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Australian Transport Safety Bureau

Grounding of *Bulk India*

Dampier, Western Australia on 11 March 2018



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Addendum

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Safety summary

What happened

On 11 March 2018, during departure from Dampier, Western Australia under harbour pilot guidance, the bulk carrier *Bulk India* experienced an electrical blackout resulting in loss of propulsion and steering control. As a result, the ship exited the channel and ran aground. The ship was recovered into the channel with the aid of tugs, before being taken out the channel, to anchor, for further investigation.

What the ATSB found

The electrical blackout occurred because the auxiliary diesel generator engines shut down after the cooling water temperature controller malfunctioned, resulting in overheated cooling water. The ship's engineers did not immediately identify the problem and were unable to manually operate the cooling water temperature control valve in time to prevent the blackout.

The ATSB also found that the problems in the engine room started about 13 minutes before the blackout, however the two pilots on board were not informed of the situation. This removed the opportunity for the pilots to prepare for the loss of control, and delayed actions that may have assisted in a more timely or more effective response.

Further, it was found that *Bulk India's* emergency generator was not fit for service. When the blackout occurred, the engine started but shut down shortly after, due to overheating. The radiator fan belt had failed several months prior but had not been replaced. The operator, Kowa Marine Service did not have in place adequate procedures to ensure that critical spares were identified and their inventory level maintained, to guarantee availability when required on board.

What's been done as a result

Kowa Marine Service has undertaken a fleetwide program of continual improvement of its safety management and operating systems, and staff education and training processes. This included actions directed at identification, operation, maintenance and spare parts management relating to critical plant and machinery.

Rio Tinto have revised escort towage arrangements for ships departing their facilities in Dampier on the basis of extensive simulation exercises and a review of existing risk assessments. As a result, attendance by a second tug has been extended to number 3 beacons. Further, a comprehensive guidance manual for ship towage operations in Dampier and Port Walcott has been developed.

Safety message

Ship operators and crewmembers should ensure that systems, machinery and equipment, critical to the continued safe operation of the ship, are thoroughly understood, as well as appropriately maintained and tested. This will reduce the likelihood of an emergency situation relating to these items developing and provide a defence against adverse outcomes, should such a situation arise.

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The occurrence

At 1806¹ on 8 March 2018, the 289 m bulk carrier *Bulk India* (Figure 1) was all fast alongside the Parker Point number 5 berth, Dampier, Western Australia. The ship had moved from anchorage after a ballast voyage from Zhoushan, China. During this port call, the ship was to load iron ore for export and take on stores and spares.

In addition to routine stores, the ship had been awaiting replacement fan belts for the emergency generator diesel engine since August 2017. The belts had not reached the ship in multiple previous ports, but on 9 March 2018, they were delivered to the ship as part of a normal delivery of ship's spares. However, neither the master nor chief engineer were aware of their arrival, as it was usual practice to check the packages and their contents once the ship was at sea.

Figure 1: *Bulk India*



Source: DDGHANSA, Shipspotting.com

Departure preparations

During the morning of 11 March, all on board were preparing to depart Dampier on the afternoon tide (high tide 3.37 m due at 1618) bound for Zhoushan. *Bulk India* was loaded with 169,789 t of iron ore and had departure draughts of 17.49 m forward and 17.51 m aft.

At 1200, 1 hour's notice of departure was provided to the engineers. In the engine room, the main engine was prepared and tested ahead and astern. A second diesel generator (number 3 – AuxDG3) was started and brought on-line to supply electrical power in parallel with the first diesel generator (number 1 – AuxDG1). The third diesel generator (number 2 – AuxDG2) was started but not connected to supply power. It was usual practice on board to have two diesel generators providing power during manoeuvring (about 250 kW each), with the third running but not supplying power.

By 1300, all navigational equipment had been checked and recorded in the navigation log as being in good working order. On the bridge were the master, third mate as the officer of the watch (OOW) and an able seaman (AB) on the helm. The engine room was attended by the chief engineer, first engineer, third engineer and an oiler. At 1330, two harbour pilots, consisting of a pilot-in-charge (PiC) and a peer,² boarded the ship. They were escorted to the bridge and the PiC

¹ All times referred to in this report are Western Australia local time, Coordinated Universal Time (UTC) + 8 hours.

² The second harbour pilot was conducting a peer review pilotage assessment of the pilot-in-charge.

and *Bulk India's* master commenced the master-pilot exchange of information (MPX). The peer pilot prepared for assessment duties and also set up the PiC's portable pilotage unit (PPU) in position at the front of the bridge.

During the MPX, the Dampier Pilots' MPX form and *Bulk India's* pilot card were worked through (see Appendices B and C). The PiC received confirmation that relevant equipment had been tested: the main engine had been run ahead and astern, the steering gear had been checked, and the anchors were cleared and ready for use. The master also confirmed that there were no machinery or equipment deficiencies that would affect the pilotage.

The prevailing weather and current conditions were discussed—wind from the north-east at 15 to 20 knots,³ and current about 0.8 knots to the south-west. The PiC also mentioned that there would be a south-westerly set and they would tend to stay middle of the channel, favouring the northern side. This would mean that the ship would be best positioned through the departure channel bend to account for the maximum tidal flow. The master and PiC signed the forms to show agreement to the plan, and the conduct of the ship transferred to the PiC. The PiC then completed a steering test with the OOW and AB, and checked that the steering operated in hand and non-follow up operational modes.

Two harbour tugs were in attendance and were made fast—*Pilbara Titan* (bollard pull⁴ 65 t) on the port shoulder⁵ and *Pilbara Vulcan* (bollard pull 65 t) centre lead aft.⁶ On instruction from the master, the mooring parties (fore and aft) let go lines and all were recovered on board. The tugs moved the ship into the Parker Point Departure Channel (maintained depth of 15.5 m) and at 1404, the main engine was started dead slow ahead and the ship was under way (Figure 2 and Appendix A).

Diesel generator engine overheating

At 1418, the ship's speed was 5 knots and in the channel, well clear of the wharf area. *Pilbara Titan* was let go and it was manoeuvred aft of the ship, to escort position off the starboard quarter. The second tug, *Pilbara Vulcan*, remained made fast.

At 1420, as the main engine was increased to full ahead, AuxDG1 went into alarm due to high temperature (85°C) of the cooling fresh water outlet. The third engineer went to investigate and reported to the chief engineer that the diesel generator engine cooling fresh water control valve was in the 'bypass open' position, rather than the 'cooler open' position. This meant the cooling water was bypassing the fresh water cooler and was not being cooled.

The chief engineer went to inspect the equipment as the third engineer attempted to manually operate the control valve via the hand wheel fitted to the top of the valve. However, the hand wheel could not be turned in the direction indicated (counterclockwise, to raise the valve spindle and open flow to the cooler) despite the use of a wheel key and considerable force.

The chief engineer instructed the first engineer to open the emergency/maintenance cooling water supply from the main engine cooling system. However, this had little effect and the cooling water temperature continued to rise. The chief engineer then telephoned the bridge and discussed the problems with the master.

Meanwhile, the PiC remained unaware of the engine room events. The main engine remained at full ahead, and the ship's speed increased to 7.7 knots. The ship remained positioned in the middle of the channel, passed the Mid Ground buoy and followed the starboard turn into the Rio Tinto Channel.

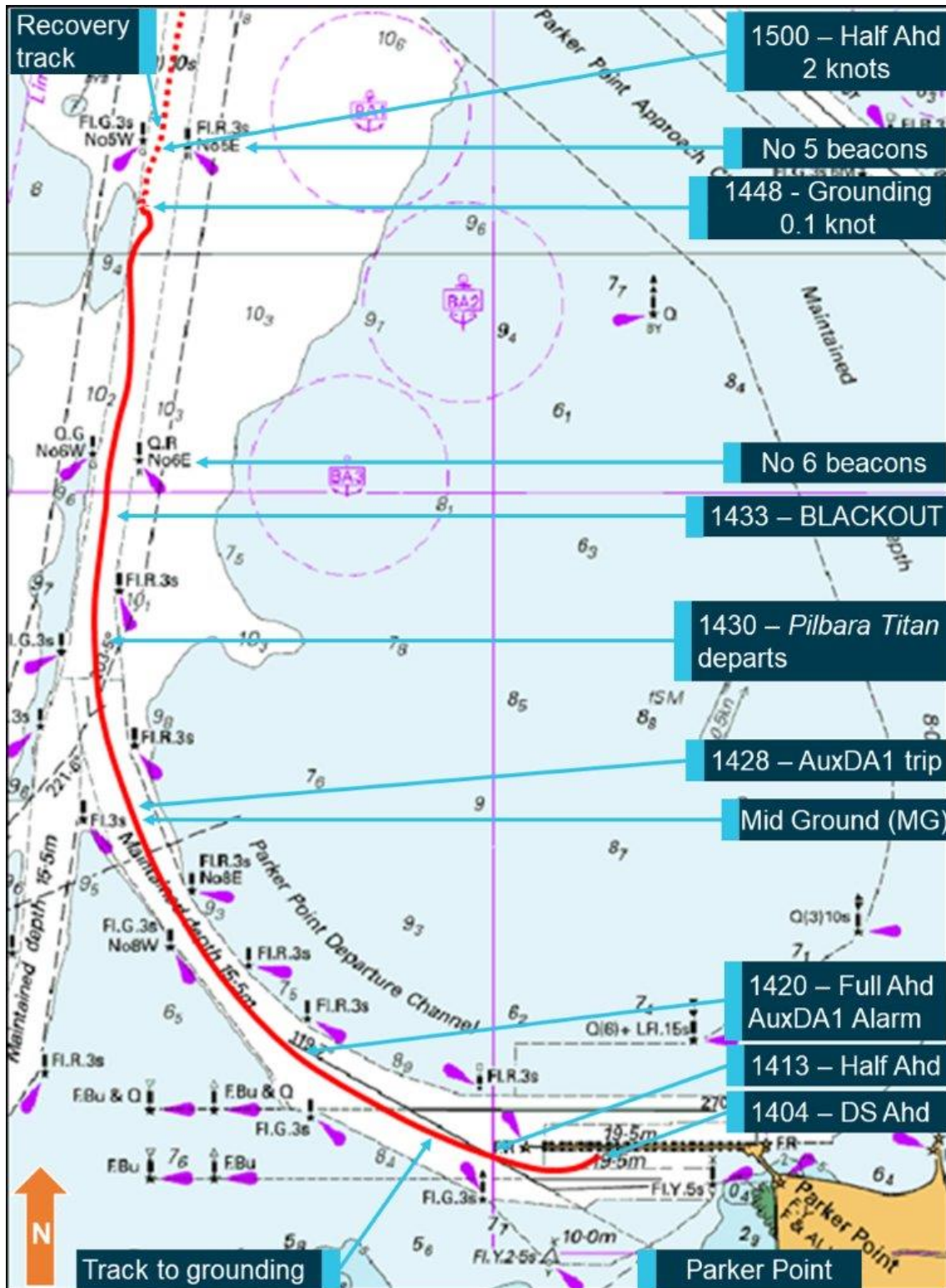
³ One knot, or one nautical mile per hour, equals 1.852 kilometres per hour.

