Australian Government
Australian Transport Safety Bureau

Grounding of the bulk carrier *Orient Centaur*

Weipa, Queensland | 6 November 2017

Investigation

ATSB Transport Safety Report
Marine Occurrence Investigation
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Cover photo: Ports North

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Addendum

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Safety summary

What happened

On 6 November 2017, the fully laden, mini cape-size dry bulk carrier *Orient Centaur* was transiting the South Channel, Weipa, Queensland, outbound under the conduct of harbour pilots as part of a trial introduction of this size of ship to the port. While in the South Channel, the ship's main engine shut down due to a loss of water from a cracked engine cooling component, and propulsion was lost. Shortly after, the ship grounded on the northern batter of the channel. The stern then slowly swung across the channel and grounded on the southern batter.

Under the guidance of the harbour pilots, three tugs were used to successfully refloat the ship. The ship was subsequently towed out of the channel to an anchorage. Surveys conducted over the following days identified that the ship did not sustain any damage.

What the ATSB found

The ATSB found that the approval process for this size of ship had only considered the risks associated with a main engine failure before the departing ship's entry into the narrow South Channel. The port risk assessment did not require the use of an escort tug for any ships transiting the South Channel during outbound voyages, and the tug masters had not been trained in the specifics of escort towage nor in emergency response.

What's been done as a result

The ship's managers advised there is now weekly on board testing of cooling water and every 6 months at a shore laboratory. Also, only manufacturers' original spares are to be used during maintenance.

In addition to the trial conditions, an escort tug is now used for all departing bulk carriers. All departing ships over 200 m now have an escort tug made fast, from the wharf to the South Channel exit. Further, two continuously manned, 85 tonne bollard pull azimuth stern drive tugs are now based at the Port of Amrun, about 60 minutes steaming time from the Port of Weipa.

All pilots and tug masters have completed emergency response and escort towage training at the Smartship simulator. The training included emergency towage scenarios, positioning and use of tugs in an emergency, competency in standard escort tug manoeuvres and indirect towage.

Arrival and departure briefs developed for the Port of Weipa have been updated with safety settings for the electronic chart display and information system, tidal information, weather conditions, wind limits and tug positions/line lengths. All masters and ship bridge teams are briefed before arrival and departure.

Safety message

The introduction of this size of ship to the Port of Weipa was preceded by identification, and risk assessment, of a number of hazards. However, aspects of tug escort and the potential for malfunction of the heavily-laden ships within the confined channel were not considered. This occurrence highlights the importance of considering potential hazards from end to end in order to provide the best opportunity to manage safety risk.

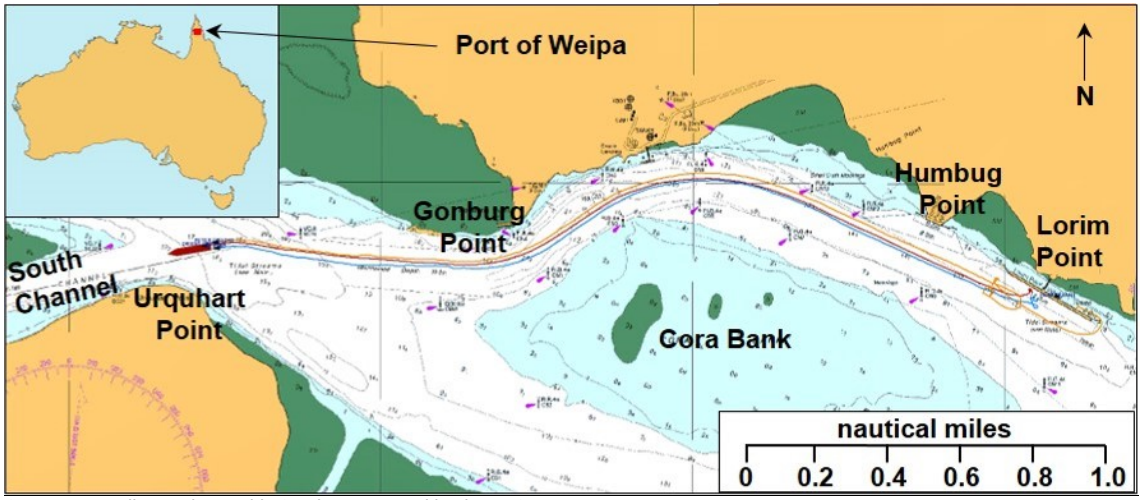
The occurrence

At 1120 Eastern Standard Time[1] on 6 November 2017, the 255 m dry bulk carrier *Orient Centaur* (cover) completed loading a cargo of bauxite in Weipa, Queensland. The draught survey was completed shortly thereafter, with departure draughts of 12.97 m fore and aft.

At about 1415, the Port of Weipa's dynamic under keel clearance (UKC) system became inoperative. As a result, the Weipa Vessel Traffic Services (VTS) duty officer was unable to determine the ship's UKC. Two harbour pilots allocated to *Orient Centaur* for its departure then calculated that, based upon the ship's draughts, tide and channel information, the static UKC would be 1.31 m.

At 1515, the ship's crewmembers commenced pre-departure checks for a 1615 departure from Lorim Point Wharf (Figure 1), to sail on the evening high tide[2] to China. Shortly after, and as required for this size of ship (mini cape-size)[3], the two harbour pilots boarded the ship. The pilot taking the conduct[4] (conning pilot) had worked in Queensland ports for 9 years and was a check pilot for the Port of Weipa. The second pilot (comms pilot) had worked in Queensland ports for 10 years and was also a check pilot for the Port of Weipa. Both pilots had also recently piloted sister ships to *Orient Centaur* departing Weipa.

Figure 1: Port of Weipa



Source: Australian Hydrographic Service annotated by the ATSB

The pilots were escorted to the navigation bridge and met by the master. By 1537, the ship's crewmembers had completed the pre-departure checks. At 1540, the master and pilots commenced the master-pilot information exchange (MPX) and discussed the pilotage. During the exchange, they discussed the Port of Weipa pilotage plan and the Full Mission Bridge Simulation (FMBS) departure report. [5] The ship's route, speeds, and UKC in the channel were detailed and the tug requirements, position and repositioning were explained. Two tugs were to be in attendance, *Peter Crooke* (48 t bollard pull)[6][7] on the centre lead forward, and *SL King* (69 t bollard

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1 Eastern Standard Time (EST): Coordinated Universal Time (UTC) + 10 hours.

2 Weipa has a diurnal tide range, which is characterised by one high water (tide) and one low water (tide) per day. Typically, with a diurnal tide each successive high or low tide is 24 hours and 50 minutes apart, this is the length of one lunar day.

3 A size that is at the lower end of the range of cape-size ships, which have dimensions larger than that allowable for transit of the Panama Canal.

4 Conduct of the ship's passage means directing the navigation and movement of the ship.

5 Weipa Port Procedures - Vessels in excess of 240 m in length with a beam greater than 38 m may be subject to Full Mission Bridge Simulation (FMBS) exercises before any approval will be considered.

6 The capacity of tugs is measured by their rated Bollard Pull. The Bollard Pull of a tug is the force it exerts at zero forward speed, in calm water conditions, with the engine working at its full power.

