Departmental investigation
into the grounding of the Indian flag bulk carrier
DAKSHINESHWAR
off Wednesday Island, in the Torres Strait
on 12 July 1997

MIIU

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Contents

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into the grounding of the Indian flag bulk carrier

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The Investigation into marine casualties occurring within the Commonwealth's jurisdiction are conducted under the provisions of the Navigation (Marine Casualty) Regulations, made pursuant to sub section 425 (1) (ea) and 425 1 (AAA) of the Navigation Act 1912. The Regulations provide discretionary powers to the Inspector to investigate incidents as defined by the regulations. Where an investigation is undertaken the Inspector must submit a report to the Secretary of the Department. It is Departmental policy to publish such reports in full as an educational tool.

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Summary

On 12 July 1997, the Indian flag bulk carrier *Dakshineshwar* was on a loaded, northbound passage through the inner route of the Great Barrier Reef, from Hay Point to the east coast of India with a cargo of coal. A licensed Reef Pilot was in charge of the navigation.

At about 2100, the vessel passed between Alert Patches and OG Rock at the eastern end of the Prince of Wales Channel, Torres Strait, and settled on a course of about 270°. The ship's speed over the previous hour had been 12 knots.

At about 2111, the vessel was abeam of Ince Point and the Pilot saw that the Global Positioning System display showed a speed of 10.5 knots. About three minutes later the Pilot, who had moved to the port bridge wing, heard an alarm or some alerting device ringing on the bridge and he went to investigate. As he got close to the centre line he glanced at the helm indicator and engine room tachometer. The helm indicator showed that full starboard rudder had been applied and the tachometer showed zero revolutions. The ship's head had been paying off to port and the rate of turn increased rapidly as the ship closed with Wednesday Island to the western side of Ince Point.

The ship's speed had slowed to about 6.5 knots when the engine was restarted. The Pilot had to make a quick decision and decided to maintain full starboard rudder and ordered emergency full ahead revolutions to maximise the rate of turn to starboard. The ship reached a heading of 172°, before starting to turn to starboard. At about 2120, *Dakshineshwar* grounded in position 10° 30.4' South 142° 17.9' East, with Ince Point Light bearing 100° x 0.85 of a mile.

Narrative

The ship

The Indian flag bulk carrier *Dakshineshwar* was built in Korea in1987. The ship is a conventional “geared” bulk carrier, with the bridge, machinery space and accommodation aft. It has 5 holds, each serviced by a crane, and is 189.01 m in length, has a beam of 30.4 m and a summer deadweight of 47,276 tonnes, at a summer draught of 11.791 m. The ship is owned and operated by the Shipping Corporation of India.

Dakshineshwar is one of 12 “*Daewoo*” class bulk carriers built for the Shipping Corporation of India. It is operated on a triangular trade between the east coast of India, Japan and Australia, carrying iron ore to Japan, and coal from the east coast of Australia to the east coast of India.

Dakshineshwar is powered by a six cylinder B&W LMC engine of 600 mm bore, producing 7944 kW and giving the ship a service speed of 14 knots. The ship’s electrical power is generated by a shaft generator of 540 kW and three diesel generators of 600 kW each.

The ship’s complement of 51, consisted of the Master, three mates, the Chief Engineer, five watchkeeping engineers, an electrician, 35 ratings and five supernumeraries.

The Master had 40 years experience at sea, being first appointed to command in 1966. He spent some years ashore in the offices of the Shipping Corporation of India, before revalidating his certificate and being appointed to a sea going command in 1992. He joined *Dakshineshwar* in July 1996.

The Mate and 2nd Mate held certificates of competency appropriate to their position. The 3rd Mate was an apprentice with 22 months sea going experience, who operated under a letter of dispensation and maintained the 8-12 watch under the Master’s direction.

The incident

Dakshineshwar arrived off Hay Point on 1 July 1997 after a voyage from the Indian east coast and Singapore. After six days at anchor, it berthed in the afternoon of 7 July. The ship was due to sail in the late evening of 8 July, but a breakdown in the shore loading equipment resulted in a delay of nearly 24 hours. At 2300 on 9 July, the ship sailed with a full load of coking coal for ports on the east coast of India, at a draught of 11.6 m forward and 12.0 m aft. *Dakshineshwar's* passage was to be by way of the inner route of the Great Barrier Reef.

A licensed Reef Pilot flew to Mackay on 8 July in anticipation of the vessel sailing that night. However, the delay in the ship's loading program resulted in the Pilot joining the ship at 2200 on 9 July. He was familiar with the ship, having piloted it on two previous occasions, as well as piloting other ships of the same class. He had also piloted with the ship's Master on two previous occasions.

The Pilot noted a red alarm light was showing on the starboard steering motor alarm panel. He was assured that this was a fault with the light, no alarm condition existed and the steering gear was working properly. The northbound voyage proceeded uneventfully; routine reports were made to REEFCENTRE. The Pilot found the ship's officers efficient and alert.

At 0752 on 11 July, *Dakshineshwar* passed Low Isles at the southern limit of the compulsory pilotage area of the inner route.

At about 1610, *Dakshineshwar* was approaching the course alteration position off Palfrey Island; the steering was in automatic. The Pilot ordered the alteration and the quartermaster switched to hand steering, but the rudder did not respond to the wheel. Without delay the officer of the watch switched the control to auxiliary (non follow-up) steering and the ship was brought to its intended course. After the alteration, the ship's staff tested the steering in all modes: they found it was working in all three, hand, automatic and auxiliary modes. As a safeguard, however, the Master ordered that a quartermaster should steer the ship manually.