⁴ Bollard pull is a measure of the pulling power of a tug, expressed in tonnes.

⁵ A shoulder is the area where a ship's hull form changes from the bow shape to the parallel mid-body.

⁶ Centre lead aft—a guide for a mooring line (a fairlead) which enables the line to be passed through a ship bulwark without snagging or fouling and is mounted on the centreline of the ship (centre) at the stern (aft).

Figure 2: Bulk India's track from berth to grounding and recovery



Blackout—navigation/pilotage actions

At about 1428, AuxDG1 tripped due to excessively high cooling water temperature (90°C). All electrical load transferred to AuxDG3.⁷ The chief engineer called the master and provided an update of the situation in their native language (Filipino). The details were not shared with either of the pilots.

At 1430, the turn into the Rio Tinto Channel had been completed. The PiC was satisfied that the ship was safely positioned in the fairway and, as there was no further assistance required from it, *Pilbara Titan* was released. *Pilbara Titan* fell back and turned to return to Parker Point. *Pilbara Vulcan* remained made fast and trailed close astern. At this stage, the ship had a speed of 8 knots (Table 1, Figure 3).

At 1431, as the ship was lined up and steadied in the channel, the PiC asked the AB to steer 008° and at 1432:30, 009° to account for the tidal flow pushing the ship to port. The rudder had been put to starboard, arresting a slow turn to port and the rate of turn (RoT) increased to starboard. At 1433:06 the AB reported that the ship was on 009° and applied port rudder which slowed the RoT to starboard. At about this time, the rudder was put 20° to port.

At 1433:23, AuxDG3 tripped on excessively high cooling water outlet temperature and the ship lost all electrical power (blackout). The emergency generator started and soon after, shut down due to overheated cooling water. Multiple alarms sounded on the bridge, signalling that the ship had lost electrical power and propulsion.⁸ Loss of power to the steering gear meant that the rudder remained at 20° to port.

Table 1: Selected data (from AIS and PPU) at time of the blackout and grounding

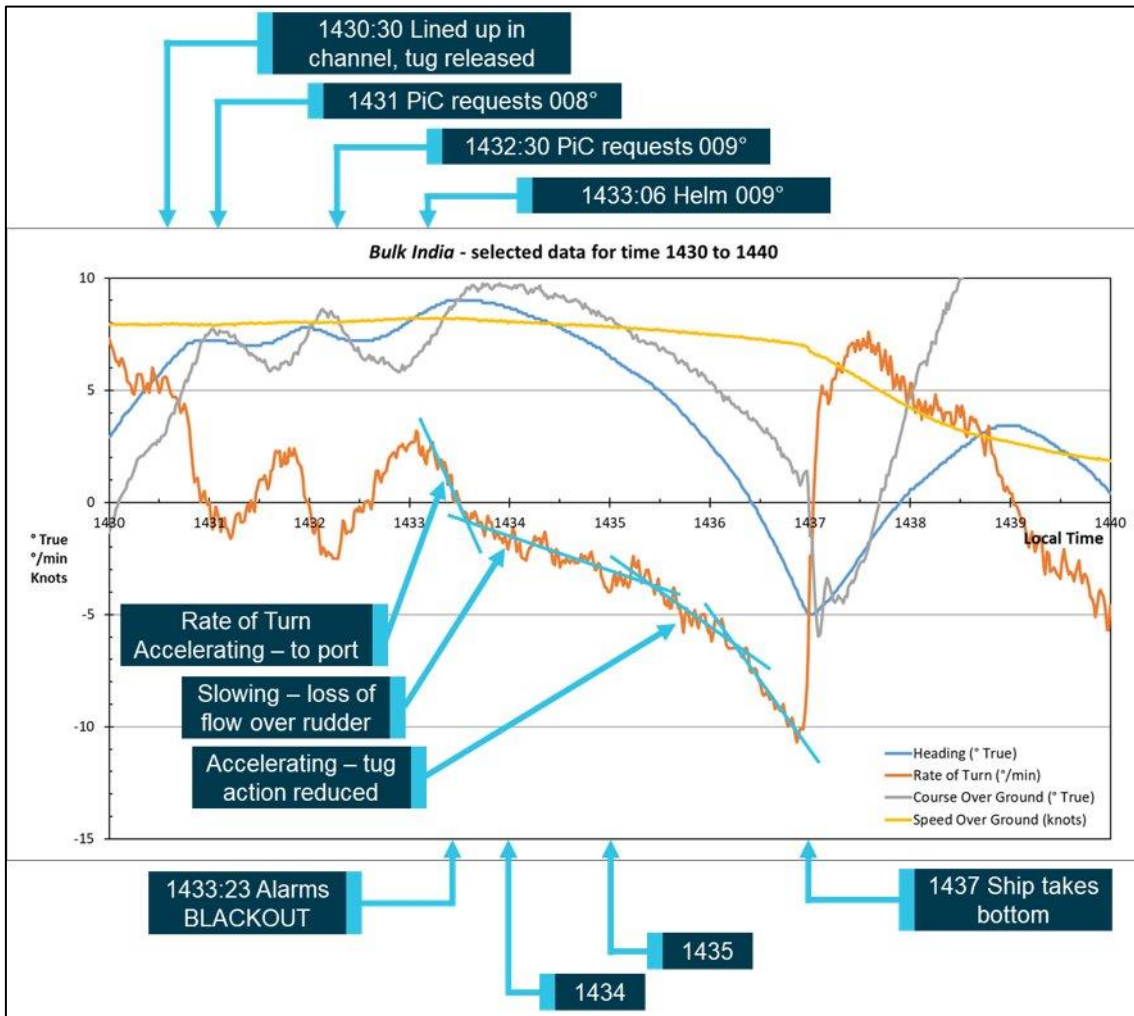
Time (LT)	SOG	HDG	COG	RoT	Comment
1430:00	7.9	3.0	358.7	7.3	<i>Pilbara Titan</i> released from escort towage
1430:30	7.9	5.8	2.7	4.9	
1431:00	8.0	7.2	7.6	-0.6	PiC orders steer 008°
1431:30	8.0	7.0	6.3	1.0	
1432:00	8.0	7.8	7.8	-0.6	
1432:30	8.1	7.2	6.5	-0.4	PiC orders steer 009°
1433:00	8.2	8.1	6.1	2.7	Rudder to 20° to port
1433:23	8.2	9.0	8.5	1.2	BLACKOUT
1433:30	8.2	9.0	9.1	-0.3	
1434:00	8.1	8.6	9.6	-1.7	
1434:30	7.9	7.8	9.2	-2.7	
1435:00	7.8	6.4	8.2	-4.0	
1435:30	7.7	4.9	6.8	-3.9	
1436:00	7.5	2.5	5.3	-5.7	
1436:30	7.3	359.4	3.4	-8.0	
1437:00	6.8	355.0	359.6	-2.4	Ship departs channel and contacts bottom
1437:30	5.5	357.7	357.3	6.8	
1438:00	4.2	0.6	4.9	5.3	

Local time (LT) - UTC +8 hours; SOG is speed over the ground in knots; HDG is heading in degrees true; COG is course over the ground in degrees true; RoT is rate of turn in degrees per minute – negative indicates turn to port.

⁷ No evidence was provided to show that AuxDG2 was brought on load or that the electrical preferential trips activated to reduce the load on AuxDG3.

⁸ Many of the main engine systems and services (including engine control) are provided by electrical machinery and equipment. Consequently, when electrical power was lost the main engine also stopped.

Figure 3: *Bulk India* movement data taken from PPU



Rate of turn in degrees per minute—negative indicates turn to port.
 Source: Marine Services Western Australia, annotated by the ATSB

The grounding

The PiC went to the helm and determined that all control of the steering had been lost. The applied port rudder had taken effect and the ship had stopped turning to starboard and the RoT increased to port. The PiC directed the master of *Pilbara Vulcan* to take the stern to port, with full power, in an attempt to stop the turn. Anchors were ready and available but the PiC advised the master not to release them at this stage, in case they passed under the ship and holed the hull.

The peer pilot assumed communications responsibility and provided information and updates to the PiC. At 1433:45, Dampier vessel traffic service (VTS) was contacted and notified of the situation. The peer pilot also used the radio to alert all stations to the ship having blacked out and of a port emergency, and requested all tugs to attend the ship. *Pilbara Titan* was then radioed and the tug master asked to return to *Bulk India*. The tug was just over 1 nautical mile (NM) away and was immediately turned around and steamed back toward the ship under full power. Another tug, *Pilbara Neptune* (bollard pull 65 t) was approaching Parker Point wharf when the port emergency call was made. *Pilbara Neptune's* master immediately turned the tug and increased speed to go to the ship's aid.

Despite the loss of rudder effectiveness when the main engine stopped, and the efforts of the tug, the RoT to port increased from 2°/min at 1434, to 4°/min by 1435.

At 1435, the master directed the second mate (at the aft mooring station) to go to the steering gear room and engage the emergency steering. The second mate was aware that the emergency

generator had started and upon checking inside the accommodation, realised the ship had blacked out. Once at the steering gear (directly below the aft mooring station), the second mate radioed the bridge and informed the master that emergency steering could not be engaged because there was no power to either of the steering motors.

The PiC realised that control of the steering would not return and that the ship was going to turn out of the channel and run aground. The priority for the PiC changed from arresting the turn to slowing the ship, to limit any damage from contact with the bottom. The master of *Pilbara Vulcan* was directed to reposition and apply full transverse arrest⁹ while continuing to take the stern to port.

The ship's speed began to slow while the RoT increased. At 1435:45, the peer pilot informed the PiC that the ship was going out of the channel—the ship had speed of 7.6 knots and a rate of turn to port of 5°/minute. The PiC directed *Pilbara Vulcan* to direct all power to slowing the vessel in order to reduce the severity of the imminent hull contact with the channel side. VTS was informed that the ship was departing the channel and running aground. At 1437, at 7.2 knots, on heading 355° and with a rate of turn of 10°/min to port, *Bulk India* took the bottom.

