Departmental investigation into the contact with "Old Man Rock", Darwin Harbour by the Singaporean livestock carrier CARABAO 1 on 21 January 1996

MIIU

Report No 90

Transport and Regional Development

Contents

Navigation Act 1912
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investigation into the
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Darwin Harbour
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CARABAO 1
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Summary

On Sunday 21 January 1996, the Singaporean flag, 1941 tonnes deadweight livestock carrier Carabao 1, while sailing under pilotage from the privately owned Labroy wharf, Hudson Creek, Darwin, struck Old Man Rock, in the East Arm of the harbour.

No compartments were breached and no pollution occurred. An inspection carried out by divers ascertained that only minor indentation was visible on sections of bottom plating on the vessel's starboard side and the vessel was permitted to continue on its voyage.

Sources of Information

The Mate and Helmsman, mv Carabao 1

The Harbour Master, Darwin

The coxswain and deckhand of the Darwin pilot launch Mathew Flinders

Darwin Port Authority

Rooney Shipping & Trading Pty Ltd, Darwin, Agent for Labroy Marine Pte Ltd of Singapore

Territory Diving Services, Darwin

Northern Territory Department of Transport and Works

Department of Defence, Public Affairs Office

Airservices Australia, Brisbane Office

Hydrographic Office, RAN, Wollongong

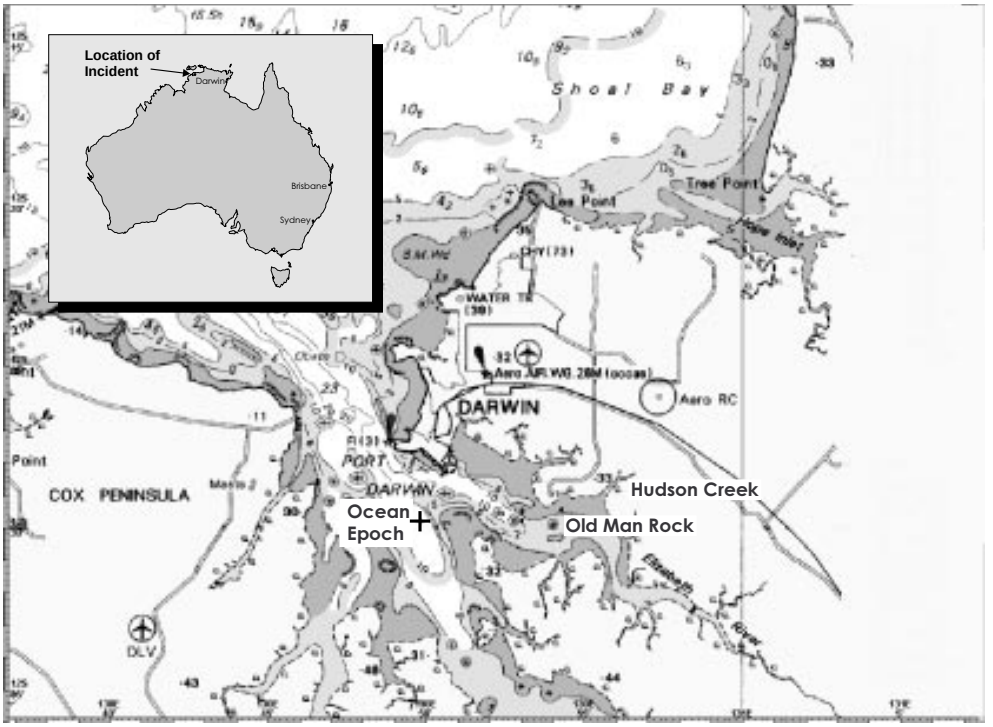
Bureau of Air Safety Investigation, Investigation Support Section

At the time of the investigation, neither the Master nor the Second Mate were available for interview, both having left the vessel, the Master also having left the owner's employment. Efforts to obtain written information from the two officers proved fruitless.

Acknowledgement

The Inspector wishes to thank the Harbour Master, Darwin for making the pilot launch available to the Investigating Officer, to enable him to observe the tidal flow around Old Man Rock, also for providing the investigating officer the opportunity to observe the pilotage of Carabao 1 to and from the Labroy wharf on 11 and 12 March 1996, respectively.

Portions of navigation charts Aus 309 and Aus 28 reproduced by permission of the Hydrographic Office, RAN.