The remainder of the passage through 11 July and into 12 July continued without incident.

At 1955 on 12 July, *Dakshineshwar* was approaching Alpha Rock at a speed of a little over 12 knots. At the designated REEFCENTRE reporting point off Alpha Rock, the pilot broadcast an “all ships” warning that in one hour it would start the westbound transit of the Prince of Wales Channel at deep draught. At 2030, the officer on the bridge gave the engine room watchkeepers 20 minutes notice of readiness for “stand-by” for the passage from Alert Patches through the Prince of Wales Channel.

The bridge

As the vessel approached Alert Patches at the eastern end of the Prince of Wales Channel, the stage of the tidal stream was about three and a quarter hours after the maximum west-going rate at Hammond Rock. The current was still running in a westerly direction but at less than one knot. At Ince Point the tide was on the flood (HW at 2250 – 2.3 m), 2.0 m above datum and the broadcasting tide gauges indicated 0.1 m above the predicted height. The wind was from the south-east at about 15 knots.

The Master notified the engineers on watch that the engine was on stand-by at 2048. The Pilot had responsibility for the navigation and on the bridge with him were the Master, 3rd Mate and two quartermasters, one of whom was steering, the other on lookout duties.

Dakshineshwar passed between Herald and Alert Patches buoys at 2055 coming to a course of 270° and then to 273° to bring the vessel on to the line of the East Strait Island leading lights. The Pilot alternated his position between the centre line of the wheelhouse and the bridge wings, to maintain sight of the East Strait Island leading lights astern.

At 2107 on 12 July, the 3rd Mate fixed the ship’s position by radar and distance off Ince Point. The position showed that the vessel had regained the intended track on the line of the East Strait Island leading lights and the Pilot ordered a course adjustment to resume a heading of 270°. At about 2111, the vessel was abeam of Ince Point making good a speed of 10.5 knots. Shortly after passing Ince Point the pilot went to the port bridge wing.

At some time just before 2113, the Quartermaster reported to the 3rd Mate that he had the wheel hard to starboard but the ship was not steering. As a consequence of the incident off Palfrey Island, earlier in the passage, the 3rd Mate's immediate assumption was that the steering had failed.

At about 2113, the Pilot was alone on the port bridge wing when he heard what he thought was an alarm ringing. He went to the wheelhouse. When interviewed after the incident, he recalled that the Master and the 3rd Mate were by the engine control panel. Both the Master and 3rd Mate remembered the Quartermaster shouting that the vessel was not steering. The Pilot did not recall this report, but he did look at the indicator dials and saw the tachometer reading zero revolutions, and the rudder indicator showing hard to starboard. He was aware that the ship was beginning to swing to port, despite the starboard rudder.

With the previous incident off Palfrey Island in mind, the Pilot immediately ordered the rudder control to be put into the auxiliary (or "non follow-up" mode) and for the rudder to be kept hard to starboard. The 3rd Mate turned the control switch and the change to auxiliary steering control was made without delay. At about this time a call was received from the engine room and the 3rd Mate told the caller that there was a problem with the steering.

The Master made a broadcast on the ship's tannoy for "emergency anchor" stations.

The rate of swing to port increased rapidly and, over a two minute period, the ship's heading changed from 269° to 211°, the ship's speed dropping to about 6.5 knots. At about 2114, the tachometer showed ahead revolutions indicating that engine power had been restored, but there was no word from the engine room to this effect. Maintaining the rudder at hard to starboard, the Pilot ordered emergency full ahead. The rate of swing to port slowed and, at about 2118, the ship reached a heading of 172°, after which the ship started swinging back to starboard. About one and a half minutes later, the ship grounded on a heading of 199° about eight cables west of Ince Point, in position 10° 30.4' South 142° 17.9' East.

The Mate

A number of the officers, including the Mate and 3rd Engineer were in the mess room, next to the dining saloon, watching a film. At some time after 2100, the Mate sensed that the engine vibration had stopped. He recalled that, about 30 seconds to one minute later, the phone rang. He went to the dining saloon. Looking out of the forward facing window he saw the ship's head turning to port.

The Mate left the dining saloon for the bridge. Before he could reach the navigation bridge deck he heard a tannoy announcement - “emergency anchor stations”. He immediately diverted to his cabin to collect his UHF radio and torch and hurried to the forecastle.

He arrived on the forecastle and was joined by the Carpenter. The anchors were cleared and the Mate reported to the bridge. The time of the report was recalled as being about 2116.

The engine room

The engineers keep traditional watches below. The 2nd Engineer keeps the 4-8 watch, the 3rd Engineer keeps the 12-4 and the 4th Engineer keeps the 8-12. One of the 5th Engineers keeps the 4-8 with the 2nd Engineer and the other keeps the 12-4 watch with the 3rd Engineer. In the case of “Stand-bys”, each watchkeeper remains for up to two hours after his watch to cover the Stand-by, or if necessary, starts two hours earlier.

On the evening of 12 July, the 2nd Engineer stood the 4-8 watch and was then on “stand-by” for the next two hours. However, as he anticipated it would be about 50 minutes before they went on stand-by, he went up to the accommodation at about 2015, to get something to eat and to go the lavatory.