The ship contacted the bottom at an angle of about 15° to the channel side. The ship rode up the channel side, heeled and slewed to starboard, coming back parallel with the channel. It slid along the bottom and slowed. The PiC asked the peer pilot to call the port authorities, including the harbour master and pilot manager, and inform them of the incident. The peer pilot referred to the pilotage company emergency checklist and informed the necessary parties.

By 1440, *Bulk India* had slowed to 2 knots. With the port bow still in contact with the bottom, momentum took the ship's stern to starboard and into the channel, which kept the ship's propeller and rudder in deep water. The PiC directed *Pilbara Vulcan* to counter the swing to prevent the stern from turning across to the other side of the channel.

The ship continued to slow and closed in on the number 5W channel beacon. At 1441, the master of *Pilbara Titan* contacted the PiC, and was directed to the port shoulder to push up on the port bow and take it clear of the channel beacon. The tug was about 0.4 NM astern of *Bulk India*, closing fast at about 12 knots.

Blackout—engine room actions

The engineers eventually applied sufficient force to move the cooling water control valve manual hand wheel in the 'cooler open' direction. However, the valve spindle remained in the 'bypass open' position. In addition to this, opening the cooling water supply from the main engine system had no effect. The engineers dismantled the control valve pneumatic actuator and, when the control air pressure was released, the valve moved to 'cooler open' position. However, it was about this time that AuxDG3, AuxDG2 and, shortly after, the emergency generator shut down due to the high cooling water temperature.

The engineers dismantled the control valve actuator and found that the thrust bearing and disc fitted to the end of the manual operating hand wheel shaft had come adrift. The set screws normally holding these components in place had broken, allowing the assembly to fall off the shaft. The set screws were replaced and the control valve actuator reassembled.

The time taken to repair the valve actuator allowed the engines to cool a little and, at 1435, the temperature of AuxDG2's cooling fresh water outlet returned to within normal limits (83°). This allowed the engine to be restarted, which commenced circulation of the cooling water. Electrical power and services were then slowly restored as control of the engine temperatures was regained

⁹ Transverse arrest is a method of using a tug to slow the speed of a ship by having the tug on a line astern with its thrusters pointing at 90° to the travel. Large forces can be generated due to the athwartships component of the tug propeller wash creating drag.

by manual operation of the control valve. By 1440, all three cooling water temperatures were within the normal operating range.

At 1443, the chief engineer spoke with the master on the telephone (in Filipino) regarding the blackout and attempts to restore power. They discussed the restoration of power using the main generators and the failure of the emergency generator to operate correctly.

Recovery to anchor

The channel beacon was about 200 m ahead of the bow as *Pilbara Titan* passed up the port side of the ship. At 1444, the tug was in position and applied weight to the port shoulder.

At about 1445, alarms began to sound and lighting flickered on the bridge, indicating that restoration of power was underway in the engine room. However, no communication was received from the engine room regarding the return of power.

At 1447, *Pilbara Neptune* was approaching *Bulk India* and the PiC directed the tug to the starboard shoulder to assist the ship's bow back into the channel. The ship slowed below 0.5 knots and then stopped for a short period.

At about 1448, electrical power was restored. The engineers continued to restore services and check systems in preparation for restarting the main engine. In the minutes following, the master directed the second mate to engage emergency steering and move the rudder to midships.

At this time, with power available to mooring winches, three tugs were in attendance and made fast: *Pilbara Vulcan* on the centre lead aft, *Pilbara Titan* on the port shoulder and *Pilbara Neptune* on the starboard shoulder. The PiC directed the tug masters to manoeuvre the ship back into the channel. A fourth tug, *Riverwijs Rowan* (bollard pull 84 t), responded to the request for assistance and at 1451, was under way from the King Bay Supply Base, about 4 NM from the ship.

From this time, the ship's speed was slowly increased as it came free of the channel edge and cleared beacon 5W. At 1452, the ship was back in the channel and proceeding at 0.5 knots, with *Pilbara Vulcan* pushed up on the stern and the two forward tugs controlling the bow. As the PiC manoeuvred the ship with the tugs, the master and ship's crew confirmed that power and services had been reinstated. The second mate engaged emergency steering and by 1455, the rudder was centred and operation of the steering gear tested. The ship's speed steadily increased through 1 knot as the ship moved into the middle of the channel.

At 1457, the master spoke with the chief engineer and confirmed that the main engine was available. At 1458, the main engine was started at dead slow ahead and propulsion was restored. At 1500, as the ship passed between number 5 channel beacons, at 2 knots, the main engine speed was increased to half ahead.

At 1506, the master of a fifth tug, *Pilbara Thor* (bollard pull 65 t), contacted VTS to notify that the tug was underway to *Bulk India*. It was about 5 NM away at that time and proceeded at full speed.

Riverwijs Rowan arrived off *Bulk India* at 1513, by which time the ship was passing number 4 beacons at a speed of 4.5 knots. The ship's speed was increased further, until it reached 5 knots (a speed the pilots were comfortable with) at 1520. At 1530, after receiving a request from the harbour master, the master confirmed that tank soundings showed that the ship's hull had not been breached.

At 1547, as the Fairway beacon was passed, *Pilbara Thor* reached the ship. With 2 tugs port and starboard forward (on the shoulders), two tugs aft under the bridge wings, the fifth tug astern, and the main engine at half ahead, *Bulk India* was taken out the channel, past the Sea Buoy and to anchor.

At 1830, the starboard anchor was let go at anchorage WA17. At 1845, the pilots departed the ship by helicopter and at 1848, finished with engines was rung.

Subsequent events

As a consequence of the incident, the Australian Maritime Safety Authority (AMSA) detained the ship as unseaworthy.

On 13 March, a ClassNK¹⁰ surveyor attended the ship and oversaw a dive inspection of the hull. Evidence was found of contact with the bottom but no significant damage. The surveyor also inspected the cooling water system, including the control valve repairs, and the emergency generator condition and operation. The systems were tested to the surveyor's satisfaction. The AMSA detention order was lifted on 13 March, and at 2248 the same day, standby was called and the ship departed the anchorage to continue its voyage.

A ClassNK recommendation was issued for the installed emergency generator fan belts to be replaced with correctly sized belts as soon as possible and within one month. On 29 March the ship was attended by ClassNK while alongside in Ningbo, China. The emergency generator fan belts were confirmed to have been replaced with the correct sized belts from the original equipment manufacturer. The class recommendation was cleared.

¹⁰ ClassNK—the ship's classification society. See later Classification section in Context for more detail.

Context

Bulk India

At the time of the incident, *Bulk India* was registered in Panama, operated by Kowa Marine Service Co Ltd (Japan), owned by Southern Route Maritime S.A. and Nissen Kaiun Co Ltd (Panama), and classed with ClassNK (Nippon Kaiji Kyokai).

Bulk India's navigation bridge was equipped with navigational equipment consistent with SOLAS¹¹ requirements. The layout included a control console with radars, Electronic Chart Display and Information System (ECDIS), main engine controls, a machinery alarm panel, a steering stand and communications equipment. The console was located on the ship's centreline, just forward of the chart table

Crewmembers

Bulk India had a complement of 23 Philippines nationals all qualified for the positions which they held.

The master had 33 years' experience at sea, 20 years with Kowa Marine Service, held a Philippine master's certificate of competency and had sailed as master since 2011. The master had joined *Bulk India* during November 2017.

The chief mate had 37 years of sea-going experience, worked for Kowa Marine Service for 5 years, held a Philippine certificate of competency and had sailed as chief mate for 1 year.

The chief engineer had 35 years of sea-going experience, 26 years with Kowa Marine Service, held a Philippine chief marine engineer's certificate of competency and had sailed as chief engineer for 3 years.

The first engineer had 19 years of sea-going experience, 2 years with Kowa Marine Service, held a Philippine marine engineer's certificate of competency and had sailed as first engineer for 4 years.

The third engineer held a Philippine marine engineer's certificate of competency, had worked for Kowa Marine Service for 10 years and had sailed as third engineer for 5 months.

The chief mate and the chief and third engineers joined *Bulk India* during October 2017. The first engineer had joined the ship during May 2017.

Machinery

Bulk India's main engine was a Mitsui MAN B&W 6S70MC delivering 16,860 kW via a directly driven, fixed pitch propeller at 91 rpm. The ship had three Daihatsu 5DK-20 auxiliary diesel generators. Each provided 560 kW of electrical power at 60 Hz.

Auxiliary cooling fresh water system

Bulk India's auxiliary diesel generator engine cooling fresh water system was a closed system with contents maintained via an expansion tank. Water was circulated through each engine and the common auxiliary fresh water cooler via engine driven pumps (Figure 4). Sea water for the cooler was supplied by external electric motor driven pumps. The temperature of the fresh water returning to the pump suctions was monitored and a pneumatic controller adjusted a three-way control valve to control the temperature.