Portion of chart Aus309 showing location of incident

Narrative

General

Carabao 1 is a 1941.3 tonnes deadweight, single hold, livestock carrier having an overall length of 66.667 m, a beam of 13.21 m and a summer load draught of 5.312 m. Built in Haugesund, Norway in 1974 as a general cargo/heavy lift ship primarily for the Baltic trade, the vessel is strengthened for ice and, as such, the hull is ideal for a trade where the vessel sits on the bottom in tidal rivers. Because of the original heavy lift capability, the vessel is fitted with large diameter

air pipes to the double bottom ballast tanks, to facilitate the rapid transfer of ballast during heavy lift operations. The vessel is equipped with a magnetic compass, radar, GPS and echo sounder.

Main propulsion is by means of a
1394 kW Alpha diesel engine driving a single, variable pitch propeller in a fixed Kort nozzle, providing a service speed of 12 knots. The vessel is also equipped with a bow thruster. At the time of the incident, neither the bridge control of the variable pitch propeller nor the bow thruster had been functional for some considerable time.

The vessel was purchased by the present owner, Labroy Marine (Pte) Ltd of Singapore, in 1994 and was the second of three vessels purchased and converted for carrying cattle in the developing trade between northern Australian ports and the Archipelagic Islands to the north. The vessel frequently loads at Hudson Creek, Darwin, as do the company's other vessels Camira and the recently acquired Janet 1.

Carabao 1 is manned by a Filipino master and crew, the latter comprised of two deck officers, two engineers, one radio officer and eight ratings. An Australian stockman is also carried.

Hudson Creek is a drying creek located on the northern shore of the East Arm of Darwin Harbour, and lies about five miles above the main jetties of the Port of Darwin. The main channel of the creek lies on its eastern side, the eastern bank of the channel being steep-to and about two metres high, while the western side rises gently to about 1.5 m above chart datum and is strewn with rocks and boulders.

The privately owned Labroy wharf is of concrete construction, built on reclaimed land on the western side of Hudson Creek, and was originally designed to accommodate Lady Geraldine, a 2.8 m draught landing barge. Development of the wharf, to accommodate the

deeper draught vessels, included the bulldozing of the western side of the creek adjacent to the wharf to 0.5 m above chart datum level. Water depth indicators (half metre divisions) are painted on piles at each end of the wharf, to help indicate whether the vessel is actually afloat. Three pole beacons were installed to mark the eastern side of the main channel of the creek, the outer beacon also indicating the datum contour where the creek enters the East Arm. For night-time operations the Port Authority attaches a portable battery operated strobe light to each of the beacons. Vessels proceeding to and from Hudson Creek pass to the south of both South Shell Island and Old Man Rock, both of which lie close northward of the centre line of East Arm, both of which become covered by the tide and are marked by beacons.

Photograph: Darwin Port Authority

Old Man Rock

Old Man Rock Beacon

Old Man Rock is the pinnacle of an ironstone and quartz ridge, running north and south and extending about 25 m southward of the pinnacle, at the southeast point of a flat, rock strewn shoal. The shoal has a drying height of about one metre above datum, while Old Man Rock has a drying height of 5 m above datum.

Pilotage is compulsory for vessels, other than local craft, proceeding to and from Hudson Creek[1]. Vessels are usually berthed at, and sailed from, the Labroy wharf while the tide is still flooding, as a contingency measure against being caught on the mud on a falling tide.

The incident

Carabao 1 arrived in Darwin from Amamapare, Indonesia on the afternoon of Friday 19 January 1996 and, after undergoing quarantine inspection, berthed at the Labroy wharf, Hudson Creek, starboard side to in accordance with normal practice, at 1749. The vessel then proceeded to load 733 head of cattle for Cilicap, South Kalimantan (formerly Tjilitjap, South Borneo) plus the necessary fodder and fresh water.

Loading completed on schedule and the Harbour Master boarded at 1655 on Sunday 21 January, to pilot the vessel outwards through the harbour. Arriving by pilot launch, he first checked the vessel's draught fore and aft (4.1 m and 5.2 m respectively) and the depth of water (5.3 m), to ascertain that the vessel was in fact afloat. Time of predicted High Water was 1925, with a height of tide of 7.8 m.