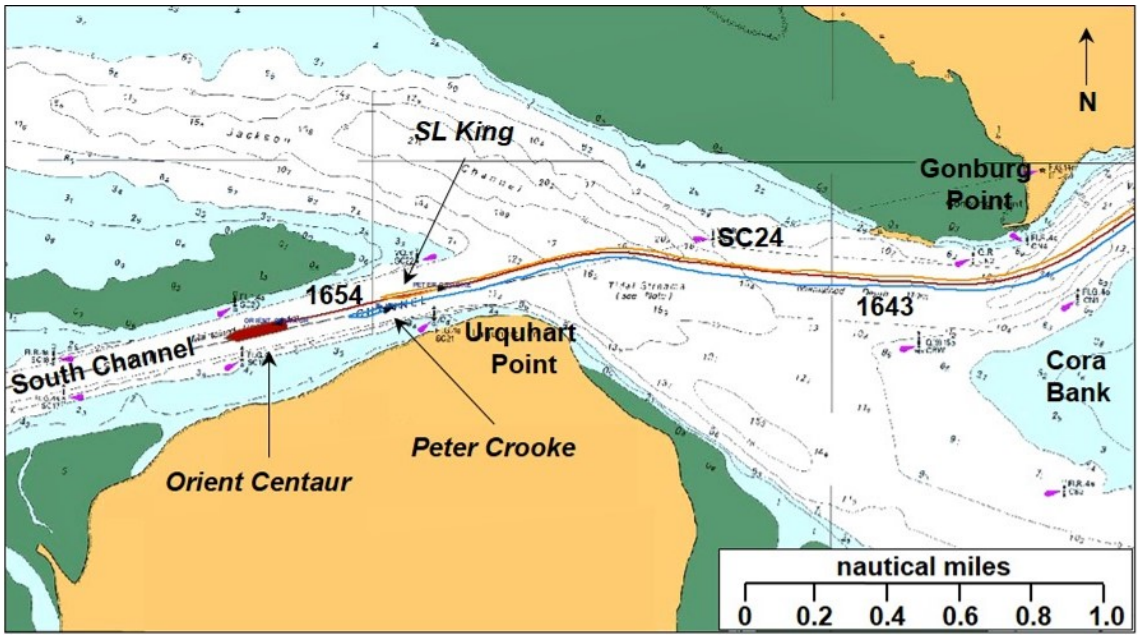
7 Bollard pull test measuring the static pull from the vessel undertaken in July 2012.

pull)[8] on the centre lead aft. The master was informed *Peter Crooke* would let go when the ship was off the berth and in the centre of the channel. *SL King* would let go at Gonburg Point.

The MPX form also noted that a flood tide setting from the north-west was expected at Urquhart Point, the entrance to the South Channel. The master and pilots completed the MPX at 1602, and the tugs were made fast shortly after. At 1610, the ship's last mooring line was retrieved on board, and shortly after, the tugs started pulling the ship off the berth. By 1615, the ship was in the centre of the channel off Lorim Point, and the conning pilot ordered slow ahead. At 1618, the conning pilot ordered half ahead, and *Peter Crooke* was let go and stood by off the starboard quarter as the ship proceeded north of Cora Bank, to Gonburg Point.

At 1643, as the ship passed Gonburg Point, *SL King* was let go and stood by on the quarter, and the conning pilot ordered full ahead. Shortly after, as the ship passed beacon SC24, the conning pilot ordered port helm and started altering course into the South Channel. At about 1654, when the ship was steady in the South Channel, the conning pilot released the tugs as they passed SC22, and they headed back to their berth (Figure 2). The ship then proceeded outbound in the South Channel as planned, at a speed of about 8 knots.

Figure 2: *Orient Centaur* passing Urquhart Point and entering the South Channel



Source: *Orient Centaur* VDR, annotated by ATSB

At 1716, as the ship passed SC13 and SC14, the ship's main engine jacket water header tank went into low-level alarm, followed by low-pressure and high-temperature alarms. The chief engineer phoned the bridge and asked the master to stop the main engine for repairs, as there was a cooling water issue. The conning pilot advised the master that half ahead was acceptable and the master moved the telegraph to half ahead. He then advised the chief engineer, the main engine could not be stopped as the ship was in a narrow channel.

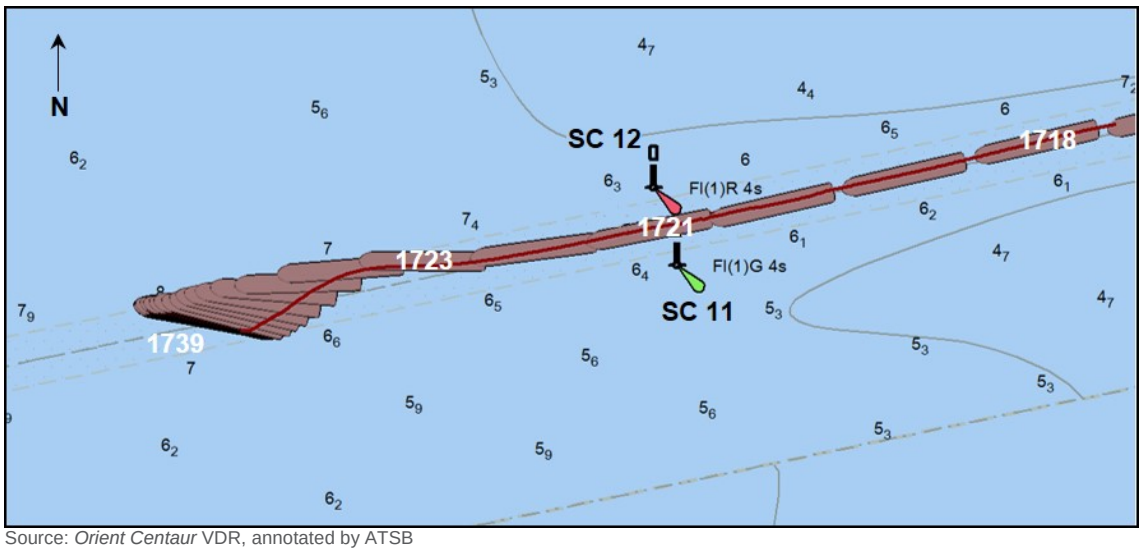
At 1717, the conning pilot asked the master to contact the chief engineer and confirm if half ahead was available for about an hour. Shortly after, the main engine's automatic slowdown was activated. The master tried to contact the chief engineer regarding the main engine status. The comms pilot reported the ship was experiencing engine problems to Weipa VTS, and then issued a general call to all tugs for assistance.

At 1718, the main engine shut down, with the ship's speed at 8.6 knots (Figure 3). *Peter Crooke* was the first tug to respond to the call for assistance, and the comms pilot asked the tug master to attend the ship as soon as possible. The comms pilot then made several further radio calls to

[8] Bollard pull information from the Port Procedures and Information for Shipping – Port of Weipa, August 2017.

Weipa VTS, stating 'the ship had lost the main engine, taking a sheer, and was about to ground in the vicinity of SC12'.

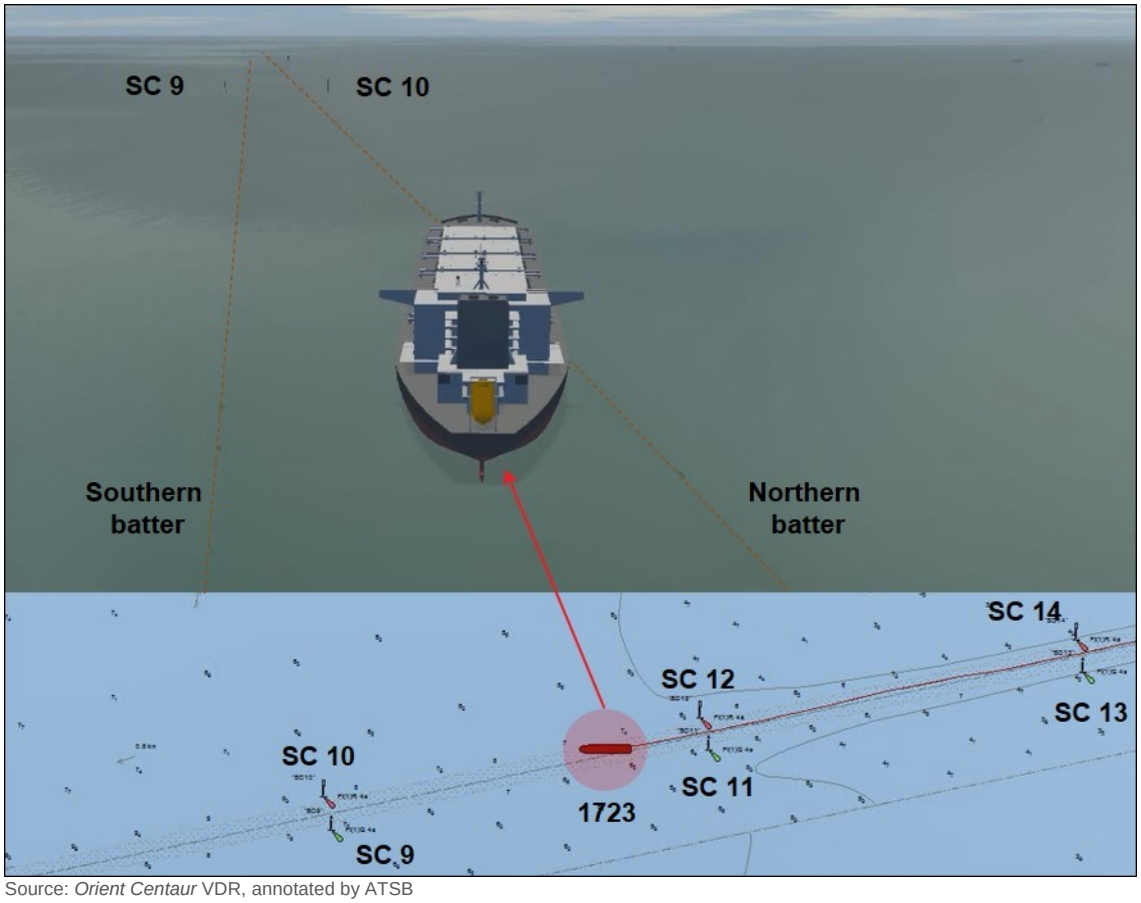
Figure 3: *Orient Centaur*'s main engine shutdown to the grounding at 1 minute intervals