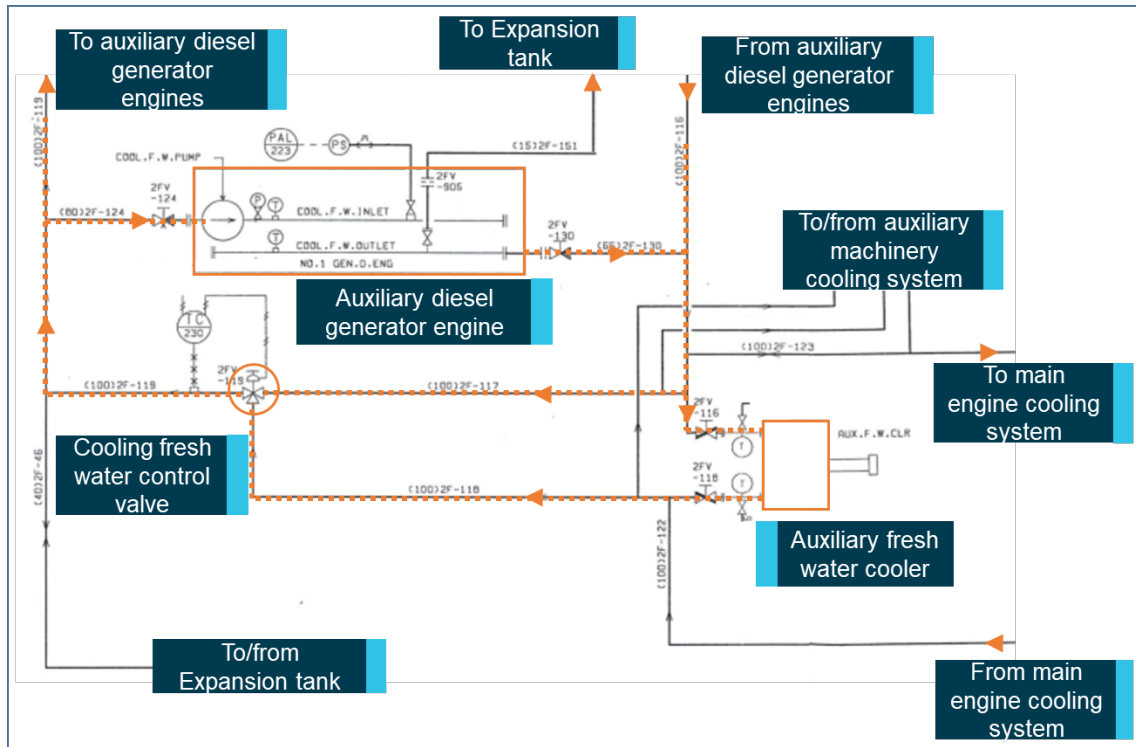
Without electrical power and with all engines stopped, the cooling water (fresh and sea water) was not circulated. Therefore, temperature control during engine start-up relied upon thermal inertia within the engine mass and the volume of cooling water in the system to provide time for the

¹¹ SOLAS - The International Convention for the Safety of Life at Sea, 1974, as amended.

cooling system to become effective. If the engine did overheat, safety interlocks prevented it from being restarted until the cooling fresh water outlet temperature reduced below a threshold and the shutdown circuit reset.

The main engine fresh water cooler could be used in place of, or to supplement, the auxiliary fresh water cooler if the need arose (during maintenance or for emergency cooling). However, this arrangement continued to rely on the auxiliary engine cooling water temperature controller and control valve. Therefore, the temperature of the cooling water for the ship’s main source of electrical power was reliant upon operation of the one controller and one control valve.

Figure 4: Auxiliary diesel generator engines cooling fresh water system



Source: Kowa Marine Service, annotations by ATSB

Pneumatic temperature controller

The pneumatic automatic indicating controller sensed the cooling water temperature in the line to the pump suction and compared this to the desired temperature. The difference in temperatures was converted to air pressure which was sent to the control valve to adjust the valve position and water flow accordingly.

The controller was supplied with air from the ship’s 0.7 MPa control air system. The control air mains was filtered and dried before a branch line passed through a filter-regulator unit at the input to the controller. The controller internal components included fine nozzles, orifices and pathways for air flow, the blockage of which would cause the controller to malfunction. Reliable operation of the controller therefore depended upon the quality of the air supplied and regular maintenance.

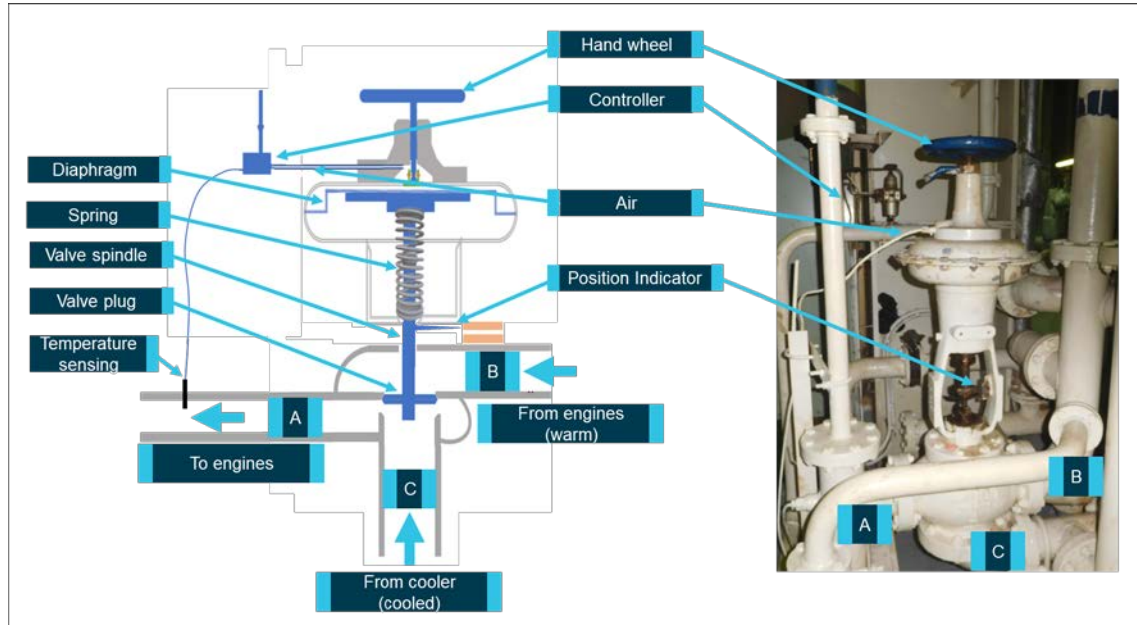
At the time of the incident, *Bulk India’s* planned maintenance system (PMS) included maintenance tasks for the control air system including checks of the reservoirs, in-line filter, dehumidifier, auto drains and reducing and relief valves. The PMS did not include maintenance tasks (for example, function tests over the full range of operation in manual and automatic modes) for control equipment for individual systems such as the auxiliary cooling water.

Control valve

The final control element in the auxiliary engine fresh water cooling system was the three-way control valve with pneumatic actuator and manual hand wheel (Figure 5). The valve position was controlled by air pressure from the controller, which pushed the valve spindle down against spring

pressure. The hand wheel was not physically connected to the diaphragm or the valve spindle. In automatic mode the hand wheel was in the fully up position (turned fully counterclockwise) so that it remained clear of the diaphragm and did not impede the full range of motion.

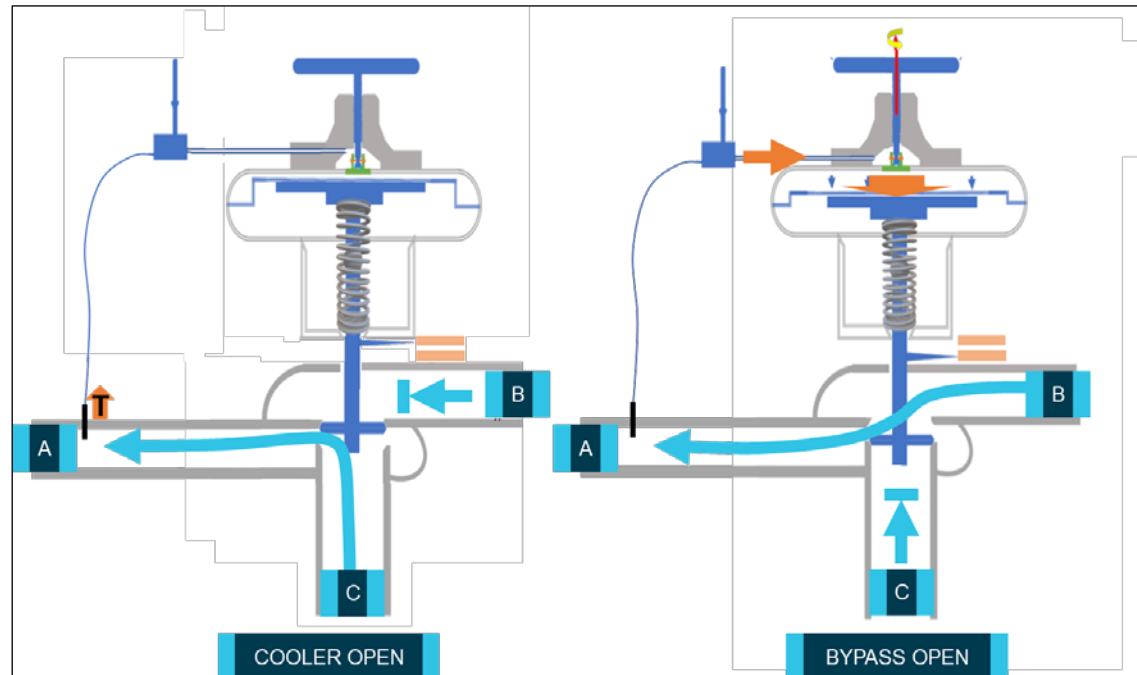
Figure 5: Three-way, single-acting pneumatic temperature control valve



Source: Kowa Marine Service, annotations by ATSB

In the non-energized condition (fail-safe with no air pressure applied), the valve allowed full flow from the cooler outlet to the pump suction (flow from the engine outlets was closed). All water flow from the engines was directed through the cooler (Figure 6 left). The valve body position indicator pointed to this as 'cooler open'.

Figure 6: Control valve flow positions



Line A – to engines, B – from engines, C – from cooler.

Source: Kowa Marine Service, annotations by ATSB

As air pressure was applied on top of the diaphragm, the valve spindle moved down and warmer water from the engine outlet bypassed the cooler and mixed with the cooler water from the cooler.

The full air, extreme position was the ‘bypass open’ position with no flow through the cooler (Figure 6 right).

For manual operation, the hand wheel acted in place of the air pressure. When pressure was vented, the spring moved the valve spindle (and diaphragm plate) fully up, against the thrust piece attached to the end of the hand wheel spindle. This (upper) position initially provided full flow through the cooler. The hand wheel was then wound down or up to decrease or increase cooling respectively, as required.

Previous blackout

On 26 February 2018 (2 weeks before the incident), *Bulk India* had a blackout due to auxiliary diesel generator high cooling fresh water outlet temperature. Afterwards, the sea water side of a limited number of engine coolers (lubricating oil and charge air) were cleaned. No evidence was recorded to show whether the fresh water cooling or temperature control systems were identified as faults.

Emergency generator

When the mains power supply is lost, a ship’s emergency generator is required to automatically start and supply power to essential equipment, including the steering gear and emergency lighting.^{12,13}

Bulk India was fitted with a Demp¹⁴ MAN type D2866TE emergency generator providing 140 kW at 60 Hz. The engine cooling water was circulated by an engine driven pump and cooled through a front end mounted radiator with engine driven fan.

Fan belt

About 7 months before the incident, on 29th July 2017, *Bulk India* was loading cargo at San Nicolas, Peru. During routine testing of the emergency generator, the fan belt failed. This failure was reported to shore management, accompanied by a request for replacement belts. The requisition indicated that there were no spares on hand and was marked urgent. This stores request was repeated a month later in August 2017.