The Harbour Master presented himself to the Master and advised him that the vessel was afloat and that, in his opinion, the vessel could sail as soon as they were ready. He also advised the Master Carabao 1 might require a bit of a push to get it over the mud ridge that forms along the port bilge keel, caused by the vessel sitting on the bottom. The Master agreed to sail immediately, advising the Harbour Master that everything, apart from the bow thruster, was working properly.

The Harbour Master followed the usual procedure for taking the vessel off the berth, the pilot launch Matthew Flinders taking a line

[1]As from 23 May 1996, pilotage is no longer compulsory for Labroy vessels in Hudson Creek. However, this exemption from pilotage is open to review.

from the port quarter and the workboat Mister Mick pushing on the starboard bow. The last line was cast off at 1705 and, once clear of the wharf, the vessel was turned to port to head for the eastern side of the creek, then manoeuvred to head down the main channel. As soon as stations were secured aft, the Second Mate went to the bridge: forward, the Mate remained on the forecastle, supervising the stowage of the mooring ropes and standing by in case an anchor should be needed.

Due to the shallowness of the water in the creek, the Harbour Master proceeded at slow speed until the third, outer beacon was abeam to port, recorded as being at 1725, when the vessel entered East Arm and he ordered Full Ahead. Following his normal practice, particularly on a vessel not fitted with a gyro compass, he conned Carabao 1 visually, giving the helmsman helm orders rather than a course to steer, and adjusted the heading to bring Old Man Rock beacon to a position about 5° to 7° on the starboard bow.

The pilot launch, having been relinquished from its duties as a tug, followed astern of Carabao 1, at a distance of about 260 m, the crew wishing to keep clear of the pungent cattle smell. On the way down the creek their attention was drawn towards the latter part of the RAF "Red Arrows" air display, centred over Mindil Beach and the Casino, five and a half miles (10 km) to the north-west.

Although it was the rainy season, there was little or no wind and the air was clear with good visibility. The sky was overcast with high cloud and there were distant showers, mainly to the west. The Harbour Master conned the vessel by watching the relative movement of the A-frame derrick post and forestay against Peak Hill, on the south side of East Arm, and the relative position of Old Man Rock beacon on the starboard bow, adjusting the course as necessary to counter the effect of the flooding tide.

A lone dinghy was at anchor, about 400 m east by north of the beacon, lying to the flooding tide and fishing, close to the normal line of approach. The Harbour Master therefore adjusted the course a few degrees to port, to keep clear of the dinghy.

The Harbour Master's normal procedure is to approach to a position "three good ship's lengths", or about 200 m to 250 m, off Old Man Rock beacon and, with the beacon about 20º forward of the starboard beam, to commence a constant radius turn to starboard, maintaining the beacon on a steady relative bearing, until the vessel arrives on the next course. This manoeuvre usually requires between 5º and 10º of starboard helm, the amount being adjusted to maintain the correct turn. The easterly flooding tide, passing over Old Man Rock, had been found to help keep vessels clear of the rock.

However, the presence of the dinghy and the adjustment of the heading resulted in Carabao 1 arriving at the wheel-over position at about twice the normal distance from Old Man Rock beacon. Mindful of the shallows over the mid East Arm ridge to the south, the Harbour Master did not want to make a constant radius turn, as this would take the vessel too far to the south. Instead, he made a quicker turn to starboard, using 20º of starboard helm to initiate the turn. He then steadied Carabao 1 on a heading with South Shell beacon about five degrees on the starboard bow, judging that he was on his normal track, but about
100 m further east, but then he realised that the relative bearing of Old Man Rock beacon was too far forward of the beam for this to be the case.

At that time, the drilling rig Ocean Epoch was anchored in the Middle Arm of the harbour, due west of South Shell beacon and provided a distant marker for the course between Old Man Rock and South Shell beacons. With Carabao 1 steadied on the new course, Ocean Epoch was bearing about 2° on the starboard bow and about 3° to the left of

South Shell beacon. While proceeding between Old Man Rock and South Shell, the angle between Ocean Epoch and South Shell should open, with South Shell beacon opening to starboard. However, the Harbour Master suddenly realised that instead of opening, this angle was closing, meaning that Carabao 1 was being set quite rapidly to starboard, towards Old Man Rock beacon.