Source: *Orient Centaur* VDR, annotated by ATSB

The ship's speed reduced to 8.3 knots as it passed beacons SC11/SC12, and it started to turn to starboard with an increasing rate of turn. The conning pilot ordered hard to port, but this had little effect. The ship continued to turn to starboard and at 1723 (Figure 4), the ship's starboard shoulder grounded on the northern batter (bank of the channel) of the South Channel, at a speed of 6.7 knots, on a heading of 270°, and the rudder positioned amidships.

Figure 4: *Orient Centaur* aground in the South Channel at 1723



Source: *Orient Centaur* VDR, annotated by ATSB

Shortly after, *SL King*'s tug master responded to the comms pilot's radio call and was asked to keep him advised of their position, as the ship's stern started to swing across the channel. The tug master advised that S*L King* had just passed the wharf and would be at the ship as soon as possible. *Peter Crooke*'s master also advised that they were about 3 minutes behind *SL King*. The comms pilot then made a radio call to Weipa VTS and requested a third tug, due to the need to control the situation before the tide dropped (high water was at 1737).

At 1728, Weipa VTS advised the comms pilot that the third tug, *Harry Evans* (43 t bollard pull)[9] had been raised and would head out to the ship as soon as possible. At 1730, the comms pilot phoned the Regional Harbour Master (RHM) to inform him of the grounding. Unable to reach him, he called the Assistant Regional Harbour Master (ARHM). Subsequently, the ARHM gave the pilots authorisation to act in whatever manner was required to get the ship off the bank and prevent it from being aground forward and aft, across the channel, with a falling tide.

Several minutes later, the comms pilot requested the pilot boat, *Windah*, to read the draughts on both sides of the ship and take depth soundings around the ship's stern. The comms pilot then advised *SL King*'s master to have lines ready to do heavy lifting upon their arrival.

By 1739, the ship had come to rest with the starboard shoulder aground on the northern batter, on a heading of 279°, south-west of SC 12 with the port quarter across the channel and drifting towards the southern batter.

At 1745, the comms pilot managed to contact the RHM and provided a situation update. At the same time, the ship's crew activated their emergency procedures for a grounding. The ship's stern continued moving slowly across the channel, before coming to rest on the southern batter at 1759, on a heading of 289°.

At 1800, the ship's engineers identified that the cooling jacket of the cylinder head of number one main engine unit cylinder had cracked, which led to the loss of the jacket water, and the subsequent shutdown of the engine. They then started a cylinder liner jacket overhaul for the failed unit.

Shortly after, *SL King* arrived off the ship's starboard quarter and put a line up through the starboard side panama lead. At 1805, the tug moved abeam and started holding the stern. At about the same time, the third tug, *Harry Evans* departed its berth and proceeded to *Orient Centaur*.

At 1808, the starboard anchor was lowered to one shackle[10] in the water to control the bow on refloating of the ship.

By 1810, *Peter Crooke* had arrived off the port quarter and put a line up through the port side panama lead. After the tug's line was fast, the tug started laying back to start pulling the ship astern from the grounded position.

Orient Centaur's stern started to slowly swing clear and away from the southern batter and, at 1820, the ship was refloated. Shortly after, *SL King* was relocated forward, to run a long line up the ship's centre lead. By 1823, the line was fast and the ship's deck crewmembers started heaving up the anchor.

By 1826, the ship's anchor was aweigh and, at 1830, *Orient Centaur* was back in deep water and being manoeuvred back into the centre of the channel. The pilot's plan from here involved *SL King* towing the ship, and for *Peter Crooke* (port quarter) and *Harry Evans* (starboard quarter), to steer the ship (Figure 5). The comms pilot then updated the RHM on the situation and the intended plan. The RHM advised the pilots that the ship should be towed to the emergency anchorage, that the Australian Maritime Safety Authority (AMSA) had taken charge of the incident, and that the ship was officially detained pending inspections.

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[9] Bollard pull test measuring the static pull from the vessel undertaken in July 2012.

[10] One shackle equals 90 feet or 27.43 m.

Under towage, the ship passed between SC10 and SC9 at 1838, at a speed of 3.8 knots with an UKC of 3.2m. At 1843, the third tug, *Harry Evans* was off the starboard quarter and by 1848, had made fast a line through the starboard side panama lead.

By 1856, the ship had passed SC7 at a steady speed of 4.5 knots and shortly after 1948, passed the fairway buoy and was clear of the South Channel.

The pilots and *Orient Centaur*'s master checked the proposed route to the emergency anchorage, and determined that the emergency anchorage position would not provide a satisfactory UKC for the ship in the loaded condition. At 2010, the comms pilot informed RHM that the emergency anchorage area did not have sufficient water for the ship's draught and an alternative position was agreed.

Figure 5: Tugs *Harry Evans* arriving at *Orient Centaur* and *Peter Crooke* fast on the port quarter

Source: Ports North pilots

At 2120, the tugs started slowing the ship in preparation for letting go the starboard anchor. Shortly after, *SL King* was cast off and the ship's crew prepared the anchor for letting go.

The ship's starboard anchor was let go at 2137. By 2206, all three tugs were clear of the ship and the pilots disembarked at 2218.

Orient Centaur remained at anchor throughout 7 November 2017, during which time the ship's engineers completed the cylinder liner jacket replacement. The main engine was tested and made ready for departure.

At 0800, 8 November 2017, marine surveyors from AMSA and the ship's classification society attended the ship with a dive team. The dive report noted some loss of paint on the starboard shoulder and no damage or paint loss on the port quarter.

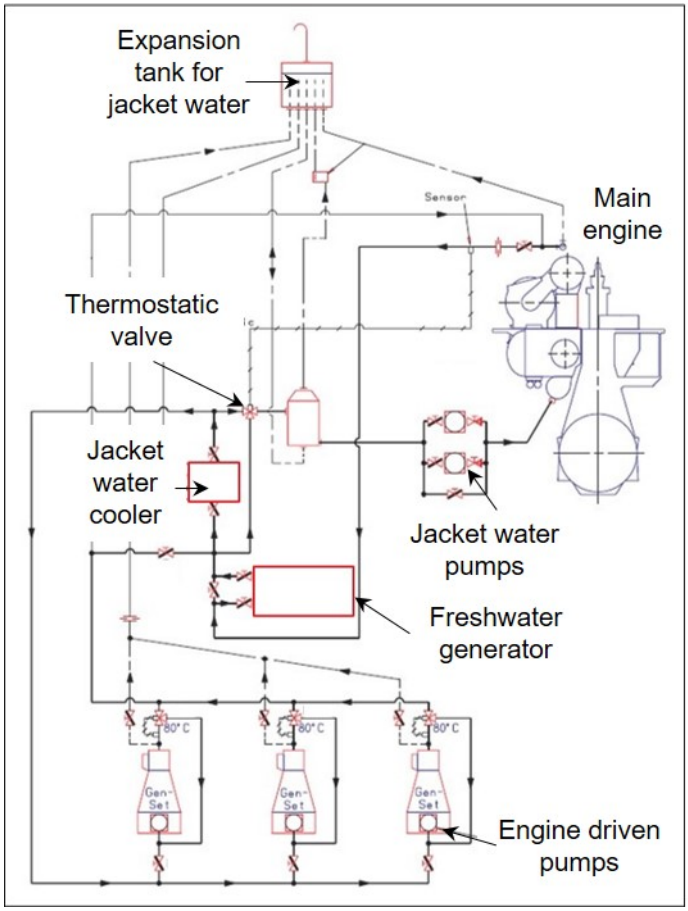
The AMSA surveyor revoked the detention order at 1345, and at 1518, the ship weighed anchor and proceeded to China.