Some delays were experienced in sourcing the parts and they were not supplied to the ship before it departed Peru almost 3 weeks later. From then, until arriving into Dampier on 9 March 2018, *Bulk India* visited nine ports. The required emergency generator fan belts did not reach the ship at any of these ports. The company was unable to provide an explanation as to how this occurred.

The master and chief engineer stated that the emergency generator would start and take load but could only run for a short time before overheating and shutting down. However, no officials, including in the ports visited, or other authorities such as the flag Administration or Class were made aware of this situation.

Bulk India maintenance records showed that the emergency generator was inspected and test run each week. The generator was shown to be in good condition, with no defects recorded since July 2017. A blackout test was conducted on 30 December 2017 while the ship was at anchor. No record of fan belt condition, that spares were on order, or other relevant details were recorded on the inspection sheets.

¹² SOLAS Chapter II – 1 Reg 43: Ch II-1 Construction – Structure, subdivision and stability, machinery and electrical installations, Part D Electrical installation, Reg. 43 Emergency source of electrical power in cargo ships

¹³ Classification society (ClassNK) rules require that the emergency generator must automatically supply power within 45 seconds and supply the steering system for at least 30 minutes of continuous operation.

¹⁴ Demp – Danish engineering and marine power

Critical equipment and functions

The International Safety Management (ISM) Code¹⁵ required that ship operators identify equipment and technical systems the sudden operational failure of which may result in hazardous situations—that is, critical systems. The company’s safety management system (SMS) should provide for specific measures aimed at promoting the reliability of such equipment or systems and these should be included in the ship’s maintenance routines. The measures should include the regular testing of stand-by arrangements and equipment or technical systems that are not in continuous use. It follows that systems associated with the operation of critical equipment should also be identified. This includes maintenance and spare parts.

At the time of the incident, Kowa Marine Service did not have in place systems and procedures to monitor and maintain the reliability of identified critical equipment, including maintaining spare parts inventory.

Port of Dampier

The Port of Dampier is one of Australia’s largest bulk export ports and is located about 1,550 km north of Perth, Western Australia. The port comprises public and private port terminals, which predominantly service the iron ore industry of the Pilbara region and the oil and gas fields of the North West Shelf (together more than 94 per cent of cargo throughput).

The terminals are functionally separate (including separate towage and pilotage services), legislatively governed by the Pilbara Ports Authority (PPA).¹⁶ The PPA provides Vessel Traffic Services (VTS) for multi-user facilities, port communications, and oversees marine safety and port security. The PPA also issues licences for port services including pilotage, towage, lines boats, bunkering, pilot boat transfers, security, stevedoring and waste management. The PPA provides information and directions on ship operations within Dampier port limits with specific terminal information provided by the individual terminal operators.

During financial year 2017-2018, the port had more than 9,500 vessel movements and in excess of 177,000,000 t cargo throughput. Of this, more than 145,000,000 t of iron ore was exported, representing 82 per cent of the port’s total cargo throughput.

Vessel Traffic Service

The Pilbara Ports Authority—Port of Dampier was authorised as a Vessel Traffic Service (VTS) Authority and provided an Information Service (INS) and a Traffic Organisation Service (TOS).¹⁷ All areas within port limits and anchorage areas immediately adjacent were covered by the VTS service.

Pilotage

The PPA was to ensure pilotage services were provided within the port, ensure pilotage providers were licensed, and approve individual pilots. Pilotage within port limits was compulsory for all vessels over 35 m in length or 150 gross tonnes, unless the master held a current exemption certificate.

Three pilot service providers had been licensed by the PPA with Marine Services Western Australia (MSWA) the supplier of pilotage services under contract to Rio Tinto in Dampier. The

¹⁵ The International Management Code for the Safe Operation of Ships and for Pollution Prevention

¹⁶ Pilbara Ports Authority (PPA) operates as a Western Australian Government Trading Enterprise, and is governed under the *Port Authorities Act 1999 WA*.

¹⁷ Information Service (INS) is defined as provision of relevant information at appropriate times and on request for the VTS area. Traffic Organisation Service (TOS) is defined as a service to prevent the development of dangerous maritime traffic situations and to provide for the safe and efficient movement of vessel traffic within the declared VTS area.

MSWA website provided relevant pilotage information, including waypoint passage plans and master-pilot exchange of information forms (www.mswa-pilots.com.au).

The pilot in charge (PiC) on board *Bulk India* joined MSWA in 2011 and was a fully licensed (unrestricted) pilot for the Port of Dampier. The PiC first went to sea with the Royal Australian Navy in 1985, moved to the offshore industry in 1998, completed a master Class 1 certificate of competency in 2001 and moved to pilotage in 2008. Recent activities involved up to two, or infrequently, three pilotages per day. After being well rested, *Bulk India* was the PiC's second pilotage for 11 March.

The peer pilot had an unrestricted licence, had been piloting in Dampier for 6 years after obtaining a master Class 1 certificate of competency in 1992 and had more than 15 years' pilotage experience in New Zealand and Australia. On 11 March, the peer pilot was conducting a routine peer review of the PiC to satisfy MSWA and the PPA requirements.

Towage

The PPA issued licences for Dampier port towage services. At the time of the incident, Westug was licensed to provide towage services to Rio Tinto, under contract. This included operating and maintaining the Rio Tinto fleet of 11 tugs plus lines and pilot boats.

The *Rio Tinto Dampier and Port Walcott Port Handbook* (July 2016) provided guidance on typical towage requirements for all Rio Tinto berths. For departure from Parker Point berth 5, the guidance stated that two tugs were to be in attendance with one tug to escort the ship into the Rio Tinto Channel and accompany the ship to the Fairway beacon.

Rio Tinto—Dampier

In the Pilbara region of Western Australia, Rio Tinto operated an integrated network of 16 iron ore mines, four port facilities, a 1,700 kilometre rail network, and related infrastructure. Dampier port facilities comprised the Parker Point and East Intercourse Island terminals, and Rio Tinto had exclusive use of the channels servicing these terminals. This included the Rio Tinto Channel and the Parker Point Departure and Approach channels.

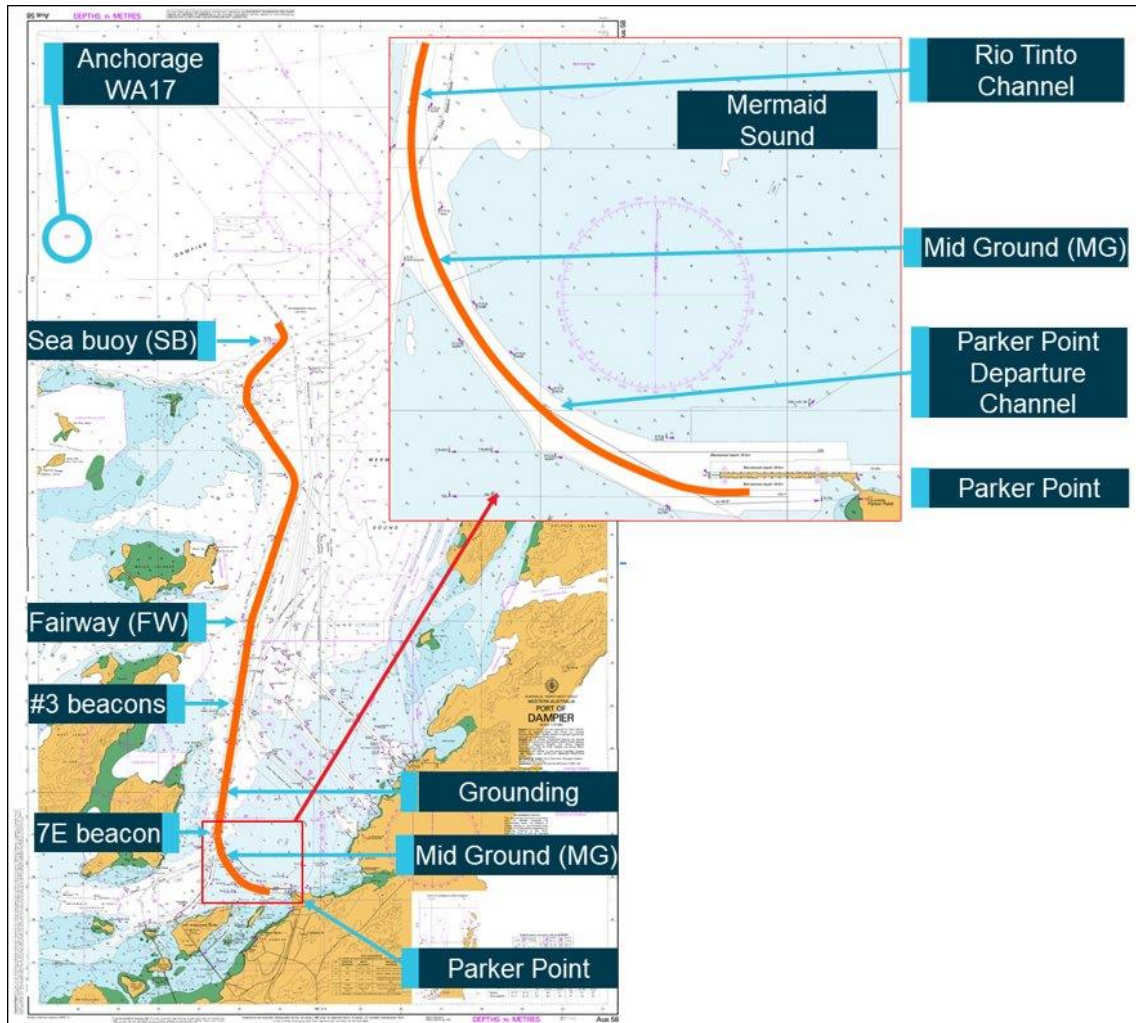
Specific terminal and berth information and guidance for ships calling at Rio Tinto's Dampier terminals was available via the *Rio Tinto Dampier and Port Walcott Port Handbook* (accessible at the time of the incident via the Rio Tinto website).

Pilotage from Parker Point

Ships departing Parker Point transited a 15 NM channel and sea-track maintained to a depth of 15.5 m (Figure 7). From the Parker Point berthing pocket, the channel led on 270° before curving north. After about 2 NM it met the channel from East Intercourse Island at a point called Mid Ground (MG). A single straight channel extended from MG about 5 NM to the Fairway channel marker (FW), where ships continued along a natural deep water track to the sea buoy (SB). The transit from berth to sea buoy took about 2 hours.