At 2030 that evening, the 4th Engineer, in the machinery control room (MCR), received a telephone call from the bridge advising him that “stand-by” would be in 20 minutes time. He told the 5th Engineer to start the stand-by diesel generator and to take the shaft generator off line.

The 5th Engineer went down to the generator flat and manually started the diesel after carrying out the usual pre-start checks and procedures. Once the machine was running he returned to the MCR and the 4th Engineer put it on load at the main switchboard before taking the shaft generator off line. At a time reported to have been about 2040, when this routine was completed, the 4th Engineer told the 5th Engineer to go down again and shut down the fresh water generator.

When he arrived at the fresh water generator, the 5th Engineer progressively opened the Main Engine jacket cooling water (JCW) bypass valve then closed in the JCW inlet and outlet valves. Having done this, he opened the front cover on the automatic controller for the JCW temperature and reduced the control set point from its normal setting of 81°C to about 77°C.

Some minutes later, the 4th Engineer, still in the control room and observing the digital readout for temperature of the JCW on the central monitoring and alarm system, noticed the temperature starting to climb. He ran down to the jacket cooler and further reduced the set point of the temperature controller to 75°C before returning to the MCR. At 2048, the bridge telephoned to say that they were now on “stand-by”, by which time the 2nd engineer had not returned to the engine room. At this time, the 4th Engineer observed that the temperature appeared to be falling and he instructed the 5th Engineer to continue with the “stand-by” routine and record the main engine revolution counter and fuel flowmeter readings.

A few minutes after they had been notified of “stand-by”, the 4th Engineer noticed that the JCW temperature was again climbing, rapidly. He reduced the main engine speed from 100 to 88 rpm in an attempt to reduce the load on the engine and hence the cooling water temperature, then left the MCR, ran down to the cooler and further reduced the temperature setting on the controller for the JCW. However, while he was below, the “high jacket cooling water temperature” alarm sounded and, shortly afterwards, the main engine was automatically shut down by the “High JCW temperature” emergency trip.

The 4th Engineer, having returned to the MCR, tried to telephone the bridge to advise that the main engine had stopped on high temperature cut-out, however there was no answer to his telephone call. He then called the officers’ recreation room in the hope of finding the 2nd Engineer but he was not there. However the 3rd Engineer was, and on hearing of the problem he rushed down to the engine room while the 4th Engineer was making further attempts to telephone the 2nd Engineer. He eventually located the 2nd Engineer in his cabin and he too, made his way down.

On the bridge, nobody had realised that the main engine had stopped. The 4th Engineer tried again to telephone the bridge to advise them of what was occurring below. This time the 3rd Mate answered, but when he was told of what was happening, the 3rd Mate said, “The rudder angle indicator is on hard to starboard, but the vessel is not responding to the helm”. The 4th Engineer, somewhat confused, understood this to mean that the steering gear had failed. He checked the steering gear indication panel and saw that both steering motor running lights were on and there was no apparent fault.

He put the telegraph and the engine fuel control lever to “Stop”, then made an attempt to restart the main engine but it would not start. The 3rd Engineer arrived in the MCR and he also made an attempt to start the main engine but, again, it would not restart.

Shortly after that, at a time estimated to be about 2110, the 2nd Engineer arrived and, as he passed through the MCR the two other engineers advised him that the engine had tripped on high cooling water temperature. The Chief Engineer in his cabin had, in the meantime, seen his repeater of the main engine tachometer indicate zero revolutions. He attempted to telephone the engine room but, finding the line engaged he too made his way down to the MCR.

The 2nd Engineer went down to the temperature controller and reduced the set temperature to 60°C. The Chief Engineer, meanwhile, had gone down to the aft end of the main engine middle platform where there is a panel which indicates various alarms and trips for the main engine. Two indicator lights, one for no. 5 unit and one for no. 6 unit, both of which indicate engine trip on high cooling water temperature, were illuminated. On returning to the control room he then reset the high temperature trip.

While this was going on, the Master, alerted by one of the crew on the bridge to the fact that the main engine had stopped, telephoned the engine room to say that he must have the main engine. He was told that he was getting the main engine. There was, however, no response to his telegraph orders.

The 2nd Engineer went back up to the MCR and saw that the cooling water temperature had, by this time, fallen below the trip temperature. The jacket cooling high temperature trip having been reset, he restarted the engine.

Once the engine had been started, there were two telegraph orders, the first for “slow ahead” then followed by “full ahead”. At a time logged in the engine room bell book as 2117½, an order was given to stop the engine. The ship was aground.

After the grounding

Initially, the engine was put to full astern for eleven minutes but the ship did not move. The engine was then stopped.

The Mate instructed the Bosun to sound all tanks to see if the hull had been breached. Soundings of the tanks and spaces showed that the hull was intact. The 2nd Mate, who was asleep, was called and he and the 3rd Mate took soundings of the depth of water around the ship, arming the lead with tallow to determine the nature of the seabed.

In consultation with the Queensland and Commonwealth authorities the Master decided that he would not attempt to refloat *Dakshineshwar* until salvors boarded the ship. Salvors boarded at 0843 on 14 July by helicopter.

Dakshineshwar was refloated at 2354 on 15 July with the aid of the salvage tug *"Pacific Salvor",* which had been despatched from Port Moresby in Papua New Guinea. Navigation through the Prince of Wales Channel was restricted while salvage operations were being undertaken.

Damage to the ship as a result of the grounding was apparently minimal.

While there may have been some localised degradation of the seabed at the grounding position, no pollution occurred while the vessel was aground or during the refloating operation.