Context

Orient Centaur main engine cooling system

Orient Centaur was fitted with a Hyundai MAN B&W 6S60MC-C7 slow speed engine (appendix A). The six-cylinder engine is cooled by a central cooling system.[11]

Figure 6: Jacket water cooling diagram



Source: MAN Two-stroke MC/MC-C Engines

The cylinder liner is made of alloyed cast iron and suspended in the cylinder frame with a low-situated flange. The top of the cylinder liner is fitted with a cooling jacket. The cylinder cover, made of forged steel, is attached to the cylinder liner and has bores for cooling water.

The jacket cooling water system (Figure 6) is used for cooling the cylinder liners, cylinder covers, and exhaust valves of the main engine, and for heating the fuel oil drainpipes.

The jacket water pumps draw water from the jacket water cooler outlet and delivers it to the engine. At the inlet to the jacket water cooler, there is a thermostatically controlled regulating valve, with a sensor at the engine cooling water outlet. That valve keeps the main engine cooling water outlet at a temperature of 80°C.

The engine manufacturer had issued a service letter (SL2014-584/LRA) in January 2014, regarding the cooling water systems associated with engines of this type. The service letter provided a number of possible actions to prevent corroded or cracked engine parts (cylinder cover, cylinder liner and cooling jackets) and cooling water leakage. It stated:

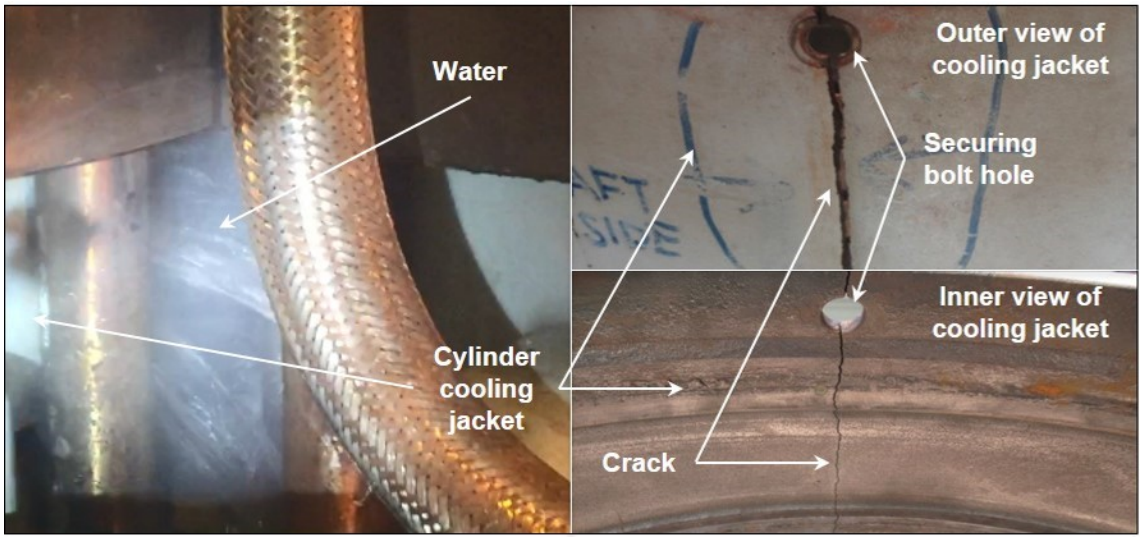
> …most cases of heavy corrosion in the cooling water system or cracked cylinder cooling jackets on the cylinder cover, were related to insufficient cooling water maintenance. Heavy deposits tended to find the way into the clearances between the cylinder cover and the cooling jacket. This made heat expansion of the cylinder cover impossible without also exposing the cooling jacket to significant stress as the heat expansion is reducing the clearances. In combination with heavy corrosion of the engine components caused by insufficient cooling water treatment, the cooling jacket may consequently crack.

Consistent with the detail in the service letter, the engine jacket water needed to be carefully treated, maintained and monitored to avoid corrosion, corrosion fatigue, cavitation, and scale formation.

[11] The cooling water system has three circuits: a seawater system, a low temperature freshwater system and a jacket cooling water system.

The crewmembers who were in the engine room at that time of the occurrence sighted water coming from a crack in the cylinder cooling jacket of the cylinder head of cylinder number 1 (Figure 7). The loss of jacket water triggered the main engine to shut down.

Figure 7: Cylinder cooling jacket failure and crack (after cleaning)



Source: Interorient accident investigation report annotated by ATSB

The engine manufacturer subsequently inspected the failed cylinder cooling jacket and identified that:

- the jacket had one vertical crack that passed through a securing bolt hole
- there were four bulges around the crack but no evidence of any impact marks
- the cooling space of the inner cooling jacket had heavy corrosion/rust and metal peeled off.

The cooling water systems were tested for nitrites, chlorides and pH after the incident. All were within limits, however the chloride tests of the high temperature cooling water were slightly high.

Port of Weipa

Located on the north-west coast of Cape York Peninsula, the Port of Weipa's primary export is bauxite (aluminium ore) from the Rio Tinto Alcan mine (RTA). North Queensland Bulk Ports Corporation (NQBPC) is a statutory Queensland government-owned corporation charged with overseeing the commercial activities in the port, including the maintenance of the port infrastructure. The primary function of NQBPC, under the *Transport Infrastructure Act 1994*, is to establish, manage and operate effective and efficient facilities and services within the port, while maintaining appropriate levels of safety and security.

Port Procedures

Maritime Safety Queensland (MSQ), the maritime regulator, administers the State's shipping legislation. MSQ appoint Regional Harbour Masters (RHM), who are authorised to give direction under the relevant provisions of the *Transport Operations (Marine Safety) Act 1994.* An RHM controls the pilotage areas within their region and has the authority to direct the master of a ship to navigate or operate a ship in a prescribed way.

Each pilotage area has a Port Procedures and Information for Shipping Manual (PPM).[12] The PPM details services, mandatory regulations and procedures to be observed. The manual also includes guidelines and information to assist masters, owners and agents of vessels arriving and departing the area.

[12] Port Procedures and Information for Shipping – Port of Weipa, August 2017.

MSQ operates a Vessel Traffic Service (VTS) for the Port of Weipa. The VTS is based at the RHM's office in Cairns, Queensland. VTS operators at Cairns have direct contact with shipping. In the event of an emergency, the VTS centre is the key notification and communications facility and activates the appropriate response agencies.

Pilotage

All ships that are 50 m or more in length, proceeding within a Queensland pilotage area, must carry a licensed marine pilot or be under the command of a master who holds a pilotage exemption certificate for the area. Far North Queensland Ports Corporation Ltd (Ports North) provide the compulsory pilotage service for the Port of Weipa, as well as for the ports of Cairns, Cape Flattery, Mourilyan, Karumba, Thursday Island (Port Kennedy) and Skardon River.

Sailing times

Ships can only depart Lorim Point on a flood tide and are scheduled so as to depart the berth 1 hour 15 minutes before the high water at Humbug Point (Figure 1). This scheduling allows ships about 30 minutes to enter and steady in the South Channel by the time they are off Urquhart Point. By that time, the tidal stream should have reduced to less than one knot.

First-strike response

The Port of Weipa had an emergency response plan (First-strike Oil Spill Response Plan), prepared by the Queensland Department of Transport and Main Roads, for dealing with pollution from ships. The plan detailed the operational arrangements between MSQ and Ports Corporation of Queensland and the response and handover arrangements for oil spills within the port. Further, the plan identified available resources and key contact information for responding to an oil pollution incident.

The plan was to be used in conjunction with the following:

- the Queensland Coastal Contingency Action Plan (QCCAP)
- Maritime Safety Queensland's Standard Operating Procedures for oil spill response
- the Oil Pollution First-Strike Response Deed for the Port of Weipa.