Knowing that the rock shelves away from the beacon and that he had at least 6 m of tide, and realising that if he applied port helm the stern would cant to starboard, towards the rock, the Harbour Master considered that Carabao 1 should just pass clear if he maintained course. However, when the beacon was about 10º forward of the starboard bridge wing, at a time recorded as being 1735, there was a slight shock of contact amidships and Carabao 1 rocked to port. A few seconds later, when the beacon was abeam of the bridge, there was a second contact. The Harbour Master thought that the beacon was passed at a distance of about 100 m, whereas the Master reported the distance as being 15 m to 20 m. The Coxswain of the pilot launch, which had just completed its turn astern of Carabao 1, said the distance was one to one and a half beam widths, or 13 m to 20 m.

The Harbour Master instinctively called for a reduction in speed, but then countermanded that almost immediately, not only to avoid loss of steerage, but also deciding that Carabao 1 should be taken clear of the danger grounds of Old Man Rock and South Shell Island. He therefore continued to direct the vessel towards the main port area. The Master, in order to ascertain whether the vessel had been holed and taking in water, ordered the Mate to take one of the crew and to sound the bilges and double bottom tanks.

As soon as the vessel had rounded South Shell Island, where he estimated the tide as running at about 3.5 knots, and had negotiated the strong tidal shear experienced in that area, the Harbour Master

reduced the speed to slow ahead and went down into the cargo hold to see for himself. The bilges were found to contain some water and cattle urine, but this was at a steady level. However, when the sounding pipe to No 2 starboard double bottom tank, located in the hold, was opened, water gushed out and it was immediately closed again.

Returning to the bridge, the Harbour Master used his mobile telephone to contact various persons ashore, to advise them of the incident and to arrange for divers to inspect the hull for damage, then brought Carabao 1 to anchor off the main port at 1818. Thereafter he suggested that the ballast pump be started to pump from No 2 starboard double bottom tank, suspecting that this might have been "over filled" during ballasting operations alongside the wharf. The water level in No 2 starboard double bottom tank was duly lowered, after which it remained steady, indicating that the tank had not been breached by the contact with Old Man Rock.

A diving team arrived at the vessel at 2030 and an underwater inspection of the hull plating, within two metres of the starboard bilge keel[2], and of the propeller and rudder was conducted from 2045 to 2120. The diver was equipped with a helmet mounted video camera and those on the surface were able to monitor his progress and direct the inspection. The inspection revealed no visible damage to the bilge keel and only minor gouging, less than 3 mm, and minor depression, less than 40 mm, of some plating between frames. In the opinion of the leader of the diving team, the indentations were consistent with the age and service history of the vessel.

With the appropriate authorities satisfied that no serious damage had occurred, Carabao 1 was cleared to sail at 2130 and was under way at 2137, the sea passage to Cilicap being commenced at 2142, 21 January 1996.

[2] Subsequent drydocking of the vessel in August 1996 revealed damage to the bottom plating in way of the engine room.

Comment and Analysis

The Harbour Master at Darwin has considerable experience in piloting in the port, having been harbour master and pilot of the port since 1977. During that time he had conducted, by his own estimates, some 13 - 14,000 pilotage operations and it had always been his practice, whenever possible, to conduct the pilotage of every vessel calling at the port for the first time. As there is only one other full time pilot employed by the Port Authority, it is reasonable to assume that he would have conducted half, at least, of the Hudson Creek pilotage operations, which during 1995 were between 12 and 18 per month.

