat of the pants' judgement. Based on any local knowledge the ship was not in the best position to start the turn to starboard into Platypus Channel. If, as was reported, the port rudder failed to port with the starboard rudder was amidships, some indication of a change in the ship's heading to port could be expected.

Supporting data from the ship is unable to substantiate the master's report of an initial turning moment to port. The electronic chart data does not indicate any movement of the ship over the ground to port from 1905 until after *Astor* made contact with the channel bank.

If, however, the automatic stop valve failed and the flow of hydraulic oil to the port rudder was reduced, the rudder response time would have been increased, the rate of turn would have been affected and the turning radius increased. Under the circumstances, these may have been marginal effects, but given the available fairway, the accumulation of small factors would be sufficient to account for the immediate factors attending the grounding.

The data indicates that the turn was delayed. Whether this was a case of misjudgement on the master's part, or whether the delay was caused by the reported malfunction of number two port steering gear, it is not possible to state with confidence. However, evidence suggests that the former is more likely.

The tide, which was ebbing at the time of the incident, is not considered to have been a causal factor in the grounding. An ebb tide at Townsville flows from the northwest to the southeast, across the entrance to the harbour, so at the time of the incident, any ebb tide effect would have been setting the ship away from the western bank. The wind is also considered not to have played any part in the grounding.

Master/pilot relationship

The grounding was, in part, due to very poor bridge resource management and poor attitude on the part of the master. Proper passage planning is an integral part of managing the resources required to operate the ship effectively, particularly on the bridge, but also in key control areas such as the machinery space.

A proper exchange of information between the master and a pilot is an essential safety element when a ship is in pilotage waters, so that they have a 'shared mental model' of the intended operation. The pilot knows and understands the working of the port and brings an understanding of local conditions that may affect the conduct of a ship. The master (and other bridge staff) should know their ship, the state of its equipment and its handling characteristics. The exchange of such information is no guarantee that accidents will not happen, but the briefing and proper planning reduce the risk of an adverse event.

The SMS documentation required under *Astor*'s International Safety Management (ISM) Certification for passage planning states:

> Passage planning should be carried out in accordance with the ICS Bridge Procedures Guide and British MGN 72. The plan should be made out on the Passage Plan checklist, which should be signed by the Master prior to sailing.

The third edition of the International Chamber of Shipping (ICS) 'Bridge Procedures Guide', 1998, contains a number of sections pertaining to the master/pilot relationship and the exchange of information. At section 3.3.3.3., covering the master/pilot exchange, the Guide states:

> The preliminary pilotage passage plan prepared in advance by the ship should be immediately discussed and agreed with the pilot after boarding.

The United Kingdom Maritime and Coastguard Agency issued Maritime Guidance Notice 72 [MGN 72] in August 1998.[14] The summary states:

> This notice draws attention to systematic planning of all stages of a voyage. (A detailed annex complements the ICS Guidelines.)

In Chapter V (Regulation 34) of the SOLAS Convention (as amended in 2000), an obligation for proper voyage planning is placed on the masters of ships and on their staff. Guidelines to assist ships' staff for such planning are contained in IMO Resolution A.893(21). Paragraph 3.1 of the Resolution clearly states that:

> On the basis of the fullest possible appraisal, a detailed voyage or passage plan should be prepared which should cover the entire voyage or passage from berth to berth, including those areas where the services of a pilot will be used.

The number of authoritative references to passage planning and the sheer volume of guidance underline the importance of proper planning. As MGN 72 notes:

> Most accidents happen because of simple mistakes in use of navigational equipment and interpretation of the available information, rather than because of any deficiency in basic navigational skills or ability to use equipment.

There is no evidence that the ship's staff had prepared an adequate 'berth to berth' passage plan, that is, one including the plans for departure and arrival.

When the pilot boarded *Astor*, he went to the bridge. The pre-departure planning was conducted with the staff captain. The ship had developed no substantial plan of its own for the outward pilotage phase of the voyage, the inference to the pilot being that the ship would accept the pilot's plan. However when the master came to the bridge, he took minimal note of the pilot's documentation.