MSQ is both the statutory and combat agency for ship-sourced oil spills and the incident controller for all incidents within the scope of the plan. North Queensland Bulk Ports (NQBP) are responsible for ensuring that an adequate first-strike oil spill response capability is maintained within the port. The incident controller was the RHM, assisted by the NQBP Port Manager. The local first-strike response team consisted of six personnel, with either the NQBP Port Supervisor or MSQ representative as local incident controller, with five personnel from Rio Tinto Alcan.

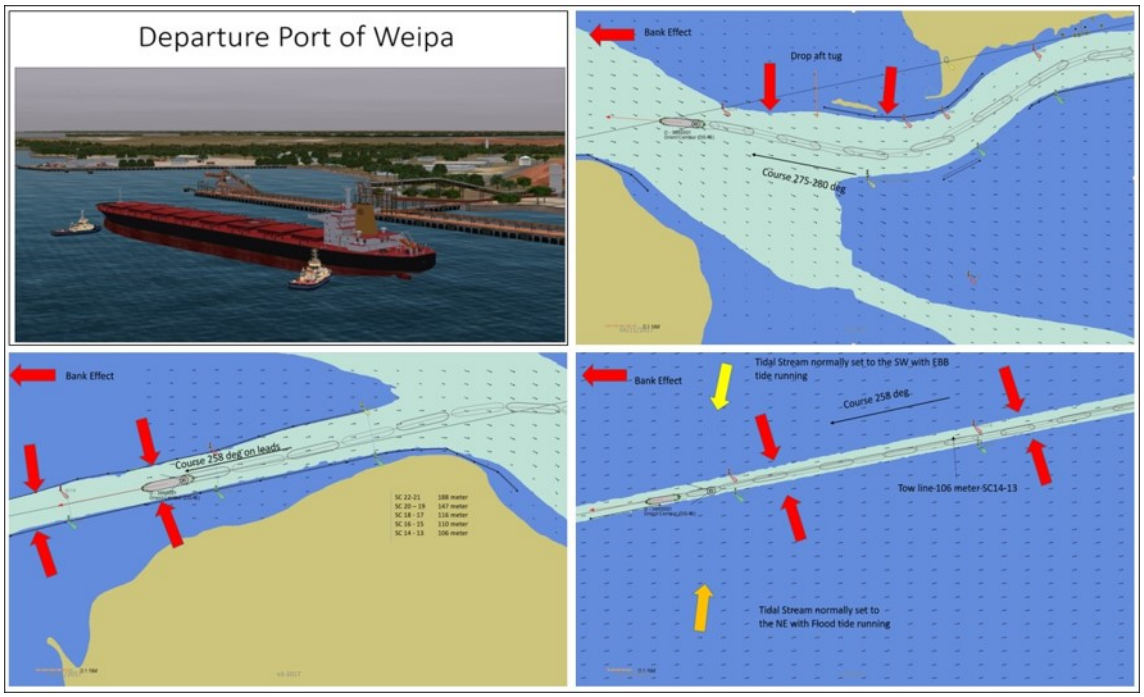
Although the grounding incident did not result in any pollution, the incident debrief attended by all directly involved parties identified an issue with the first-strike response. As NQBP and MSQ have only one officer each based in Weipa, NQBP utilises Rio Tinto personnel to meet their responsibilities. It was not clear whether the first-strike response team could have been assembled in a timely manner with the number of local personnel as required by the QCCAP.

Mini cape-size bulk carrier

Weipa arrival and departure simulation

In 2017, Rio Tinto Marine submitted a written application to the RHM for mini cape-size ships that were 255 m in length with a 43 m beam to export bauxite from Weipa. As the ships exceeded the port's size limits, Full Mission Bridge Simulation (FMBS) exercises were required. In May and July 2017, the RHM, pilot manager, several senior pilots and a Rio Tinto shipping specialist, attended the MSQ Smartship simulator in Brisbane, Queensland, to conduct the FMBS exercises. The exercises (Figure 8) used a model of the mini cape-size bulk carrier for arrivals in a ballast condition and departures in a fully laden condition, to a maximum draught of 12.8 m.

Figure 8: Port simulation exercise report



Red arrows show areas of bank effect, yellow arrows show flood tide, other annotations show ship's course, past positions and tidal information.
Source: MSQ regional harbour master (Cairns)

The ship's manoeuvrability was tested in normal[13] and extreme[14] weather conditions. The recommendations included, among others:

> The vessels push the limits for the channel, but simulation indicated they can safely enter and leave the port in conditions expected at Weipa.
>
> Before final sign off can be given the following will need to be completed:
>
> All pilots will need to spend two days in the simulator before handling the vessels to ensure they get "the feel". These vessels are marginal and it was shown in the initial simulation that the pilots need to get used to the lack of power and the effect on the steering capability.
>
> It was further recommended another 2-day simulation exercise be conducted to train two more pilots to handle the vessels. On the completion of the (Full Mission Bridge Simulation) exercise and risk assessment, a vessel of this class is chartered to Weipa for a couple of voyages to "prove" the feasibility. Provided this is successful more pilots would be trained and the number of mini cape vessels be limited to 5 vessels of the same class.

Risk assessment

The RHM's risk treatment action plan, based on the outcomes of the FMBS exercises for mini cape-size ships entering the Port of Weipa was completed prior to any shipment trials. The plan covered four areas, general, channel entry, berthing and departure. The plan also covered the risks, current controls, interventions and identified the responsible officer in each area.

The general risk controls included the PPM requirements, simulated arrival and departure conditions, bridge resources management issues, and ship characteristics among others. The risk controls also required that two pilots, appropriately qualified and trained in the simulator, were to be on board for the ship's transit.

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[13] Normal weather conditions – wind, 20 knots gusting 25 knots from south-east and current, 2.7 knots maximum on flood and ebb tides.

[14] Extreme weather conditions – wind, 30 knots gusting 35 knots from south-east, south-south-west, west and north-west and current, 2.7 knots maximum on flood and ebb tides.

The arrival channel entry risks detailed environmental effects, wind and leeway limits related to the 106 m wide South Channel widening to Cora Bank (Bell Mouth). The average draught of the mini cape-size bulk carriers in ballast was 7.5 m and the ships arrive on a rising tide, with the maintained channel depth at 11.1m. The risk assessment identified the possibility of main engine failure during arrival, and the ship's anchors ready and tugs available as the mitigating risk controls. This was on the basis that ships in ballast have shallower draught, and therefore have less chance of grounding in the 11.1 m deep approach channel. Further, with this greater clearance under the keel (compared to fully-laden deep draught departure channel clearance) the ships' anchors can be used to assist manoeuvring and control.

In addition, during arrivals, a tug is required to be on stand-by at SC24 beacon, at the entry into Cora Channel. The tug is positioned adjacent to the section of approach channel with the more shallow water outside the channel and thus the greater risk to grounding should a ship leave the channel. From this position, the tug is immediately available to assist ships on approach to Urquhart Point if needed.

The berthing risks included control measures for the ship's draught, usage of tugs, speed of approach and use of sound navigational methods. An intervention measure required that only pilots with an endorsement for mini cape-size ships would be assigned to this type of ship.

The departure risks identified the same areas of risk as for the channel entry, with the same controls and intervention measures. Engine failure was also identified as a risk, with controls being escort tugs, and that they be available.

At the conclusion of the exercises, the RHM recommended ship trials into the Port of Weipa under the following conditions:

- the vessels must be one of the five sister ships
- vessel to be loaded no deeper than 12.8 m and use static UKC of 10 per cent draught
- entry and departure for first six visits to be in daylight only
- two senior pilots who have attended the simulation to be on board
- wind conditions maximum 25 to 30 knots
- departure from Lorim Point to be 1 hour 15 minutes before high water at Humbug Point to minimise current at Bell Mouth
- tugs to be available to escort until vessel has entered the South Channel – this may restrict other departures or arrivals
- 6 trial shipments to be permitted subject to the above conditions
- following trial, review pilot observations
- should further shipments be approved all, pilots who conduct the vessel to have completed 2 days simulator training.