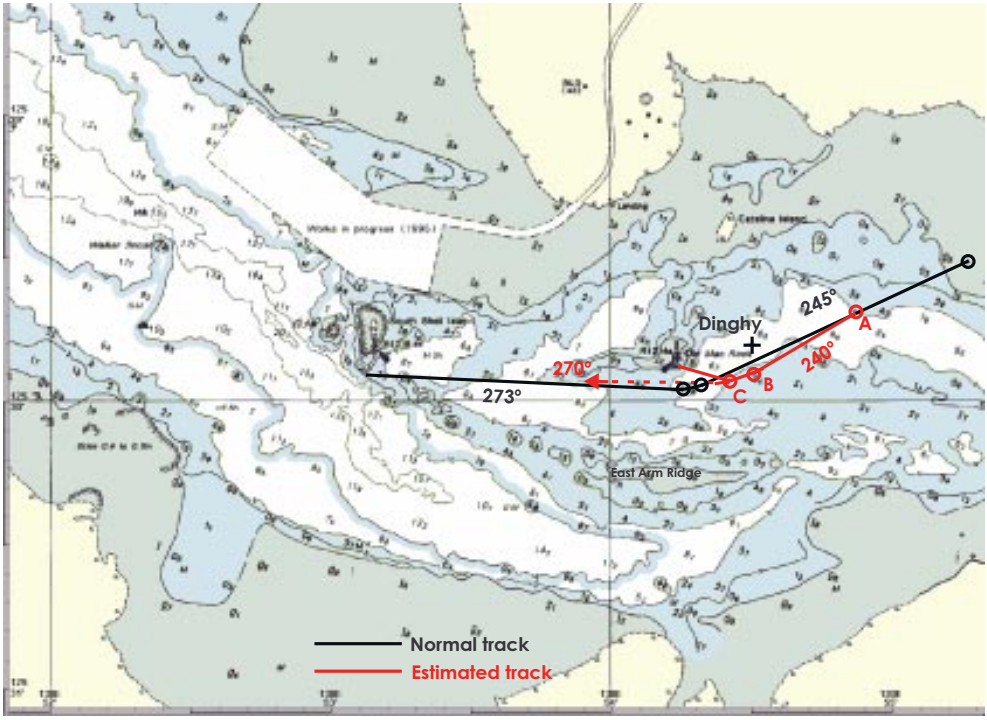
There was no mechanical, power or systems failure and, according to the Harbour Master, the helmsman responded correctly to all orders given to him.

To ascertain how and why a routine departure turned into an incident it is first necessary to try to reconstruct what occurred.

Reconstruction and Analysis

Contemporaneous records of what took place are sparse. Carabao 1 is not equipped with a course recorder and little information is recorded in the Bell Book, just the time the Pilot boarded, the time of casting off and the time of the contact with Old Man Rock. The Harbour Master's note book contains the time he boarded, the vessel's draught, and the times of the last line, clear and proceeding, deep water and full ahead (passing the third beacon) and the time of the contact with Old Man Rock.

At the time of the investigation there was no detailed information on the tidal direction and rate in the vicinity of Old Man Rock. The flood



Portion of chart Aus 28 showing estimated track of Carabao 1

tide is considered to flow in generally an easterly direction and local opinion is that the rate at Old Man Rock is less than that at South Shell.

In the absence of more detailed statements from the Master and 2nd Mate, reconstruction has to be based mainly on the information provided by the Harbour Master.

Old Man Rock and South Shell Island beacons are in transit on a bearing of 271¾°. The Harbour Master stated that he waited until South Shell beacon had opened to the south, until Old Man Rock was at its usual relative bearing (70° to starboard), before altering course to starboard. Although he did not note the ship's head when steadied on the next course, he considered that it was probably around 270° True.

The distance between No.3 beacon and the contact position is 1.115 miles and the time factor was 10 minutes (1725 - 1735) requiring an average speed of 6.69 knots. The speed of the vessel on passing No.3 beacon was considered by the Harbour Master to have been about four knots, thus at the time of the contact Carabao 1 would have been making good a speed over the ground of about nine knots.

Had the Harbour Master commenced the turn to starboard when Old Man Rock beacon was on the usual relative bearing, in this instance a bearing of 310º True, then when Carabao 1 was brought on to the next course, Old Man Rock beacon would have been bearing a little over four points on the starboard bow at a distance of about 250 metres. For Carabao 1 to then make contact with the rock, a north flowing tide nearly equal to the ship's speed (nine knots) would have been required.

For the incident to occur without a northerly set component of the flooding tide, the Harbour Master would have had to initiate the alteration of course before Old Man Rock and South Shell beacons came into transit. As the two beacons would have then been close to being in transit when Carabao 1 was steadied on the next course, this would immediately make it obvious that the vessel was not positioned correctly.

Based on the limited information available, it is probable that the Harbour Master commenced the starboard turn at about 1733:30, at position (B) shortly after the two beacons were in transit, and that he steadied the vessel on the westerly heading at about 1733:55, at position (C). In this position, on a heading of 270°, South Shell beacon would lie 5°on the starboard bow, and Ocean Epoch 1.5° on the starboard bow.