At the time of the incident, usual practice was for ships departing Parker Point, once clear of the wharf, to be escorted by a single tug, tethered centre lead aft until FW. From FW, the ship proceeded under its own engines along the deep water track to sea. However, on a trial basis, and in the case of *Bulk India*, two tugs were to escort ships until past MG, with the second (short escort) tug made fast on the port shoulder. The short escort tug remained until the ship completed the turn into and straightened up in the Rio Tinto Channel and it was considered to be of no more assistance. At this point, usually in the vicinity of channel beacon 7E, the tug was released from duty and departed. The aft tug remained made fast until FW before being dismissed.

Figure 7: Navigation chart Aus58 of the Port of Dampier showing the track from Parker Point to sea. Inset shows part of navigation chart Aus60 with detail from Parker Point



Source: Australian Hydrographic Service, annotated by the ATSB

Tug escorting assessments

Rio Tinto risk management defined the tolerable frequency for any grounding event as once in 10 years. To quantify the risk, in 2012 and 2016 Rio Tinto engaged third parties to conduct studies into the risks of loaded ships grounding during departure from the Dampier port. These studies used ship movement and incident data collected for ships servicing Rio Tinto's Dampier facilities. The 2016 study used improved data collection methods and results, as well as experience from simulation training completed by harbour pilots and tug masters. This study assessed the risk of ship groundings for variations in the method and distance for tug escorting out of the port.

The study found that the majority of groundings were likely to occur within the channel,¹⁸ before FW. Out-of-channel groundings were most likely to occur beyond FW. The most likely outcome was an in-channel grounding, resulting in no environmental release and impacting the port for one day during salvage. The grounding risk was found to lie on the threshold of Rio Tinto acceptance and required active monitoring.

In 2016, the usual practice was to maintain a single escort tug to FW. The study found that more tugs, escorting for longer, would reduce the probability of a single ship experiencing a grounding

¹⁸ The study defined an in-channel grounding as one which occurred on the channel boundary and obstructed about 60 m of the channel width. Out-of-channel grounding occurred within 3,000 m of the channel boundary, beyond which it was assumed not to have grounded.

event. If two tugs were used for escort, there was a significant reduction in risk of a grounding event, compared to no tug escort or the use of a single tug escort. The 2016 study recommended adoption of this lower risk escort strategy.

Towage training

Marine Services Western Australia (MSWA) and Westug had undertaken programs of simulator-based emergency response training for MSWA pilots and Westug Dampier tug masters. The exercises were intended to provide familiarisation in standard escort tug manoeuvres and competence in their use. The aims were to equip pilots and tug masters with enhanced knowledge and techniques so as to locate assets in the most effective/efficient positions, taking into account the conditions at the time.

As part of the training, pilots and tug masters completed exercises together.¹⁹ Emergency and contingency manoeuvres were performed to identify options available to keep the ship safe. Differing locations for the tugs and variations of indirect and direct towage were trialled to determine limitations or unnecessary risk to assets. To reduce the risk of confusion, the exercises also included the use of standard communication techniques, commands and terminology.

The simulator training programs included attendance by and input from Rio Tinto personnel and the Dampier harbour master. Specific scenarios and outcomes were discussed amongst all attendees with simulation results then used to guide port towage policies and procedures.

The PiC of *Bulk India* had completed simulator training during October 2017. Experience gained and techniques practised during the simulator exercises were employed by the pilots and tug master(s) during the incident and recovery from it.

Classification—ClassNK (Nippon Kaiji Kyokai)

A classification society is a non-governmental organization that establishes and maintains technical standards for the construction and operation of ships and offshore structures. Classification is to verify the strength, integrity, function and reliability of a ship's structure and systems in order to maintain essential services on board.²⁰ Classification societies aim to achieve this through the development and application of their own rules and by verifying compliance with international and/or national statutory regulations on behalf of flag Administrations. Activities which generally fall outside the scope of classification include such items as design and manufacturing processes. ClassNK advised the ATSB that Class is not a designer who considers the philosophy behind a design. Rather, Class is the inspector who validates and reports that the ship's construction is in accordance with relevant international regulations.

ClassNK rules²¹ required that special consideration be given to the reliability of essential machinery and equipment that affects the normal operation of the propulsion machinery, such as the main source of electrical power or sources of water pressure. Rules governing cooling systems were restricted to the more general piping systems rules. Pumping requirements were prescribed, but specific cooling system automation or control requirements were not.

In addition to main sources of electrical power, the rules required ships to have a self-contained emergency source of electrical power. When this was an emergency generator, it must start automatically within 45 seconds of failure of the main source of electrical power. It must also be capable of supplying sufficient power to all services that are essential for safety in emergencies, including lighting, communications, navigation and steering systems.

¹⁹ The simulator facilities used provide multiple bridge simulators and a tug simulator which can be used individually or configured to interact and complete the same scenario.

²⁰ Refer to International Association of Classification Societies (IACS) for additional information <www.iacs.org.uk>

²¹ *Rules for the Survey and Construction of Steel Ships*, Part D Machinery and Part H Electrical Installations.

The rules also list the minimum spare parts required for machinery installations, including diesel engines, generators or auxiliary machinery essential for main propulsion, but not emergency generators. The requirements did not extend to the identification of spare parts for support systems such as cooling water.

Ship inspection

Ship vetting (RightShip)

RightShip²² is a commercial organisation that provides risk management and environmental assessment to the maritime industry. The company provides an online ship vetting tool (RightShip Qi), which uses predictive analytics to determine the likelihood that a ship will have an incident in the following 12 months. The customer is then provided with an indication of the risk involved in selecting a particular ship for charter. The system utilises analysis of data and records from multiple sources and questionnaires to assess the ship against RightShip and customer criteria. When a ship is vetted, it undergoes a risk assessment to determine its relative safety for a particular voyage.

The system assesses against criteria related to terminal requirements include ship mooring capabilities, cargo/ballasting capabilities, ship loader compatibility, gangway details, helicopter capability, senior officer experience and ship details. The question of condition of the ship machinery and equipment is limited to Port State Control history, validity of certification (including Class), and incident history.

A RightShip Qi vetting of *Bulk India* was requested on 22 February 2018 for the voyage from Dampier to China. Records show that the terminal questionnaire was marked 'satisfactory', and the ship had no adverse reports and was recommended for approval. The RightShip risk star rating at the time was four stars.²³ *Bulk India* had undergone the RightShip vetting process on at least six occasions since the start of 2014. Of these, one vetting was unacceptable due to the ship being unable to fulfil all customer requirements.

Under some circumstances (including age, ship modification or customer request) a ship may have a physical inspection. The RightShip 'Dry bulk inspection' is used to validate a ship's condition, capabilities and application of its safety management system. The RightShip 'Inspection and Assessment Report for Dry Cargo Ships (FOD06)' checklist includes determining if 'All stores/spares requisitions are filled in less than 30 days'. No record of *Bulk India* having undergone a physical vetting inspection was provided.

Port State Control inspections

Port State Control (PSC) is an internationally agreed program for the inspection of foreign ships in other national ports. International conventions and the United Nations Convention of the Law of the Sea (UNCLOS) give responsibilities to flag States to check and control ships in their waters, so that they do not pose threats to ship and crew safety or to the marine environment. If a ship is found to have deficiencies, it may be detained until the issue is resolved.

Bulk India had been subjected to 15 Port State Control (PSC) inspections, including follow-up inspections, since 2012. The most recent inspection prior to the incident was during November 2017 while the ship was in Lianyungang, China. None of the inspections highlighted issues with power generation or with the emergency generator.

²² Information available at www.rightship.com

²³ Rightship analysis for 2014-2015 showed that a 1-star bulker was 19 times more likely to have an incident than a 5-star bulker.

Safety analysis

Bulk India ran aground as a result of an electrical blackout, which caused a loss of propulsion and steering control. This analysis will explore the equipment and machinery factors leading up to the blackout and recovery from it. This will include the condition and operation of the electrical generators and associated systems, maintenance and spare parts. In addition to this, bridge communications and the implications on emergency event response and recovery will be discussed.

Grounding

After the blackout occurred at 1433, the failure of the emergency generator meant the ship lost all power. This resulted in the loss of steering control which meant that the rudder could not be moved from 20° to port. *Bulk India* had commenced turning to port when all power was lost and, in the limited time available, *Pilbara Vulcan* was unable to stop the ship from continuing the turn. About 90 seconds after the loss of power, the PiC determined that the ship was going to run aground and redirected the tug so as to limit any damage.

It is likely that had the emergency generator worked as designed, control of the rudder would not have been sufficient to prevent the turn to port continuing, and the ship running aground. Several factors have led to this conclusion, including:

- the time for the emergency generator to start and take load (45 seconds)
- the time for bridge personnel (ship and pilots) to assess the situation, react and verify control of the rudder
- the time to turn the rudder from port to starboard
- the time to reposition the tug and apply weight
- the reduced effectiveness of the rudder due to the reduced flow over its surface
- the time taken for the tug and rudder to overcome the turn momentum of the loaded ship and turn it away from the channel side.

Auxiliary generator overheating

The exact cause of the cooling water temperature control malfunction was not determined. However, air pressure remained applied to the diaphragm until the engineers removed the air supply pipe. That is, the controller continued to supply air to the valve even though increasing temperature of the cooling water to the pumps should have led to the air pressure being reduced. It was therefore likely that this was caused by an air pathway blockage within the pneumatic controller.

Temperature control via a single-acting, spring return, pneumatically controlled three-way valve is a common arrangement used on ships. However, when the control valve was stuck in the cooler bypass position, the engineers did not know how to manually operate it. Had the air pressure been vented and the valve changed to manual control when first discovered, it is likely that the temperature of the cooling water would have been controlled and the engines would not have overheated.

As a single point of failure, this equipment should have been identified as critical and its associated systems understood by the crew and regularly tested. This would include maintenance of the valve, as well as the control air supply and system. It would also include understanding of, and familiarity with, auto-manual operation of the controller and the valve.

Emergency generator

The emergency generator overheated and shut down because the radiator fan drive belt had failed several months prior and had not been replaced. As a result, the engine would only run for a few minutes because there was no fan belt. Regular routine testing meant that the condition of the machinery was well known.

ClassNK rules required that the emergency generator start automatically, within 45 seconds of a blackout, and supply sufficient power for at least 30 minutes' continuous operation of the steering gear (longer for other emergency services such as lighting). *Bulk India's* emergency generator was not capable of meeting these requirements and was therefore unserviceable and not fit for purpose. This represented a condition that directly affected the safety of the ship. It was also a reportable deficiency that should have been rectified as soon as possible.