Comment and Analysis

The bridge

The ship's position had been plotted assiduously by the 3rd Mate and checked against the GPS, which tended to give a position slightly north of those visually plotted.

Nobody on the bridge realised that the engine had stopped until the time when the Pilot was alerted by the alarm, or telephone, at about 2113 and the ship's head was seen to be turning to port. The auxiliary machinery was said to mask the noise of the main engine and, at night, visual cues, such as a reduced wake or propeller wash would not have been obvious. The bridge team only realised that the engine had stopped when the Pilot saw the tachometer showing zero revolutions.

With loss of the engines the vessel was unable to steer.

The Master acted promptly in summoning the Mate and ratings to the forecastle to prepare the anchor.

The Pilot was reluctant to use the anchor in the shallow water, because of the danger of sitting on the anchor and breaching the hull and possibly a double bottom fuel tank. At this time the ship was still swinging to port.

With engine power restored, at about 2114, the Pilot was faced with three options, other than using the anchors. He could try to go astern, but the ship was still making in excess of 6 knots and it is probable that the ship would not have stopped and gathered sternway before it grounded. He could have ordered full port rudder to continue the swing, but his immediate judgement was that there was a real danger of grounding near, or on, Ince Point. The third option was to try and turn to starboard, this, he judged, gave the greatest chance of clearing the shoal water.

The Pilot ordered emergency full ahead, with full starboard rudder. At relatively slow speed, the vessel stopped swinging to port on a heading of 172° and came to a heading of 199° before taking the ground with

Ince Point Light bearing 100° x 0.85 of a mile.

"The control of ships does pose a very peculiar set of problems. The ship is a 'slow system' in which feed-back is not available in a direct and immediate form due to the enormous inertia of the vessel and the fluid nature of its physical environment. The navigator must thus take action in anticipation of what the situation will be at some time in the future[1]*"*

The Pilot had one opportunity to make a decision and there is no way of knowing whether any of the options would have been successful. The Inspector in no way questions, or is critical of, the Pilot's actions.

The quartermaster was efficient and when he was unable to steer informed the officer of the watch.

Communications

There was a serious and significant breakdown in communications between the MCR and the bridge. Unless the engine failed as late as 2111, there was a delay in trying to inform the bridge. The 3rd Mate, who evidently took the call from the engine room at a time between 2112 and 2113 had just become aware of the steering problem.

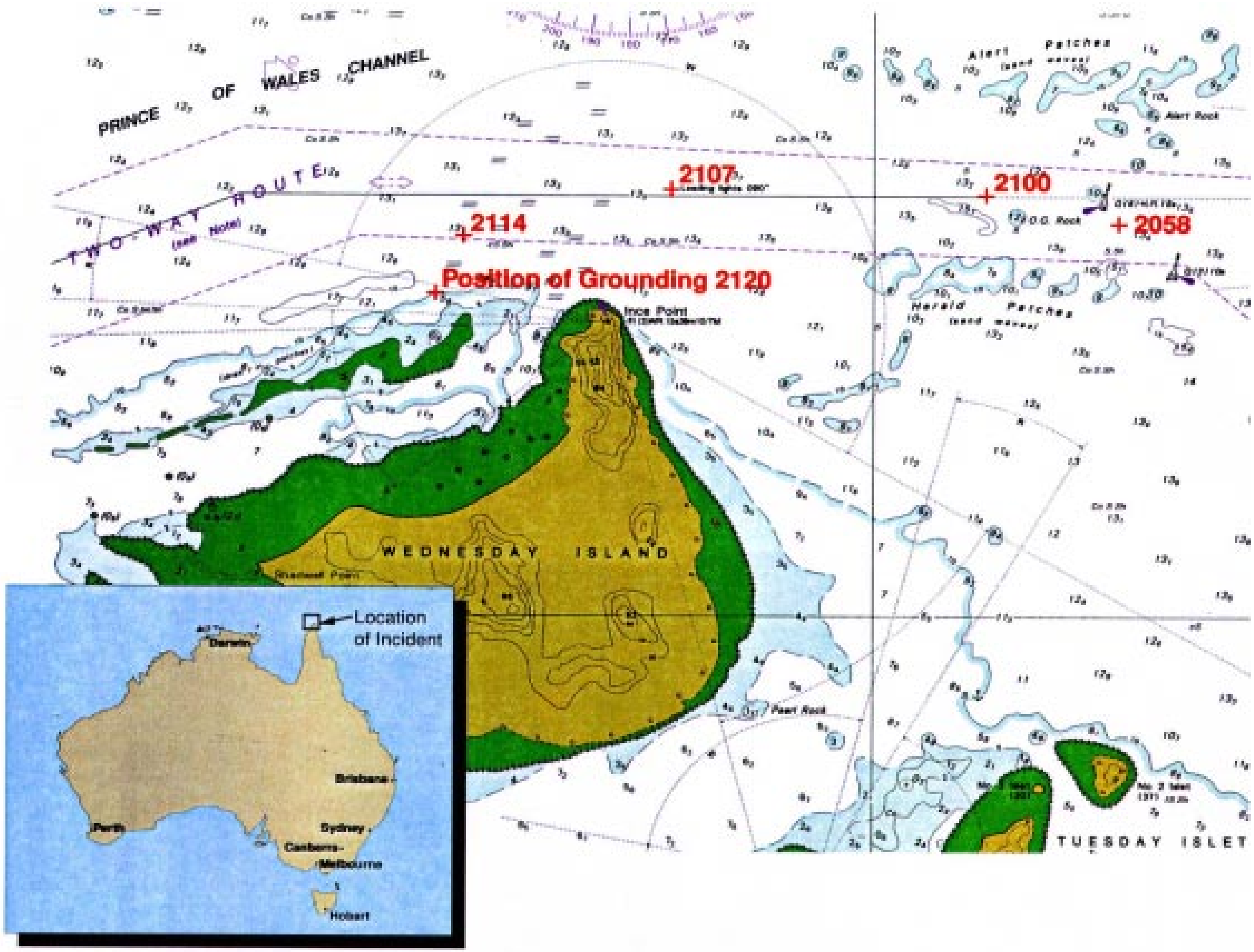
The evident confusion could easily have been overcome by simply ringing the telegraph.