Position (C) is 320 metres east and about 125 metres south of the beacon. For Carabao 1 to contact Old Man Rock required a north

flowing current of just under three knots. When Carabao 1 passed South Shell beacon, 1.06 miles to the west, a few minutes after the incident, the Harbour Master estimated the tidal rate as being more than 3.5 knots. It is improbable that Carabao 1 would have been any further south than this (C) position.

It is considered the Harbour Master commenced the turn after the transit of Old Man Rock and South Shell beacons, but before Carabao1 had reached the normal relative bearing of Old Man Rock beacon forward of the starboard beam. This early start of the turn, combined with the quicker turn, resulted in Carabao 1 being north of the normal track and in such a position that it would pass Old Man Rock some 80 to 100 metres closer than normal, if the tidal flow conditions were those normally experienced.

Consideration of the Harbour Master's actions

A slight deviation from the normal procedure was occasioned by the presence of a dinghy close to the normal line of approach to Old Man Rock, resulting in Carabao 1 approaching so as to be off the beacon at a distance, as judged by the Harbour Master, to be about twice that which was his normal practice.

The Harbour Master realised that the usual practice of a constant distance/relative bearing turn was not appropriate, as that would place the vessel too far to the south after completing the turn. Instead, he chose to make not only an earlier, but also a quicker turn. Whereas either a slightly earlier turn, when the beacon was at four points on the bow, or a quicker turn at the normal relative bearing, would have produced the desired result, an earlier, quicker turn was a misjudgment of what was required. It is considered that, faced with a deviation from the usual operational procedures, the Harbour Master did not fully evaluate the changed circumstances and assess what appropriate action was required.

It is essential that pilotage planning includes contingency planning, covering the various possibilities that may cause or require a deviation from the normal procedures and the appropriate actions necessary, taking into account the available options.

Fatigue and alcohol

Although the Operations Superintendent holds a limited pilotage licence (limited to maxima 125 metres length and 6.5 metres draught) which enables him to assist if necessary, the majority of the pilotage is conducted by the Harbour Master and Deputy Harbour Master. Although the previous week had been relatively busy, the Harbour Master had not conducted any pilotage operations on Saturday 20 January and the Carabao 1 sailing on Sunday 21 January was his only job for that day. In his view, he was well rested when he boarded Carabao 1 on the Sunday afternoon.

The Harbour Master's habit is not to consume alcoholic drinks whilst on duty, or when required for work later, and the only alcohol he had consumed that weekend was a shared bottle of wine at dinner on the Saturday evening.

It is considered that neither acute fatigue nor alcohol were factors that may have affected the Harbour Master's judgment in this incident.

Distractions

During the course of the investigation, it was suggested to the investigating officer that the Harbour Master had been distracted by the RAF Red Arrows aerobatic display. The Harbour Master denied this, stating the aircraft had flown almost directly overhead of Carabao 1, on their way to the airfield at the end of the display, as the vessel passed the outer beacon of Hudson Creek at 1725.

Advice received from the Department of Defence and Airservices Australia was that the aircraft were airborne at 1704, there was a 20-minute display and the aircraft landed at 1733 after a number of passes over the airfield.

The Red Arrows air display is quite spectacular and it would take a very strong will to ignore it entirely; however, the display had finished about 10 minutes before the incident occurred. Although the aircraft were still in the air over the airport for a few minutes after the display, they were all on the ground by the time the Harbour Master initiated the turn off Old Man Rock.

Possible visual distraction by the air display is therefore not considered to have been a contributing factor.

Carabao 1 is a regular visitor to Hudson Creek and therefore arrivals and departures could be considered routine. Under such circumstances familiarity can lead to a relaxation in concentration and an indulgence in non relevant conversation. The Master did remark upon one of the Red Arrows' colour trails, a heart, being very appropriate due to the approaching Saint Valentine's Day, but according to the Harbour Master, the Master's command of English was not conducive to involved conversation.

Inattention due to unrelated conversation is therefore not considered to have been likely. However, a relaxed attitude, due to familiarity with, and the small size of, the vessel, cannot be ruled out.