At no time was the pilot told by the master that he (the master) would maintain conduct of the ship in the harbour and through the Platypus and Sea channels. However, the pilot did not pursue the matter further with the master when it became evident that the master was not going to hand over the conduct of the ship to the pilot after it had left the berth. The pilot, on realising that the master would retain the con, adopted an advisory role. The pilot did not verbally establish exactly who had the con of the ship and the role the other person was to follow, and assumed the master had the con.

In submission, the Townsville pilot wrote:

> At that critical phase it was not the appropriate time to instigate an argument. Being of the school that accepts that the master has control of his vessel at all times and the option of the con should he so wish (other than Panama pilotage), I made

14 Marine Guidance Note 72 was superseded in October 2003 by a Marine Guidance Note on the Interpretation of SOLAS Chapter V.

> a conscious decision not to be confrontational over the issue and to adopt the time worn cliché 'To master's orders and pilot's advice', intending to advise him of the particular wheel over positions as they arrived, keeping the advice as simple, understandable and unambiguous as possible.

It is understandable that a master, particularly where a master manoeuvres a particular ship on a regular basis, would want to manoeuvre the ship alongside or off the berth. But a pilot is employed to con the ship in waters where he/she has detailed knowledge. The master of *Astor* maintained the conduct of the ship after the ship was clear of the berth. Under such circumstances it would be reasonable, at the very least, to expect the master and pilot to agree on such an arrangement and for the master to follow the pilot's advice. This is particularly important in a port in which the master has no prior experience.

The pilot had not committed any error that would have required the master to intervene and over-rule the pilot or take over the conduct of the vessel. The pilot was effectively excluded from the information flow between the master, helmsman and engine control as all orders were given in Ukrainian. When he advised the master to alter course, it was his opinion that his advice was ignored.

The discussion of the pilot's outward passage plan with the staff captain hardly qualifies as 'using the services' of a pilot. Such discussion alone does not support the practice of good bridge resource management, particularly when the staff captain's role was to set the pitch of the propellers as instructed by the master and to monitor the helmsman. It is therefore a matter of semantics whether the master was using the services of the pilot or not. Effective communication between the master and pilot, in the period of time leading up to the grounding, was virtually nonexistent.

A master's normal role during port pilotage is to have an overview of the overall passage of his ship and to be in a position to intervene early if things do not go to plan. This is a good use of his/her experience and is in accordance with bridge resource management principles. By maintaining the actual conduct of the vessel during all phases of the pilotage, *Astor*'s master was unable to perform this role effectively.

An important aspect of good shipboard operations is the interpersonal relationships between the crew, including the pilot when one is embarked. All *Astor*'s bridge staff were either Ukrainian or Russian nationals, and the pilot, Australian. Prior to boarding *Astor*, the pilot was aware that he may experience some difficulty with the master. Statements by other pilots who had worked with this master referred to the fact that, while the master appeared aloof and standoffish, they did not experience the difficulties that the Townsville pilot did on departure.

It is therefore not unreasonable to say that this incident was caused, in some part, by the poor interpersonal relationship that developed between the pilot and the master, which was aggravated by the lack of communications between the two.

Bridge Resource Management (BRM)

Nijjer (2000) defines BRM as 'the use and coordination of all the skills and resources available to the bridge team to achieve the established goal of optimum safety and efficiency'.[15]

BRM should begin at the initial pre-passage planning stage to identify the dangers to be met and the necessary precautions and contingency arrangements, and continue until the end of the passage. A debriefing should be held shortly after the passage to analyse the events and to identify improvements that can be made in the BRM arrangements for subsequent passages. BRM should include a clear identification of all the bridge team members at all stages of the voyage, their relative duties and responsibilities, and the line of command including the levels of authority in making, challenging or responding to decisions and instructions.[16]

The Maritime Safety Authority of New Zealand issued Shipping Notice 10/1997 which stated:

> Effective BRM results in good situation awareness, anticipates danger in an evolving situation, obtains relevant information early, delegates tasks and responsibilities, sets priorities and has contingency plans. It uses all data available with appropriate screening, monitors progress and helps the bridge team recognise the early development of an error chain and to take action to break the sequence.