With the absence of the 2nd Engineer from the MCR, the engineering complement had insufficient skills and numbers to both address the problem and maintain efficient communications.

Times

In the initial stages of the field investigation, while interviewing the various members of the crew, there was a wide discrepancy in times given by the bridge and engine room staff.

The times given by the Pilot, Master, and 3rd Mate (the lookout and quartermaster were not aware of the time) were supported by times of positions plotted on the chart using the GPS clock, the independent recollection of the Pilot and the course recorder. However, the course recorder does seem to have been about 3 minutes 20 seconds slow compared with the bridge time.



Portion of chart Aus 283 showing location of the vessel at times leading to the grounding

The course recorder, advanced 3 minutes 20 seconds, shows the vessel steadying on a course of 273° at 2100, which would correspond with the ship coming onto the leading lights after passing between Alert Patches buoy and Herald Patches buoy. The vessel was then steering between 270° and 273° for a period of 11 minutes 20 seconds, before the ship's head started to swing to port.

It is not possible to state with certainty the time at which the engine stopped. It is probable that the engine stopped some time after 2100 and, given the call to the mess room by the 4th Engineer and the testimony of the Mate who had the anchors ready at about 2116, it is most likely that the engine stopped closer to 2112.

The times stated by the engine room staff during the initial interviews were inaccurate and apparently given to hide the absence of the 2nd Engineer from the engine control room. This time can be gauged by the time of the call to the mess room, which led to the Mate starting out for the bridge at about 2112 or 2113 and the 3rd Engineer to the engine room.

The times given by the bridge team are therefore considered to be more accurate.

The engine room

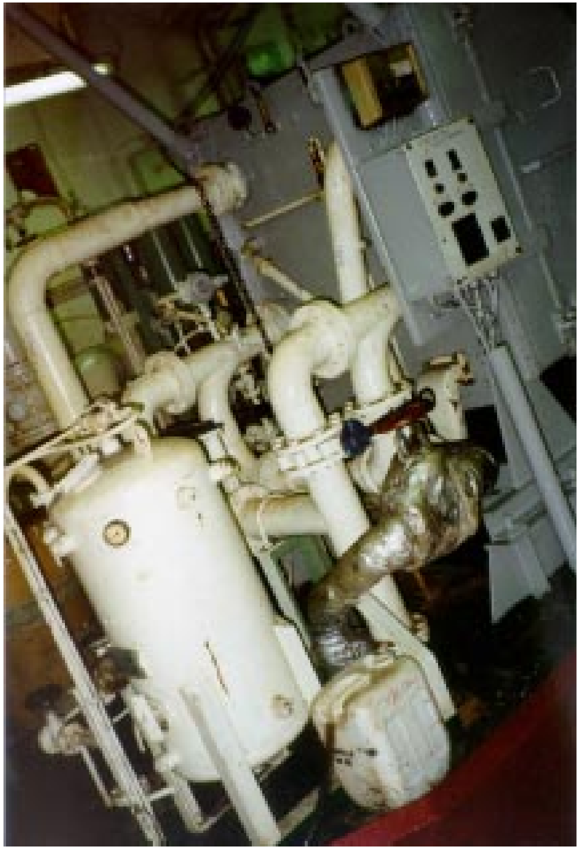
The engine room is designed for manned operation and the ship is not classed as a vessel that may operate with an unmanned machinery space (UMS). Consequently, there is little automation and only comparatively basic remote instrumentation and actuation. Automatic temperature controllers, however, are provided on the lubricating oil cooling system, the camshaft lubricating oil system, seawater circulation system and the JCW system.

An automatic 'shut-down' function for the main engine is provided in case of:

- Overspeed
- Main lubricating oil pressure low-low
- Camshaft lubricating oil pressure low-low
- Thrust pad temperature high

- JCW pressure low-low
- JCW temperature high-high.