Tug requirements

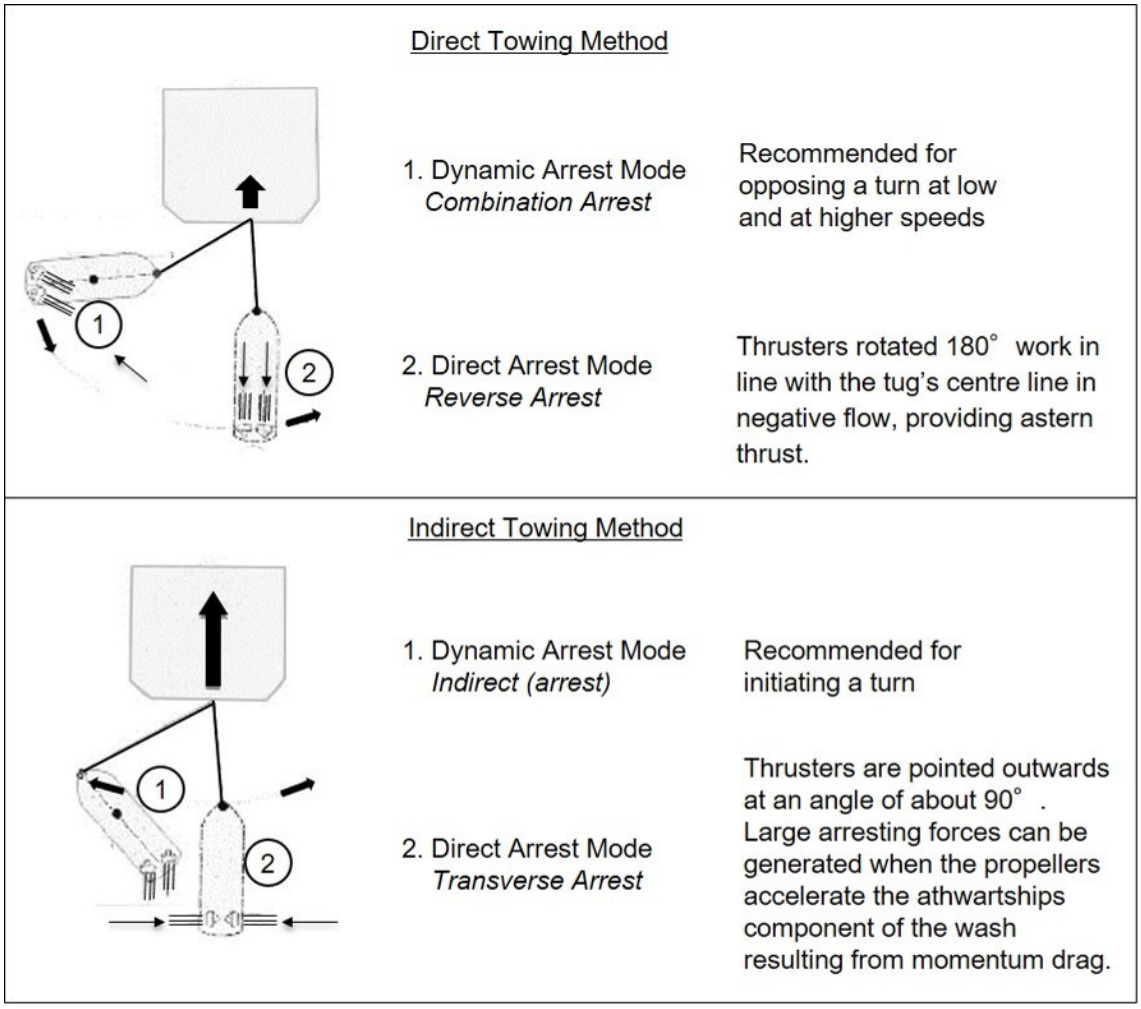
The PPM stated that all ships over a certain size that used the Lorim Point (Figure 1) berths were required to use a minimum of two azimuth stern drive (ASD) tugs for all movements. In addition, guidance for ships departing Lorim Point stated that the forward tug should be let go after the ship responded to helm movements, and the aft tug as required, when the ship was steady and passing Gonburg Point. Further, during the trials, tugs were to be available to escort until the ship had entered the South Channel. One of the objectives of escorting a ship is to apply high steering and braking forces via a towline to limit to impact of grounding. Escort tugs are specifically designed for this role to operate over long distances and at relatively high speeds. At the time of the occurrence, the Port of Weipa did not have any escort-rated tugs and the tug masters were not trained in the specifics of escort towage nor in emergency response.

ASD tugs can be operated in either direct or indirect towage methods (Figure 9). The method used in the Port of Weipa was direct towage, as the tugs were predominantly used for harbour work and assisting ship berthing and un-berthing manoeuvres. Direct towing is performed at low speeds from about 0- 5 knots. The tug uses its engines and propellers to generate the tow force (directly), which is governed by the conventional bollard pull of the tug.

Indirect towing can be performed at speeds in the range of 5-12 knots. The tug generates a tow force (indirectly) by putting tension on the tow line using a combination of the tug's weight, water pressure (from the tug's skeg) and the resultant drag of the propeller wash. The tug can assist swinging and steadying by working around the radius of the towline. When working at the stern of a ship, the pull on the towline can be increased by a factor of 1.5 to 2 times the bollard pull.

The effectiveness of the towage methods is also dependent on the availability of safe water to work in. In a narrow channel, the ability to work around the radius of the towline is restricted. Therefore, with the ship at speed (about 8 knots) in the South Channel (106 m) it was prohibitive for a tug to effectively steer it using dynamic arrest mode. However, direct arrest mode remained an effective option when retarding (braking assistance) forces were required.

Figure 9: Azimuth stern drive tugs - direct and indirect towage methods



Source: Tug Use in Port, A Practical Guide, Captain Henk Hensen, annotated by ATSB

Safety analysis

Main engine failure

As *Orient Centaur* proceeded outbound in the South Channel, the main engine shut down due to low cooling water flow, and a loss of propulsion.

The loss of cooling water was the result of a crack in a main engine unit's cylinder cooling water jacket through a securing bolt hole, an area of inherent stress concentration. Furthermore, consistent with the engine manufacturer's service letter, it is possible that the effects of corrosion products found in the cooling water space contributed to the cracking due to increased stress in the area of the failure.

Mini cape-size bulk carriers operation

Port risk assessment

The hazards associated with engine failure (loss of propulsion) during departure from Weipa was considered during the approval risk assessment process and were to be mitigated by having tugs in attendance until the ship was steady in the South Channel. On the day of the occurrence, and after the ship had passed beacon SC 21, the tugs were stood down and instructed to return to the berth. Consequently, when the loss of propulsion occurred in the narrow South Channel, there was no effective mitigation against grounding. The time taken for tugs to reach the ship would depend on its position in the channel, as well as the proximity of the tugs.

The subsequent investigation report observations prepared by the Regional Harbour Master (RHM) stated:

> Completed Risk Assessment shows having tugs standing by until vessel is steady in channel would help prevent the vessel "T boning" the shoreline in areas where the channel is wide enough for the vessel to sheer sufficiently to be 90 or almost 90 degrees to the bank when grounding could be more violent and lead to hull damage.
>
> Slope of batter in vicinity of Beacon SC 12 was beneficial to grounding as it slowly brought the vessel to a stop.
>
> Further to seaward increase in depth and reduction in slope of batter would have seen the vessel get further out of the channel and may have been grounded for more of the length of the vessel.
>
> No vessel discharge facility or equipment is available in Weipa.

As the South Channel was only 106 m wide, the ship was too long to 'T bone' in the channel. However, after grounding on the northern batter, the stern swung on the falling tide and grounded on the southern batter, effectively blocking the channel. There was then a significant risk the ship's structural integrity could be compromised and at that time, the pilots estimated they had about 30 minutes to refloat the ship. Fortunately, the actions taken by the tugs and the pilots on board enabled the ship to be re-floated before the falling tide rendered the task impossible.

The subsequent grounding debrief, attended by the RHM, Maritime Safety Queensland, Far North Queensland Ports Corporation Ltd (Ports North), North Queensland Bulk Ports and Smit Lamnalco, identified this risk:

> If the Orient Centaur hadn't been successfully floated the vessel may have grounded forward and aft across the channel. The steep channel batters coupled with the ebbing tide may have compromised the hull's integrity. This could have blocked the channel and essentially closed the Port of Weipa. Due to the potential complexity of the salvage and also the remote location and long transit times for suitable salvage equipment this could have led to a salvage and port closure lasting many months, which would have an effect on the Queensland economy.

Further:

> If the vessel had grounded further west where the gradient of the batter was more gradual, the refloat may have been more difficult, although hull integrity may not have been such a concern.