Critical spares

At the time, *Bulk India* and the wider Kowa Marine fleet did not have an adequate procedure or system to monitor and maintain reliability of critical equipment. Had they done so, the emergency generator fan belts would have been identified as critical to the safe operation of the ship and their inventory level maintained to ensure that replacement belts were always available at short notice.

Furthermore, there were no procedures in place that progressed and tracked an urgent request for spare parts. As a result, the ship was not notified that these critical spares were en route or when to expect them to arrive. As a consequence, the emergency generator fan belt had not been replaced, despite having been received on board. It also meant that *Bulk India* had sailed for more than 7 months with an emergency generator that was unserviceable and would not operate as required.

Communication during pilotage

The pilots were not informed of machinery problems which could directly affect the safe navigation of the ship (including the state of the emergency generator) at any time prior to the blackout occurring. Conversations between the master, chief engineer and others, relevant to the deteriorating situation in the engine room, were not in a language the pilots could understand, which removed an opportunity for the pilots to be informed. Even so, the master had opportunity outside of these conversations to inform the pilots, but did not do so.

The first opportunity was soon after the first cooling water high temperature alarm at 1420; 13 minutes before the blackout occurred. Secondly, after AuxDA1 tripped at 1427, at least two phone conversations were held between the bridge and engine room in the following 2 minutes. This was still about 4 minutes before the blackout. Without this knowledge, the short escort tug, *Pilbara Titan*, was released from duty at 1430, 10 minutes after the initial alarm and 3 minutes before the blackout. Had the pilots been aware of the escalating problems, their actions would have most probably changed, including that the short escort tug would not have been released when it was. This may have led to a more favourable outcome, including the possibility of avoiding the grounding.

The absence of effective communication therefore removed the opportunity for the pilots to prepare for the loss of power and control. Consequently, reactions which may have assisted in a more timely or more effective response were unnecessarily delayed.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include ‘contributing factors’ and ‘other factors that increased risk’ (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition ‘other findings’ may be included to provide important information about topics other than safety factors.

Safety issues are highlighted in bold to emphasise their importance. A safety issue is a safety factor that (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.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to the grounding of *Bulk India* during departure pilotage from Dampier, Western Australia on 11 March 2018. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing factors

- Whilst *Bulk India* was transiting the Rio Tinto Channel, all electrical power was lost. Control of the ship and its manoeuvrability were lost and the rudder remained fixed at 20° to port. The ship turned to port and contacted the channel side, running aground.
- Electrical power was lost when the auxiliary diesel generator engines shut down due to overheating of the cooling water. A fault in the pneumatic controller resulted in the cooling water bypassing the cooler and overheating.
- When the temperature control valve stuck in the cooler bypass position, the engineers did not know how to manually operate the valve. Had the valve been correctly manually operated when first discovered, it is likely that the temperature of the cooling water would have been controlled and the engines would not have overheated.
- Bridge communications were ineffective and the pilots were not informed of the machinery problems prior to the blackout occurring. This removed the opportunity for the pilots to prepare for the loss of control and delayed actions which may have assisted in a more timely or more effective response.

Other factors that increased risk

- The emergency generator was not fit for service as it was unable to provide sustained electrical power to the ship and steering. The engine overheated and shutdown because the radiator fan drive belts had failed several months prior and had not been replaced.
- **No procedure or system was in place to ensure critical spares were identified and their inventory controlled to ensure availability when required. As a consequence, the fan belts for the emergency generator had been on order for several months. [Safety issue]**

Safety issues and actions

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues. The ATSB expects relevant organisations will address all safety issues an investigation identifies.

Depending on the level of risk of a safety issue, the extent of corrective action taken by the relevant organisation(s), or the desirability of directing a broad safety message to the marine industry, the ATSB may issue a formal safety recommendation or safety advisory notice 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 further information about safety action comes to hand.

Critical spares

Safety issue description

No procedure or system was in place to ensure critical spares were identified and their inventory controlled to ensure availability when required. As a consequence, the fan belts for the emergency generator had been on order for several months.

Issue number:	MO-2018-004-SI-001
Issue owner:	Kowa Marine Service
Transport function:	Marine: Shipboard operations
Current issue status:	Closed - Adequately addressed
Issue status justification:	Kowa Marine Service has put in place procedures and systems which adequately address this issue.

Proactive safety action taken by Kowa Marine Service

Action number:	MO-2018-004-NSA-007
Action organisation:	Kowa Marine Service
Action status:	Closed

Kowa Marine Service notified the ATSB that since this incident it has undertaken a process of continuous improvement for all areas of the business including shore- and ship-based safety management processes, training and auditing.

In particular, the ATSB has been notified of the following actions in response to this incident:

- Changes to safety management system technical procedures involving critical machinery, systems and spare parts including:
 - identifying, maintaining and testing of critical machinery, equipment and systems
 - incorporating critical items into the planned maintenance system
 - identifying, listing and maintaining inventory of critical spares
 - maintenance of infrequently used equipment
- Changes to safety management system education and training procedures for staff (shore and shipboard—operational and technical)
- Upgraded ship systems to include a type approved, computer-based, planned maintenance and spare parts inventory control program. This system manages the maintenance work

schedule, monitors work progress, supports spare parts inventory management (including critical spares), and issues and manages work reports.

- Implemented company and ship-specific policy and procedure familiarisation and training for crew prior to joining the ship
- Targeted training for staff in multiple areas of the business including marine risk management, auditing, emergency preparedness and crisis management, incident investigation and technical systems including main engines and emergency generators.
- Regular ship visits and audits by management, class and external auditing services to international standards (including IMO and ISO).

Proactive safety action taken by Bulkseas Marine Management

During this investigation, the ATSB was notified that *Bulk India* had changed ownership and management. The now *Bulk Ara* had come under the management of Bulkseas Marine Management within a fleet of nine bulk carriers. The ATSB made contact with Bulkseas and provided details of the incident and investigation.

With regard to this safety issue, Bulkseas advised the ATSB that its fleetwide safety management system included procedures to ensure the reliability of critical systems, including stand-by machinery and emergency generators. Also, as a consequence of this incident, a fleetwide circular was issued, which emphasised and outlined correct management of spares on board.

On board *Bulk Ara*, targeted, regular training has been implemented for operation of the diesel generator cooling system in the event of control failure. In addition to this, instructions for manual operation of the control valve have been posted at the valve.

Safety action not associated with an identified safety issue

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.

Additional safety action addressing Dampier port operations

Rio Tinto Iron Ore (RTIO) and Rio Tinto Marine (RTM), both part of the Rio Tinto group of companies, advised that changes have been made to several areas of business operations in response to investigations into the grounding of *Bulk India*. Actions included:

- Following the incident, ‘immediate containment’ changes included extension of the short escort tug attendance to number 5 beacons. This remained in effect until additional reviews of towage arrangements had been completed.
- Rio Tinto actively engaged with Dampier port stakeholders (marine pilots, towage, Dampier harbour master and port operations) to undertake a risk-based review of vessel escorting practices and procedures. The current Dampier (and Port Lambert) escort towage risk assessments were reviewed and multiple simulation exercises were completed to determine the effectiveness of escort towage practices (including in emergency situations). The assessments, exercises and discussions resulted in changes to escort towage arrangements for vessels departing Dampier—in particular, the short escort tug was extended to number 3 beacons (Figure 7) with the primary escort tug remaining to the Fairway buoy.
- RTM, in conjunction with Marine Services Western Australia (MSWA) pilots and Westug towage, have developed a ‘Guidance manual for ship towage operations: Dampier and Port Walcott’. This manual was aimed at providing clear ‘guidance for personnel associated with terminal towage and pilotage operations in order to address risk mitigation, maintain the highest industry standards and meet regulatory compliance.’

- RTM circulated a safety bulletin to vessels, brokers and owners advising of actions expected to be taken immediately: all critical machinery to be checked and operational; associated machinery and plant to be in good order; to identify and ensure sufficient stock of critical spares; review and to reiterate bridge resource management techniques including command and communications.
- Completing improvements to ship vetting (including RightShip) through improved oversight, amended frequency of ship inspections and audits.
- Improving engagement with global ship owners and managers (for example through shipping safety forums) to enhance relationships and clarify standards and expectations in relation to vessel safety, asset quality and maintenance.

General details

Occurrence details

Date and time:	11 March 2018 – 1433 WST (UTC +8 hours)	
Occurrence category:	Serious incident	
Primary occurrence type:	Grounding	
Location:	Rio Tinto channel, Dampier, Western Australia	
	Latitude: 20° 36.56' S	Longitude: 116° 41.54' E

Ship details

Name:	<i>Bulk India</i>
IMO number:	9284271
Call sign:	H3WC
Flag:	Panama
Classification society:	ClassNK
Ship type:	Dry bulk carrier
Builder:	Mitsui Engineering & Shipbuilding Co. Ltd, Chiba, Japan
Year built:	2004
Owner(s):	Southern Route Maritime S.A. and Nissen Kaiun Co Ltd, Panama
Manager:	Kowa Marine Service Co. Ltd., Japan
Gross tonnage:	88,490
Deadweight (summer):	177,640 tonnes
Summer draught:	17.975 m
Length overall:	289.00 m
Moulded breadth:	45.00 m
Moulded depth:	24.40 m
Main engine(s):	Mitsui MAN B&W 6S70MC
Total power:	16,860 kW at 91 rpm
Speed:	14.7 knots, fully loaded
Damage:	Nil reported

Sources and submissions

Sources of information

The sources of information during the investigation included:

- the master and crew of *Bulk India*
- Kowa Marine Service
- Rio Tinto Marine (Dampier)
- Rio Tinto Iron Ore (Dampier)
- Marine Services Western Australia (MSWA)
- Westug
- ClassNK
- the Australian Maritime Safety Authority
- Bulkseas Marine Management.

References

ClassNK (Nippon Kaiji Kyokai) 2018, *Rules for the Survey and Construction of Steel Ships*, ClassNK. Available at www.classnk.or.jp

International Maritime Organization (IMO) 2014, *The International Convention for the Safety of Life at Sea (SOLAS) 1974 as amended*, IMO, London.

International Maritime Organisation (IMO) 1995, *International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code) as amended*, IMO, London.