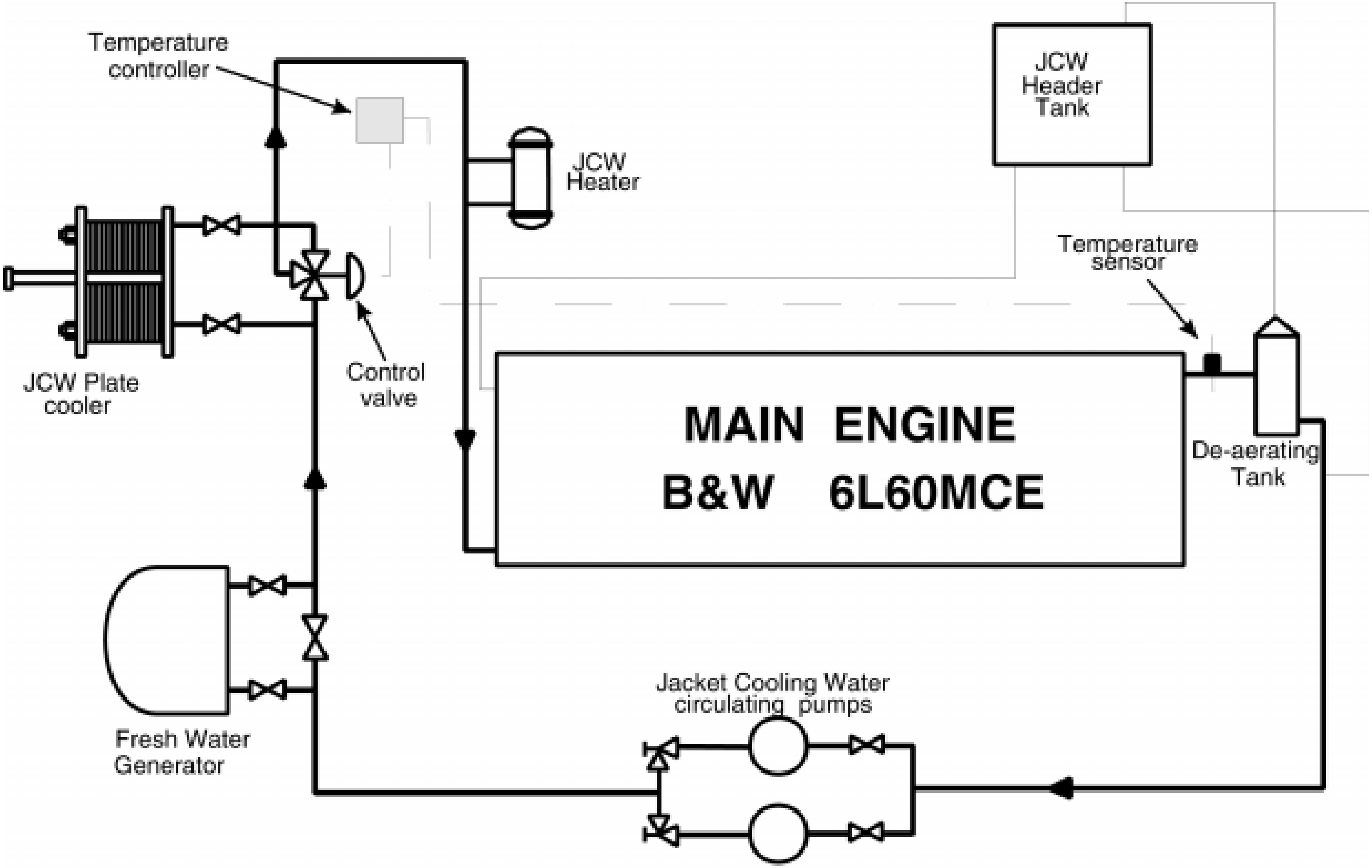
The main engine is cooled by circulating fresh water through the cylinder jackets by means of two JCW pumps. From the pumps, the cooling water is usually (when the ship is on passage) passed through the ship's fresh water generator, or evaporator, where much of the heat contained in the cooling water is given up to the generation of distilled water in the unit. The fresh water generator is an Alfa Laval "D" type. From the fresh water generator, the water then passes through the JCW cooler, where remaining excess heat is exchanged in a seawater-cooled plate type heat-exchanger.


Fresh water generator

See system diagram next page

The temperature controller on the jacket cooling water system is a Nakakita type NST M 732 which controls a Nakakita Seisakusho pneumatic actuator on the bypass valve of the jacket cooler. The cooler is an Alfa Laval "Plate Pack" plate cooler. The controller senses the temperature of the JCW at the point where it leaves the main engine and the system is designed to maintain a constant temperature at the inlet to the fresh water generator in order to ensure its stable operation. This is unlike the older, conventional system, where it was designed to maintain a constant temperature of the cooling water at the inlet to the main engine.

There is no "hand-auto" change over facility at the controller, as there is with many types; the controller output signal is not designed to be manually controlled. Manual control of the bypass valve is intended to be carried out, when necessary, by switching to "override" at the pneumatic actuator and moving the handle on the valve by hand.



M.V. Dakshineshwar - Schematic diagram of main engine jacket water cooling and temperature control system

Opening the front panel of the controller and manually moving the set-point control will, however, change the output signal from the controller, albeit in an uncontrolled manner, as the controller will then change the pneumatic output signal to try to adjust to the new desired temperature value. The change in actual output signal, however, will depend on two factors, which are a) the speed with which the set point or "desired value" is moved and b) the magnitude of the difference between the new desired value and the existing setting.

The faster the set point is changed, or the greater the difference between the new desired value and the existing setting, the more the controller will respond and the more unstable will be its initial response. If the input change is large, the system will go into an initial "hunt" and the bypass valve will move rapidly from one extreme position to the other. This will cause a drastic change in the cooling water temperature until the controller regains stable control of the temperature. If the temperature swing is sufficiently large, it would activate the "jacket water temperature - high" alarm and, if the temperature is slightly higher, may trip the emergency shut-down for the engine. The 'high jacket water temperature' was set to alarm at 85°C, 3° to 4° C above the normal running temperature at sea. The "engine trip", on high cooling water temperature, was set at 90°C.