The consequences of a transport accident in terms of injury or death, damage to costly equipment, damage or delay to cargo and pollution of the environment imposes a duty on all operators to act responsibly and ensure the highest practicable level of safe operation. Shipping is not an exception to the rule. BRM provides a method of organising the best use of human and other resources on the bridge to reduce the level of operational risk. The key safety aspect of BRM is that it puts in place defences against 'single person errors', which can result in a serious casualty.

Effective BRM principles include:

- good communications
- briefing/debriefing
- challenge and response
- delegation
- situational awareness and
- cultural awareness.

One of the positive outcomes for a ship in the effective use of BRM principles is that they allow for the early detection of errors and an optimum response to an emergency by establishing contingency planning in the minds of the people involved.

Central to the practice of effective BRM is good, interactive, 'closed loop' communication, thorough briefing in the master/pilot information exchange to create a 'shared mental model'. The system should encourage decisions to be challenged which elicits appropriate responses. When interviewed by ATSB investigators, the master stated

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15 Nijjer, R. (2000) *Bridge Resource Management: The Missing Link*, Sea Australia 2000, Sydney.

16 AMSA Marine Notice No. 34/2002 (superseding 7/1994).

that he had attended BRM training. The ship's staff on *Astor*'s bridge on departing Townsville did not practise any of these principles.

When the pilot advised the master about having the ship aligned on the centreline of the channel before exiting the harbour, and subsequently to alter course for the channel (a type of challenge and questioning of the master's intentions) the master simply did not reply.

Operational communications between the ship's bridge complement and the pilot was virtually non-existent. Operational orders were given in Ukrainian and there was no attempt to relay them in English so the pilot could understand what was being said.

Section 1.2.10 (Use of English) of the ICS 'Bridge Procedures Guide' states that:

> Communications within the bridge team needs to be understood. Communications between multilingual team members, and in particular with ratings, should either be in a language that is common to all relevant bridge team members or in English.

Additionally, in section 3.3.3.4 (Monitoring the pilotage), it states:

> It is recommended that communications between the pilot and the bridge team is conducted in the English language (see section 1.2.10).

A pilot is considered part of the bridge team when he/she is on board a ship. *Astor*'s SMS documentation references the ICS 'Bridge Procedures Guide'. While the pilot was on board, the ship's officers did not follow company procedures by conducting bridge team communications in a language other than English.

BRM is considered so crucial to navigational safety that reference to it is contained in the Seafarer's Training, Certification and Watchkeeping (STCW) Code[17], and BRM training has been mandated as part of seagoing certification training by most Flag state administrations. In addition, the basis of the ISM Code is to minimise the scope for poor human decisions during shipping operations that could contribute directly, or indirectly, to a marine casualty or pollution incident. BRM provides ship personnel with the tools to assist in implementing the Code.

BRM is not only the responsibility of the master, as all bridge team members have a role to play in the operation of a ship during pilotage. The failure of effective BRM was directly causal in the grounding of *Astor*.

Fatigue and drugs

The pilot had been on leave from 10 to 24 February 2004. He had piloted two ships on the afternoon of 25 February and he had completed his shift at 0100 on the morning of 26 February. He was on shift again on the afternoon of 26 February and had piloted two ships before joining *Astor*. The afternoon had been busy, starting at 1430, when he departed the pilot station to join the first ship at the pilot boarding ground, but the pilot's workload and duty hours had not been excessive and he was not fatigued.

17 Annex 2, Section B-VIII/2 (Guidance regarding watchkeeping arrangements and principles to be observed), Part 3-1.

Astor had berthed in Townsville earlier on 26 February. While in Townsville, the master and officers on the bridge at the time of the incident were not engaged in any activities, which are considered to have caused them to be fatigued when the ship departed at 1900.