Simulation

The pilots stated that, during departure, *Orient Centaur* handled in the same manner as during simulation. However, during the simulation exercises for the mini cape-size ships, emergencies such as loss of propulsion and/or steerage were not simulated in the South Channel. The pilots had previously been trained in simulated emergency scenarios and escort towage, but only for events such as loss of propulsion and engine failure in smaller vessels when entering/departing the less confined Bell Mouth.

After the incident, the ATSB attended the Smartship simulator to observe several pilots participating in a 2-day mini cape-size ship simulation. During this time, the incident was simulated with and without tug assistance. With tug assistance (tow line centre lead aft), the ship was kept directionally stable and its speed reduced significantly, to control a grounding. Without tug assistance, the ship grounded in an uncontrolled manner.

The inclusion of a loss of propulsion simulation in a confined channel during the mini cape-size approval process would have informed the likelihood of grounding and the subsequent impact on port operations and provided the opportunity to practice the response to such an event.

Tug usage and availability in the Port of Weipa

In addition to the requirements of the Port Procedures and Information for Shipping Manual and the Ports North pilotage operations safety management system, the RHM required two tugs to escort a mini cape-size ship until it was steady in the South Channel. The tug crews then had to remain with the tugs until the ship had departed the South Channel.

The contingency for a ship grounding in the South Channel was that the tugs would be manned and ready to proceed to the ship. After *Orient Centaur* grounded, the tugs started to arrive at the ship after about 47 minutes.

The pilot's orders to the tug masters during the refloating of the ship were standard and well understood, and the required tug movements were also standard practice. However, during the recovery, the operation of two tugs working in close proximity on the stern of the ship was different to that of the day-to-day operations of the tugs.

With a ship at speed, and with two tugs working at the stern, interaction forces between water flow patterns are generated by both the ship and tugs, and between the tugs themselves. When tugs are towing on a line, the situation is further complicated, as they are frequently changing position and heading, therefore operating in areas where they experience different interaction effects. The tug masters were conscious of these effects and reported spending a lot of time avoiding contact with each other during the recovery. This was particularly apparent when asked to either layback, or move out to lift the ship's stern from port or starboard. This shows that a higher skill set than those associated with standard harbour towage practice was required during the response to the occurrence and for escort towage more generally.

However, the tug masters had not been trained in indirect towage methods, multiple tug usage or emergency scenarios. Additionally, at the time of the occurrence, the tugs were considered to be used as a means of controlling grounding and were not escort rated.

Emergency response to a pollution incident

This grounding occurrence did not produce any pollution however, in different circumstances activation of the pollution emergency response plan would been required. That response relied on trained personnel from North Queensland Bulk Ports to form the First-strike Oil Spill Response team. However, due to the limited availability of personnel at the time of the occurrence it was unlikely that that an emergency response to a pollution incident in the Port of Weipa would have

been initiated in a timely manner. As detailed in the *Safety issues and actions* section of the report, appropriate proactive action has been taken to improve the emergency response.

Findings

From the evidence available, the following findings are made with respect to the grounding of *Orient Centaur*, which occurred in the South Channel, Weipa, Queensland on 6 November 2017. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Safety issues, or system problems, are highlighted in bold to emphasise their importance. A safety issue is an event or condition that increases safety risk and (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

Contributing factors

- As the ship was transiting the South Channel, its main engine shut down due to a loss of cooling water associated with failure of the number 1 cylinder cooling jacket. Following the loss of propulsion, the ship's starboard shoulder grounded on the northern batter and its port quarter drifted across the channel to ground on the southern batter.

Other factors that increased risk

- **In pre-trial simulations, the risks associated with engine failure during departure were only considered up to when a ship had entered the South Channel. Consequently, the tugs were not in attendance to assist if propulsion was lost. [Safety issue]**
- The conditions for trial shipments required all pilots to complete extensive arrival and departure simulations, including transit through the South Channel. However, the simulations did not include contingencies, such as loss of propulsion and/or steerage that would have assisted in determining the risk of, and response to, such occurrences.
- **Tugs were to be available to escort the mini cape-size ships until they had entered the South Channel, where they were stood down. However, the tug masters had not been trained in the specifics of escort towage nor in emergency response. [Safety issue]**

Other findings

- At the time of the incident, it was unlikely that that an emergency response to a pollution incident in the Port of Weipa would have been initiated in a timely manner. Subsequently, appropriate proactive action has been taken to address the emergency response issues.
- The actions of the pilots, ship's crewmembers and tug masters following their arrival at the ship were timely and significantly reduced the consequences of the occurrence.

Safety issues and actions

The safety issues identified during this investigation are listed in the Findings and Safety issues and actions sections of this report. The ATSB expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to initiate safety action proactively, rather than to issue formal safety recommendations or safety advisory notices.

Depending on the level of risk of the safety issue, the extent of corrective action taken by the relevant organisation, or the desirability of directing a broad safety message to the marine industry, the ATSB may issue safety recommendations or safety advisory notices as part of the final report.

All of the directly involved parties were provided with a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

The initial public version of these safety issues and actions are provided separately on the ATSB website to facilitate monitoring by interested parties. Where relevant the safety issues and actions will be updated on the ATSB website as information comes to hand.

Mini cape-size risk assessment

Safety issue number:	MO-2017-010-SI-01
Safety issue owner:	Maritime Safety Queensland
Operation affected:	Shipboard operations
Who it affects:	All owners, operators and crewmembers involved in pilotage

Safety issue description:

In pre-trial simulations, the risks associated with engine failure during departure were only considered up to when a ship had entered the South Channel. Consequently, the tugs were not in attendance to assist if propulsion was lost.

Status of the safety issue

Issue status:	Adequately addressed
Justification:	The action taken by mandating the use of an escort tug from the wharf and throughout the South Channel to Beacon SC4, and additional tug availability, should adequately address the issue.

Proactive safety action

Action taken by:	Proactive safety action taken Maritime Safety Queensland
Action number:	MO-2017-010-NSA-01
Action date:	March 2018
Action type:	Proactive safety action
Action status:	Closed

Safety action taken:

The Regional Harbour Master advised the following proactive actions have been taken:

- In addition to the trial conditions, an escort tug is now used for all departing bulk carriers.
- Escort tugs for departing loaded vessels in excess of 200 m overall length are to be made fast centre lead aft tug are to be released at Beacon SC4.

- First choice Escort tug to be 65 tonne bollard pull.
- When two vessels are departing, the vessel in excess of 240 m will have the 65 tonne bollard pull tug, the other vessel will utilise one of the 44 tonne tugs. The escort tugs are to remain made fast until released at SC4.
- Two continuously manned 85 tonne bollard pull azimuth stern drive tugs are now based at the Port of Amrun and are about 60 minutes steaming time from the Port of Weipa.

Usage of tugs

Safety issue number:	MO-2017-010-SI-02
Safety issue owner:	Ports North
Operation affected:	Shipboard operations
Who it affects:	All owners, operators and crewmembers involved in pilotage

Safety issue description:

Tugs were to be available to escort the mini cape-size ships until they had entered the South Channel, where they were stood down. However, the tug masters had not been trained in the specifics of escort towage nor in emergency response.

Status of the safety issue

Issue status:	Adequately addressed
Justification:	The action taken by training all pilots and tug masters in emergency response and escort towage adequately address the issue.

Proactive safety action

Action taken by:	Proactive safety action taken Maritime Safety Queensland
Action number:	MO-2017-010-NSA-02
Action date:	August 2018
Action type:	Proactive safety action
Action status:	Closed

Safety action taken:

The Manager Pilotage Services advised the following proactive actions have been taken:

All Ports Norths pilots and Smit Lamnalco tug masters have completed together emergency response and escort towage training including:

- emergency towage scenarios
- positioning and use of tugs in an emergency
- competency in standard escort tug manoeuvres and indirect towage.
- Arrival and departure briefs developed for the Port of Weipa have been updated with:
- safety settings for electronic chart display and information system
- tidal information
- weather conditions
- wind limits and tug positions/line lengths.

All masters and ship bridge teams are briefed before arrivals and departures.

Additional safety issues

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Interorient, the ship's managers advised the following proactive actions will be taken:

- water analysis on board weekly
- water analysis at shore every 6 months
- checking appropriate tightening of Cylinder Head every 8000 hrs
- proper overhaul of cooling jacket (replacement of o rings and cleaning) and use of original spares according to manufactures instructions, service letters and manual every overhaul
- checking securing bolts as per manufactures service letters every overhaul
- proper tracking of running hours monthly
- original spare cooling to be available on board at all times
- all cylinder jackets renewed within 1 year from incident
- maker guidance/recommendations and service letters are followed as per planned maintenance system schedule.