When the ship is under way on passage, the fresh water generator (or evaporator) is usually on line, producing domestic fresh water. The evaporation process is maintained by boiling seawater, in a vacuum, using the heat being rejected in the main engine jacket cooling water. Under these circumstances, the fresh water generator provides the main cooling effect for the jacket water.

Shutting down the fresh water generator, the operation carried out by the 5th engineer, transfers the cooling load from the fresh water generator to the jacket water plate cooler and causes an "upset" to the cooling system temperature which has to be counteracted by the controller as described above. The magnitude of the "upset", or swing in temperature, depends on the speed with which the valves on the fresh water generator are manipulated during the change-over.

After the vessel was refloated and moved through the Prince of Wales channel on 16 July, observation of the action of the jacket water cooler showed that it was behaving . There was no sign of hunting and it maintained the actual temperature of the cooling water to that of the set point when load changes occurred.

However, the set point for the system temperature had been set at between 73° and 75°C, much lower than the 80-82°C required in the Chief Engineer's Standing Orders and normally maintained when on passage.

As *Dakshineshwar* approached the Prince of Wales Channel there was a significant reduction in depth of water under the keel from seven metres to three metres (allowing for tidal height). At this time, the vessel was still proceeding at full ahead. The reduction in water depth, due to interaction with the bottom, has the effect of increasing the load on the main engine and hence the heat output. This results in an increase in JCW temperature which is then counteracted by the action of the temperature controller.

Due to considerable discrepancies in evidence provided by the engineers of *Dakshineshwar* with regard to the timing, the sequence of events and the temperatures set on the controller, it proved difficult to accurately determine these factors. Nevertheless, it is evident that the jacket water temperature control system, during the period preceding the grounding, was subject to the following disturbances: -

a) The 5th Engineer shut down the fresh water generator

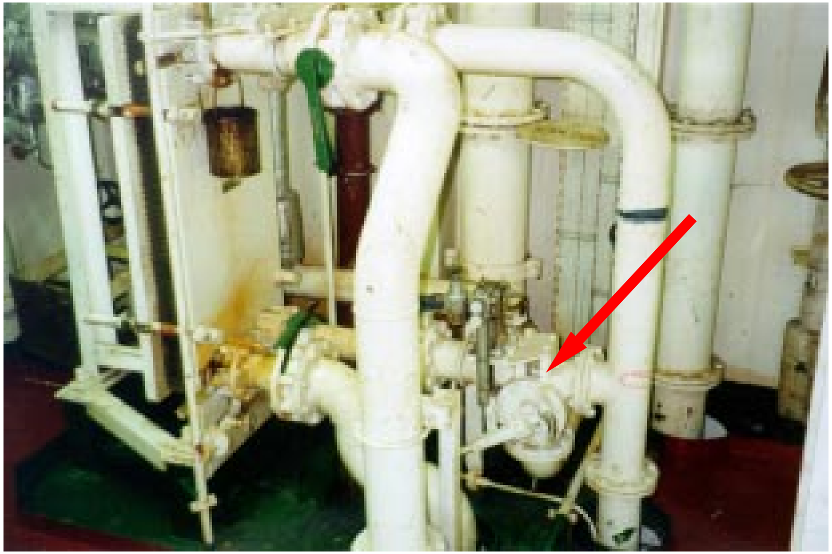
b) He then manually adjusted the set-point of the jacket water cooler, reportedly from 81°C to about 77°C

c) The 4th Engineer, soon afterwards, further reduced the setting of the set point, apparently down to 75°C

d) The load on the main engine increased as the vessel passed over the shallows

e) The 4th Engineer reduced the main engine speed from 100 to 88 rpm, causing a big reduction in engine load and in heat output.

Each of the above would have caused an "upset" to the temperature control system. The stability of the jacket water temperature control system would depend largely on the timing of the above events and the setting of the desired value or set point. If the events were sufficiently close together, they could have caused the system to temporarily lose control to the point where the "high jacket cooling water temperature" alarm sounded, followed shortly by "engine trip" on high temperature.



Main engine jacket water cooler

Main engine jacket cooling water cooler (plate type) showing 3- way by-pass valve (arrowed) and its pneumatic actuator.

Jacket water temperature controller

Nakakita Seissakusho main engine jacket cooling water temperature controller, with cover opened showing ‘set point’ indication (red pointer) and actual water temperature (black pointer)

The most dramatic effect on jacket water temperature would be caused by shutting down the fresh-water generator. In the opinion of the Inspector, there is a distinct possibility that the fresh water generator was shut down considerably later than stated in evidence, a view reinforced by the confusion that existed amongst the engineers about the timing of events. If it had been shut down later, there would have been concern to shut it down relatively quickly, as the ship's speed might have been reduced to manoeuvring speed at any time after "Stand-by". If shut down too quickly, the consequences for the main engine JCW temperature would have been as actually occurred.

Engineering personnel

The Chief Engineer had started his marine engineering career with a four year apprenticeship in a Calcutta dockyard. He had also studied for a BSc (Honours) degree in mathematics. His seagoing career had commenced when he joined the Shipping Corporation of India in 1981. He had remained with the company since that date and had become a permanent Chief Engineer in 1992. He had been on *Dakshineshwar* for 4½ months at the time of the grounding.