Perceptual tunnel vision

It is possible, when concentrating on a distant point, to mentally ignore closer objects, particularly the wider the angle of the closer objects from the direction of concentration. Thus, while concentrating on lining up Carabao 1 with Ocean Epoch and South Shell beacon fine on

the starboard bow, rather than making a constant relative bearing turn, it was possible for the Harbour Master, for a time, to have lost awareness of the relative position of Old Man Rock beacon. It is considered that this may have been the case, as it was only when lined up on South Shell Island that the Harbour Master became aware that Old Man Rock beacon was too far forward of the beam.

Port Development and tidal flow

The increasing trade links between Australia and Asian countries have provided the opportunity for Darwin to become a much larger transport centre. To take advantage of this opportunity the decision was taken to build a completely new port facility.

Initially, the new development was to take the form of a dredged deep water basin, in the vicinity of North Shell Island. However, the hard rock nature of the sea bed made dredging impractical, necessitating infilling to deep water.

Construction work on the new port project started in February 1995. A solid causeway was constructed from the point between Bleesers and Hudson creeks to North Shell Island, followed by infilling in the proposed new port area.

The main tidal flow in East Arm is mainly east going for the flooding tide and west going for the ebb. However, before construction work commenced, as soon as a rock reef joining Catalina Island to the northern shore line was covered at 2.5 metres flooding tide, a counter, or westerly flow would occur along the northern shore. Experience had shown that once Old Man Rock was covered, the flooding tide flowed over the top of the rock and helped keep vessels, rounding it to eastward, from getting too close.

During the development stage of the project, the tidal flow was checked in the main port and the proposed new port areas and modelling, to determine possible effects on the manoeuvring of vessels off the new berths and tug requirements, was undertaken at the Australian Maritime College in Launceston. Modelling of the East Arm tidal flows, to a point approximately 500 m east of Old Man Rock, was also carried out on behalf of the contractors by Australian Water and Coastal Studies Pty Ltd. This indicated a generally easterly flow during flood tides, although strong north-westerly and south-westerly flows were indicated during ebb tides. The contract for the construction of the new port did not call for the tidal flows to be monitored to establish if any changes to the flows did occur.

At no time before this incident, had any of the pilots experienced a northerly tidal set after rounding Old Man Rock.

When the investigating officer visited the area of Old Man Rock in the pilot launch during the evening of 8 March 1996, at around two hours before high water, there was a noticeable tidal shear, with a slight westerly flow, about 200 metres north of the beacon. When proceeding to Hudson Creek on the morning of 12 March, a tidal shear was noticed to the south-west of the beacon at about 0900, one and a half hours before high water, but this was not evident when Carabao 1 passed one hour later. However, at that later time, a slight westerly flow was evident at the beacon, although Janet 1, holding about 1300 metres to the east of the beacon, was experiencing an easterly set.

While piloting a ship to sea from Hudson Creek at the time of the March Spring Tides, the Assistant Harbour Master experienced a strong northerly set while approaching South Shell island, something not experienced before. Also, much stronger tidal shears and eddies are now experienced to the south and west of South Shell island.

The causeway and earth works of the new port development extend about one third of the high-water width of the East Arm and it is apparent that, during Wet Season Spring Tides at least, the tidal flow in the vicinity of both South Shell Island and Old Man Rock has been affected quite considerably. Not only is a surface counter flow now evident at Old Man Rock at certain stages of the flood tide, it is possible that a strong northerly sub-surface flow may develop in the channel close east of the rock, but only careful monitoring will determine this.

If such a sub-surface flow does exist, this would be stemmed on the normal line of approach and rounding of the beacon. However, after making the turn from a wider approach, a vessel would be crossing such a flow almost at right angles.

It is considered that it would have been appropriate for the contract for the construction work of the new port to have required the tidal flows to be monitored, using both flow rate and direction recording monitors, particularly with the increased usage of the Hudson Creek wharf. In the absence of such a requirement, it would have been appropriate for the Port Authority Management to arrange for and to ensure that such monitoring was carried out.

Bridge management and operational procedures

Regulation II/1.10 (Navigation with pilot embarked) of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 states:

"Despite the duties and obligations of a pilot, his presence on board does not relieve the master or officer in charge of the watch from their duties and obligations for the safety of the ship. The master and the pilot shall exchange information regarding navigation

procedures, local conditions and the ship's characteristics. The master and the officer of the watch shall co-operate closely with the pilot and maintain an accurate check on the ship's position and movement."