North Queensland Bulk Ports (NQBP) advised their operations have been reviewed and have taken the following proactive actions:

NQBP have prepared a tender package for the provision of Salvage and Casualty Advice for all NQBP Ports to include:

guidelines to assist NQBP on items that may be included in vetting requirements to minimise the likelihood of an incident in the future

the establishment of appropriate minimum insurance requirements for ships using NQBP ports

provide response timing and plans, which are considered for reasonably foreseeable events within their Ports.

Obtained quotes for Vessel Vetting Service (Rightship) to facilitate implementation of additional vetting protocols. Implementation is planned following the review of Salvage Planning, as this work will also consider vetting parameters that can be enforced to minimise the likelihood of an incident occurring.

As part of this process, NQBP has already sought from each of our Terminal Operators detail of their vetting processes, specifically the criteria that they are vetting to.

Completed a First Strike Oil Response exercise in Weipa

NQBP was added to the Weipa VTS Incident Notifications

NQBP are currently in the process of undertaking a Risk Assessment & Management review of our Ports for marine operations. This process is being completed in conjunction with the RHM, Terminal Operators and Towage Providers for each Port.

General details

Occurrence details

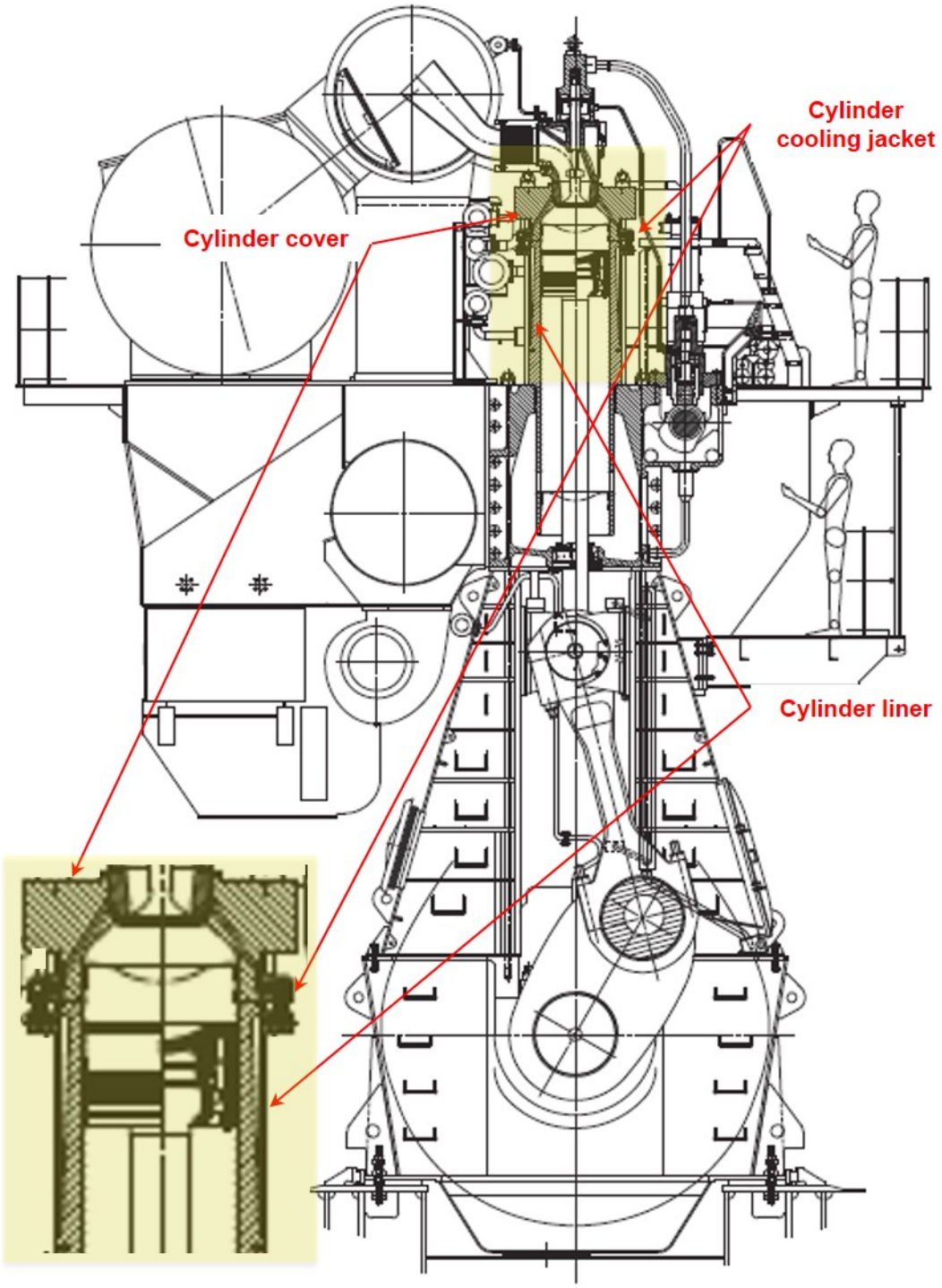
Date and time:	6 November 2017 – 1723 EST	
Occurrence category:	Incident	
Primary occurrence type:	Grounding	
Location:	12 km west-south-west Weipa, Queensland	
	Latitude: 12° 43.9’ S	Longitude: 141° 44.88’ E

Ship details

Name:	*Orient Centaur*
IMO number:	9464572
Call sign:	5BYD2
Flag:	Cyprus
Classification society:	Lloyd’s Register
Ship type:	Bulk carrier
Year built:	2010
Owner(s):	Orient Centaur Shipping
Manager:	Interorient Marine Services
Gross tonnage:	63993
Deadweight (summer):	114841 t
Summer draught:	12.97
Length overall:	255.258
Moulded breadth:	43.00
Main engine(s):	Hyundai MAN B&W 6S60MC-C7
Total power:	13560 kW
Speed:	14.5
Damage:	nil

Appendices

Appendix A – Engine cross section MAN B&W 6S60MC-C7



Sources and submissions

Sources of information

The sources of information during the investigation include:

- the master and involved crewmembers of *Orient Centaur*
- Interorient
- the Australian Maritime Safety Authority
- the Regional Harbour Master (Cairns), Maritime Safety Queensland
- the Manager Pilotage Services, Ports North
- North Queensland Bulk Ports
- Smit Lamnalco

References

Rowe, Captain RW (with Russell, Captain PJD). *The Ship Handler's Guide*, The Nautical Institute in conjunction with the Warsash Maritime Centre, London.

Hensen, Captain Henk. *Tug Use in Port, A Practical Guide*, The Nautical Institute, London.

Maritime Safety Queensland (MSQ) 2017, *Port Procedure and Information for Shipping – Weipa*, MSQ, Brisbane. Available at https://www.msq.qld.gov.au

Submissions

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

A draft of this report was provided to master and directly involved crew and managers of *Orient Centaur*, the ship's flag State, the pilots and manager pilot services, the Regional Harbour Master (Cairns), North Queensland Bulk Ports, Smit Lamnalco and the Australian Maritime Safety Authority and Regional Harbour Master (Cairns).

Submissions were received from the Australian Maritime Safety Authority, the pilots and manager pilot services and the Regional Harbour Master (Cairns). The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

The ATSB is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Terminology used in this report

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, current risk controls and organisational influences.

Contributing factor: a factor that, had it not occurred or existed at the time of an occurrence, then either:

(a) the occurrence would probably not have occurred; or

(b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or

(c) another contributing factor would probably not have occurred or existed.

Other factors that increased risk: a safety factor identified during an occurrence investigation, which did not meet the definition of contributing factor but was still considered to be important to communicate in an investigation report in the interest of improved transport safety.

Other findings: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which ‘saved the day’ or played an important role in reducing the risk associated with an occurrence.

Australian Transport Safety Bureau

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Investigation

ATSB Transport Safety Report
Rail Occurrence Investigation

Grounding of the bulk carrier *Orient Centaur*
Weipa, Queensland on 6 November 2017

MO-2017-010
Final – 14 November 2019