The 2nd Engineer had obtained a Diploma in Electrical and Mechanical Engineering at Calcutta Technical College, concurrently with four years of workshop training, after which he had obtained Part A of his 2nd Class Motor Certificate. He then joined the Shipping Corporation of India in 1988, and obtained Part B in 1994. He had been on *Dakshineshwar* for about 10 months.

The 4th Engineer had obtained a Bachelor of Engineering (Mechanical) degree from an engineering college in West Bengal. He had then spent four years as a service engineer, working on earth-moving equipment, before joining the Shipping Corporation of India and spending one year as a Trainee Marine Engineer in Calcutta. Following that, he did various marine courses, (fire-fighting, survival at sea, etc.) at a nautical establishment in Bombay. He joined a VLCC as a trainee in 1993 and became 5th Engineer in 1994. *Dakshineshwar* was his first vessel as 4th Engineer and he had joined the ship only a few days before the grounding.

The 5th Engineer on watch at the time of the grounding had completed a four year course for a Bachelor of Engineering degree at an engineering college in India, completing the course in mid-1994. Having passed a general examination in engineering, English language and aptitude, he had been accepted by the Shipping Corporation of India and sent to Cochin shipyard for one year of practical training. He had joined *Dakshineshwar* in December 1996.

In spite of their qualifications and their engineering experience, none of the engineers showed an understanding of the fundamentals of automatic control systems. The custom of manually adjusting the temperature controller during manoeuvring and when shutting down or starting up the fresh water generator appeared to be one of long-standing. But nobody was aware of why it was done.

The controller was not designed for continual manual intervention and, if properly set up and calibrated, should have been capable of maintaining a steady temperature of the JCW (within reasonable limits), more accurately than could a human being.

Conclusions

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

The following factors are considered to have contributed to the grounding:

1. The engine failure which occurred sometime after 2100.
2. Too rapid shut-down of the fresh water generator.
3. The practice of manually adjusting the set point on the jacket cooling water temperature controller.
4. The lack of understanding and knowledge of the proper operation of automated systems and specifically the engine temperature control system by all the engineers.
5. The lack of sufficiently experienced engineers in the engine room while preparing for stand -by.
6. Poor or deficient operational procedures in the MCR.
7. Deficient communications between the bridge and engine room and the failure to use the most basic communication system, the bridge telegraph.

It is further considered that

8. The Pilot had to make an immediate decision and took the best action under the circumstances.
9. The assumption made by the 3rd Mate that the problem was not the engine but the steering, and any confusion that caused, occurred at such a time that his actions did not alter the outcome

Submissions

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

The final draft of the report, or relevant parts thereof, was sent to the following:

The Pilot, The Master, 3rd Mate, Chief Engineer, 2nd Engineer, 4th Engineer, 5th Engineer and the ship's owners.

Submissions were received from the Shipping Corporation of India Ltd and the Third Mate. The submissions are reproduced below:

The text of the report has been amended where considered appropriate,while the submission of the Shipping Corporation of India Ltd is reproduced below.

The Shipping Corporation of India Ltd

2.0 We, as a prudent shipowner, are extremely concerned about the environmental sensitivity of the Torres Strait and Great Barrier Reef area and have instructed all our vessels to exercise strict caution and alertness while transiting these important channels to avoid such incidents which may jeopardize the movement of ships and cargo traffic through the channels.

3.0 We find the report is well prepared and takes into account the factual data provided by the persons actually involved on board M.V.DAKSHINESHWAR, fresh from their memory.

4.0 The Main Engine failure as it occurred on M.V.DAKSHINESHWAR in Torres Strait, was an isolated instance and arose due to slight human error while shutting down the fresh water generator. A too rapid shut down of the Fresh Water Generator and manually adjusting the set paint of the jacket *cooling water temperature controller, had resulted into the tripping of the Main Engine due to high Jacket cooling water temperature.*

In order to avoid any similar incident in future, we have issued Circular to all our vessels calling at Australian ports to take all required precautionary measures for safe operation of the machinery on board by following correct procedures and in particular to exercise extreme caution while shutting off the Fresh Water Generator to prevent any possibility of undue rise in jacket cooling water temperature.

We are closely monitoring the operation of our vessels plying in Australian Waters in order to improve the performance and also have been attending to Main Engine operating controls/manoeuvering systems by utilising the services of Maker's Service Engineer at regular intervals.

5.0 In order to avoid possibility of any damaging effect to the enviroment or to the vessel in an emergency situation in future if it occurs due to unforseen circumstances beyond our control, we have taken steps to train our ship staff to ensure that they are fully familiar with emergency procedures and preparedness in regard to Main Engine and steering gear operation.

We are encouraging our vesssels to actively participate in the various drills as required by STCW-95 Convention and ISM guidelines. In fact, one of the suggested drills for emergency prepardeness is Main Engine tripping off , as given in our Shipboard Management System.

6.0 We once again thank you for your valuable draft of the report and give our full assurance to you and to the concerned authorities that we shall draw valuable lessons from the enquiry findings for improving our vessel' operation in Australian waters for meeting the high standards of safety.

Details of Dakshineshwar

IMO No.	8409771
Flag	Indian
Classification Society	Bureau Veritas
Ship type	Bulk Carrier
Owner	The Shipping Corporation of India.
Year of build	1987
Builder	Daewoo SB & Heavy Machinery Ltd, Korea
Gross tonnage	28,739
Net tonnage	14,253
Summer deadweight	47,276 tonnes
Length overall	189.01 m
Breadth extreme	30.41 m
Draught (summer)	11.791 m
Engine	Motor
Crew	51