When the Harbour Master boarded the vessel for departure, there was a brief discussion between him and the Master as to the operational readiness of the vessel and on the clearing of the berth. The pilotage plan for the passage through the harbour, with clearing distances and wheel-over positions, was not discussed.

The ship's bridge team consisted of the Master and a helmsman, with the addition of the Second Mate when not required for stations aft. However, pilotage was left entirely to the pilot, in this instance the Harbour Master. Neither the Master nor the Second Mate carried out any checks, no advice was given to the pilot as to distances from, or passing distances off, strategic points and, in fact, the appropriate navigation chart was not even on the chart table.

Although language difficulties reportedly precluded all but general formalities, a drawn plan, showing headings, clearing distances and wheel-over positions would have enabled some discussion with both the Master and the Second Mate. This would have familiarised them both with the pilotage operation and enabled them to monitor the situation effectively, particularly had the Harbour Master requested their input.

When conning visually and bringing a point to bear on the bow, it is essential to check that the vessel is on the desired track, either by fixing the position on the chart, or by checking by radar, or by checking the True heading. In confined waters, there is very often insufficient time for position fixing and effective use of the radar is the quickest means of checking. However, parallel indexing has its limitations in areas where there is a large tidal range and low gradient

foreshore and small beacons may not show on the radar screen at very close range, particularly if the radar is not tuned correctly.

A check of the true heading, when initially lined up, will provide a quick indication of the vessel's position relative to the intended track. A heading to the left of the correct course indicates the vessel is to the right of the desired track and a heading to the right indicates that the vessel is to the left of the desired track. With a vessel fitted only with a magnetic compass, it is necessary that the various compass courses are pre-calculated, before the pilotage operation commences.

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.

The following factors are considered to have contributed to Carabao 1 making contact with Old Man Rock:

1. Faced with a deviation from the usual operational procedures, the Harbour Master did not fully evaluate the changed circumstances and assess what appropriate action was required.

2. The Harbour Master's decision to make an earlier, quicker turn than normal, which resulted in Carabao 1 being shaped to pass Old Man Rock on the westerly heading at a much closer distance than normal.

3. The phenomenon of tunnel, or narrowing field vision while the Harbour Master was executing the turn around Old Man Rock.

4. The absence of any checks to ensure that Carabao 1 was at the correct wheel-over position before, and on the intended track at completion of, the turn off Old Man Rock.

5. A totally unexpected strong northerly tidal flow to the south-east of Old Man Rock.

6. The lack of structured bridge management procedures on board, to assist and monitor a pilot's actions.

7. The lack of a drawn up pilotage plan, one that included contingency alternatives.

8. The lack of a tidal monitoring regime for the area eastwards of the new port construction, either under the new port construction contract or under Port Authority Managment procedures, to ascertain any changes in tidal flows, particularly at Spring Tides, brought about by the new port development.

Submissions

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

The final draft of the report was sent to the Harbour Master, Darwin. Relevant portions of the final draft of the report were sent to Rooney Shipping & Trading Pty Ltd, as agents for the owner, and to the Port Manager, Darwin Port Authority.

Written submissions were received from the Harbour Master and the Port Manager and the text of the report was amended where considered appropriate.

On the subject of "Bridge managment and operational procedures", the Harbour Master submitted:

"... if no perceptible organisation exists then there is nothing to join. The Second Mate appeared on the bridge soon after departure when the harbourmaster was totally immersed in the business of piloting a ship which was not even properly afloat. We were not introduced nor did he make himself known nor did he seem to take any part in the pilotage operation. The master continued to respond to the pilot, relaying helm orders and operating the engine "telegraphs"."

On the subject of monitoring the tidal flows, the Port Manager submitted:

"The Water Resources Division of the Northern Territory's Power and Water Authority have deployed flow and direction meters on three occasions to verify the initial computer modelling. These were not placed east of South Shell Island but provided useful data which could be extrapolated for the adjacent areas.

Throughout the construction period, pilots have taken vessels to and from Hudson Creek at an average of just under four times per week. Each passage is at approximately the same stage of the tide, that is, inward just before high water and outward at, or near, high water.

Any changes of the tidal patterns at Old Man Rock would have been gradual, as the construction progressed, and should have been apparent over such a large number of pilotages. This monitoring of tidal patterns may not have been 'scientific' but should nevertheless, have revealed any major changes in either flow rate or direction of the tide in the vicinity of the Rock."