Oil Companies International Marine Forum (OCIMF) 2018, *Safety Critical Equipment and Spare Parts Guidance*, OCIMF, London. Available at www.ocimf.org

Submissions

Under section 26 of the Transport Safety Investigation Act 2003, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section 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 the following directly involved parties:

- master and chief engineer of *Bulk India*
- the pilot in charge
- the peer pilot
- Kowa Marine Service
- Rio Tinto (Dampier)
- Pilbara Ports Authority – Dampier harbour master
- Marine Services Western Australia (MSWA)
- Westug
- Australian Maritime Safety Authority
- Panama Maritime Authority
- Bulkseas Marine Management.

Submissions were received from:

- Kowa Marine Service

- Australian Maritime Safety Authority
- Pilbara Ports Authority – Dampier harbour master
- Rio Tinto (Dampier)
- Marine Services Western Australia (MSWA)
- Westug
- Bulkseas Marine Management.

The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

Appendices

Appendix A—Table of selected AIS data for *Bulk India's* departure from Dampier

Time (LT) ²⁴	Telegraph	SOG ²⁵	COG ²⁶	HDG ²⁷	Comment
1354	STOP	0.8	2	13	All clear of wharf
1404	DSAhd	0.3	210		
1405	SlowAhd	0.4	227	266	
1413	HalfAhd	2.6	284	294	
1418	HalfAhd	5	296	302	<i>Pilbara Titan</i> let go
1420	FullAhd	5.9	304	310	Passing 9W beacon AuxDG1 high JCW temperature
1427	FullAhd	7.7	334	340	AuxDG1 trip Passing Mid Ground
1430	FullAhd	7.8	355	4	Lined up in Rio Tinto Channel <i>Pilbara Titan</i> released from duty
1433	FullAhd	8.1	6	9	Blackout – AuxDG3 trip
1435:45	STOP	7.7	7	4	Ship departing channel
1437	STOP	7.2	2	354	Ship touches bottom
1440		2.0	25	0	
1443		0.7	10	352	Closing on Beacon 5W (about 200 m)
1444		0.5	341	354	<i>Pilbara Titan</i> applies weight port shoulder
1445		0.5	320	358	Commence power restoration – alarms on bridge
1447		0.7	306	13	<i>Pilbara Neptune</i> alongside starboard shoulder
1448		0.2	333	18	Power restored – rudder to midships
1449		0.1	91	17	
1452		0.4	26	11	Clear of channel edge and beacon 5W
1455	STOP	1.1	8	17	Rudder checked, ship mid-channel
1458	DSAhd	1.6	21	14	Main engine started
1500	HalfAhd	2.2	8	11	
1513		4.5	9	10	Fourth tug alongside
1520		4.9	9	9	
1547		5.1	10	16	Pass Fairway beacon Fifth tug arrives
1710		5.8	38	38	Pass Sea Buoy
1848	FWE				Finished with engines, ship at anchor

²⁴ UTC +8 hours.

²⁵ Speed over the ground in knots.

²⁶ Course over the ground in degrees true.

²⁷ Heading in degrees true.

Appendix B—Bulk India Pilot card

MS Form 251
Revised 01/15
Page 1 of 1
Date 23.08.2017

PILOT CARD

DATE | 11 MAR 2018

I SHIP PARTICULARS	
11 Name: M.V BULK INDIA	12 Call Sign: H3WC
13 Displacement: 195,072 GRT	14 DWT: (1) 705,678 (2) Bulkow Exm.
15 Draft FWD: 17.47m	16 Draft AFT: 17.51
17 Air Draft: 17.72 m	18 Port Anchor shank: 13 shackles
19 Starboard Anchor shank: 14 shackles	20

TT Cargo Loaded: **169,789.0** (shackle = 27.4 m / 15 Bulkow)

J MAIN ENGINE	
21 Type:	Max Power Kw: Loaded Speed
22 Full Ahead:	11.9Kts
23 Half Ahead:	10.0Kts
24 Slow Ahead:	7.0Kts
25 Dead Slow Ahead:	5.0Kts
26 Dead Slow Astern:	28
27 Slow Astern:	40
28 Half Astern:	58
29 Full Astern:	65
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KORUMARINE SERVICE CO., LTD

KORUMARINE SERVICE CO., LTD




Note: For Bridge File. Shall send to the Company only if requested.

PILOT

Appendix C—Marine Services Western Australia master/pilot exchange of information (MPX) form

Copy of MPX form in use on the day. Page 1:

289x45 (251) SAP 170218



DAMPIER PILOTS

Vessel:	BULK INDIA				Agent:	
Berth:	PPT2	PPT3	PPT4	PPT5	DFB	

	Inward	Outward
Date	8/03/18	11. MARCH 2018
Pilot		
Draft	(Fwd) 6.28	(Fwd) 17.49
	(Mid) 7.28	(Mid) 17.51
	(Aft) 8.27	(Aft) 17.51
Tides	HW/LW 1424 4.34 m	HW/LW 1618 3.37 m
	HW/LW 2050 1.40 m	HW/LW 1400 3.11 m
	HW/LW 2336	HW/LW 2336
Current (Flood/Ebb)	ebb	Flood
Wind	E 12 Kts	E 15-20 Kts
Checklist		
Pilot Card Presented	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
All equipment tested and working	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Engine ahead and astern	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Steering gear FU and <u>NFU</u> tested, 2 motors running	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Gyro error	Nil	Nil
Navigation lights/shapes displayed	N/A	<input checked="" type="checkbox"/>
Anchors cleared and ready for use	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Monitoring VHF channels 11 & 16	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Gangway prepared/recovered	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	POB 1500	POB 1320
	First line ashore 1724	Last line 1354
	All fast 1810	Disembarked 1845

- The bridge team is reminded of its duty to maintain an accurate check on the vessel's position and movement as laid down in the ISM code, STCW Convention, IMO Regulations and ICS Bridge Procedures, and immediately bring to the attention of the pilot any matter which causes concern
- No metal weights are to be included in any heaving lines; rubber is preferred
- All crew are to stand well clear of the "line of fire" during the mooring, unmooring of your vessel and whilst tugs are secure to your vessel
- Prior to running the forward breast lines and headlines the pilot will instruct the Captain to walk out the port and starboard anchors such that anchors are 2 meters below waterline. The anchors should then be secured with the brake and stopper bar and the officer in charge report to the Captain that the anchors are ALL SECURE
- All mooring lines are to remain slack, touching the water, until advised by the pilot
- Rat guards are not required if the vessel's Sanitation Certificate (De-rat) is valid.

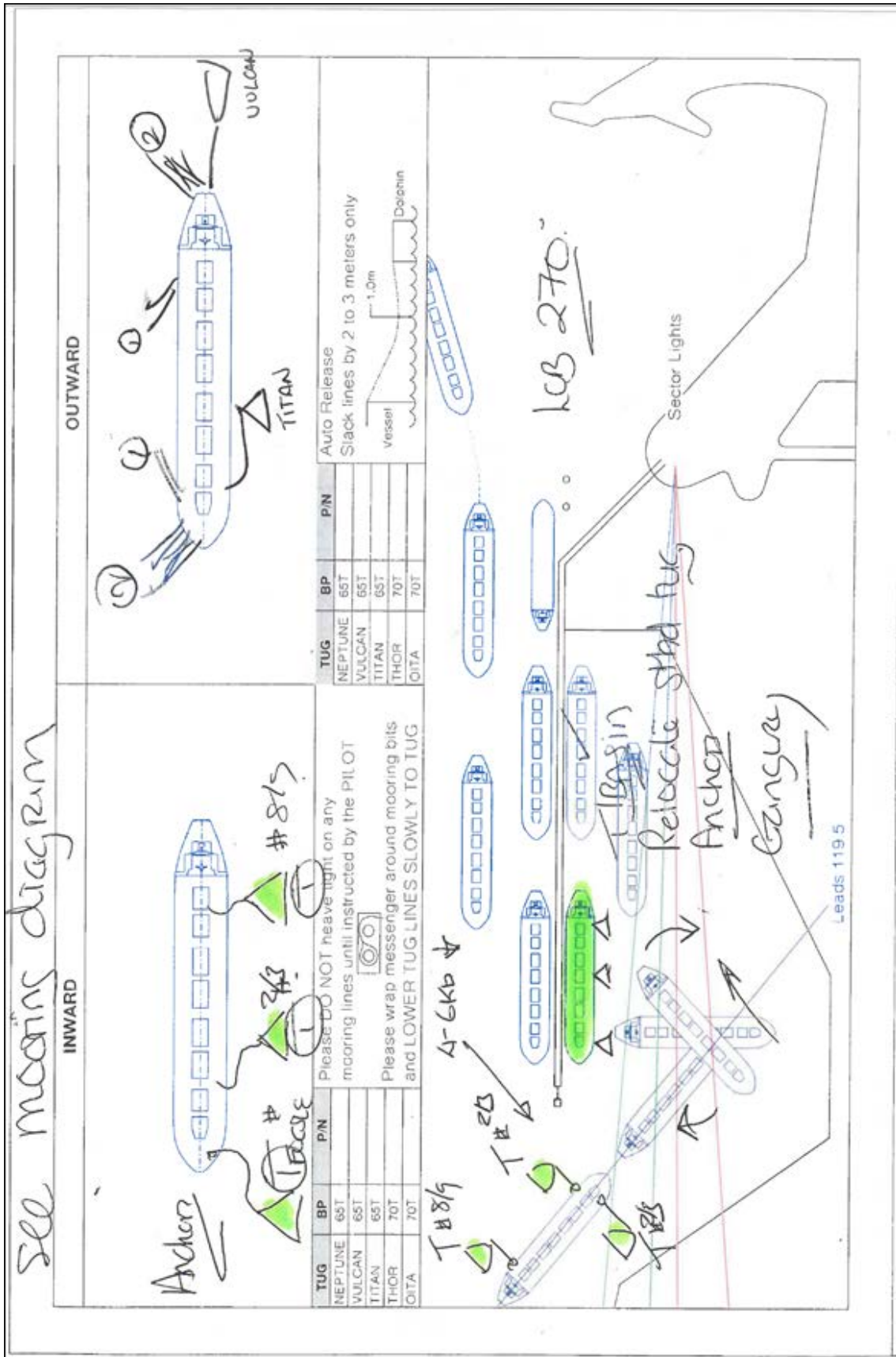
Master / Pilot Exchange

By signing Master agrees to passage plan, berthing plan and safety requirements of the Port and Rio Tinto Conduct of vessel given to Pilot

Master

Master

Marine Services Western Australia master/pilot exchange of information (MPX) form. Page 2:



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 the ATSB's 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.