There is no evidence that neither alcohol nor drugs, prescribed or illicit, were taken by any of those involved in the grounding.

6 CONCLUSIONS

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

Based on the available evidence:

1. The investigation has been unable to determine the degree, if any, to which the reported steering malfunction contributed to the grounding.

The following factors, however, are considered to have contributed to the incident on 26 February 2004, independently from any steering malfunction:

2. The master did not accept the pilot's advice after the ship left the berth.
3. Communications on the bridge were in a language the pilot was not able to understand.
4. The ship's master and bridge team members did not employ good BRM practices at any time leading up to the grounding.
5. The master had not positioned the ship correctly for a turn to starboard into Platypus Channel.
6. The master did not present an outward passage plan to any of those present on the bridge at the time of departure.

The investigation into the grounding of *Astor* was complicated by the fact that VDR data was not backed up in the time immediately after the grounding (highlighting a deficiency in crew training in this important facet of ship operations) and by the fact that company procedures were not followed with respect to the keeping of bridge records.

The investigation showed:

7. That crucial VDR information is easily lost by unintentional actions.

Of additional concern to the safety of navigation and the prevention of pollution on the Australian coast is that:

8. The master did not declare any steering defect to the Cairns pilot or port authority and *Astor* entered the Cairns Channel using only one steering motor on the port rudder without the pilot's knowledge.

7 RECOMMENDATIONS

MR20040021

Ship owners, managers, operators and masters of ships ensure that all bridge staff are fully trained in the correct operation of VDR data backup procedures for the particular ship on which they are serving.

MR20040022

Manufacturers of VDR units should ensure that indicator lights are free of any possible ambiguity and that consideration be given to printing emergency back-up instructions on VDR control panels on ships' bridges.

MR20040023

Masters of vessels should not actively con the ship directly during pilotage unless they are familiar with the port and they do so in full agreement with any pilot.

MR20040024

Ships' masters should ensure that all bridge orders in pilotage waters are in a language understood by pilots and ships' staff.

MR20040025

Ship owners, managers and operators should instruct masters and ships' crews to use all elements of effective Bridge Resource Management at all times.

8 SUBMISSIONS

Under Part 4, Division 2 (Investigation Reports), Section 26 of the Transport Safety Investigation Act 2003, the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the Executive Director about the draft report.

The final draft of this report was sent to the master, staff captain, chief engineer and managers of the ship, the Townsville pilot, Townsville Port Authority, the GBR pilot, Maritime Safety Queensland, the Bahamas Maritime Authority, the steering gear manufacturers and the Australian Maritime Safety Authority.

Submissions were received from the ship's managers, the Townsville pilot and The Bahamas Maritime Authority.

Submissions were included and/or the text of the report amended where appropriate.

9 *ASTOR*

Previous names	*Astor* (1986), *Fedor Dostoevskiy* (1995)
IMO number	8506373
Call sign	C6JR3
Flag	Bahamas
Port of registry	Nassau
Classification society	Germanischer Lloyd (GL)
Ship type	Twin propeller passenger ship, ice strengthened
Builder	Howaldtswerke-Deutsche Werft A G Kiel, Germany
Year built	1986
Owners	Astor Shipping Company, Cyprus
Ship managers	Passat Shipmanagement, Cyprus
Summer displacement	14 440 tonnes
Gross tonnage	20 606
Net tonnage	7 637
Deadweight (summer)	3 880 tonnes
Summer draught	6.10 m
Length overall	176.50 m
Length between perpendiculars	151.90 m
Breadth	22.60 m
Moulded depth	13.40 m
Engines	2 x 3 300 kW Sulzer 6ZAL40 2 x 4 400 kW Sulzer 8ZAL40
Total power	15 400 kW
Rudder type	Twin 'semi-spade'
Bow thruster	1 x 860 kW
Crew	294

Independent investigation into the grounding of the Bahamas registered passenger ship *Astor* in Platypus Channel, Townsvile, Queensland, 26 February 2004

Astor 8.04

ISSN 1447-087X
ISBN 1 877071 75 7

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