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Summary

Pierre LD, a bulk carrier of 165,239 tonnes deadweight, registered in French Antarctic Territory, sailed from the Western Australian port of Dampier on 21 November 1992 with a full cargo of iron ore. While transiting the departure channel, the ship suffered a major electrical failure together with a failure of the emergency steering system. The ship veered out of the departure channel and grounded to the east of East Malus Island.

The ship remained fast aground for 48 hours and suffered damage to bottom plating, including being holed in four places. Temporary repairs were carried out at anchorage off Dampier, and the ship was permitted to sail to Fos sur Mer, France on 19 December, accompanied by the escort vessel Pacific Taipan.

Information sources

Information was provided by the Master and Chief Engineer of Pierre LD, by the Dampier Harbour Pilot in attendance for departure, and by the Bureau Veritas Marine Branch Manager, Australasia.

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Photographs courtesy of Bureau Veritas.

The ship

The 165,239 tonnes deadweight, 281.84m French Bulk Carrier Pierre LD is a relatively new ship, having been delivered from the Polish Stocznia im. "Komuny Paryskiej" yard, Gdynia in January 1992. The ship is designed to be manned by a total crew of 18 and is highly automated.

The ship's machinery arrangement is provided with a level of automation consistent with Bureau Veritas unmanned machinery space operation notation "✠AUT" and includes generator automation, and machinery surveillance and monitoring.

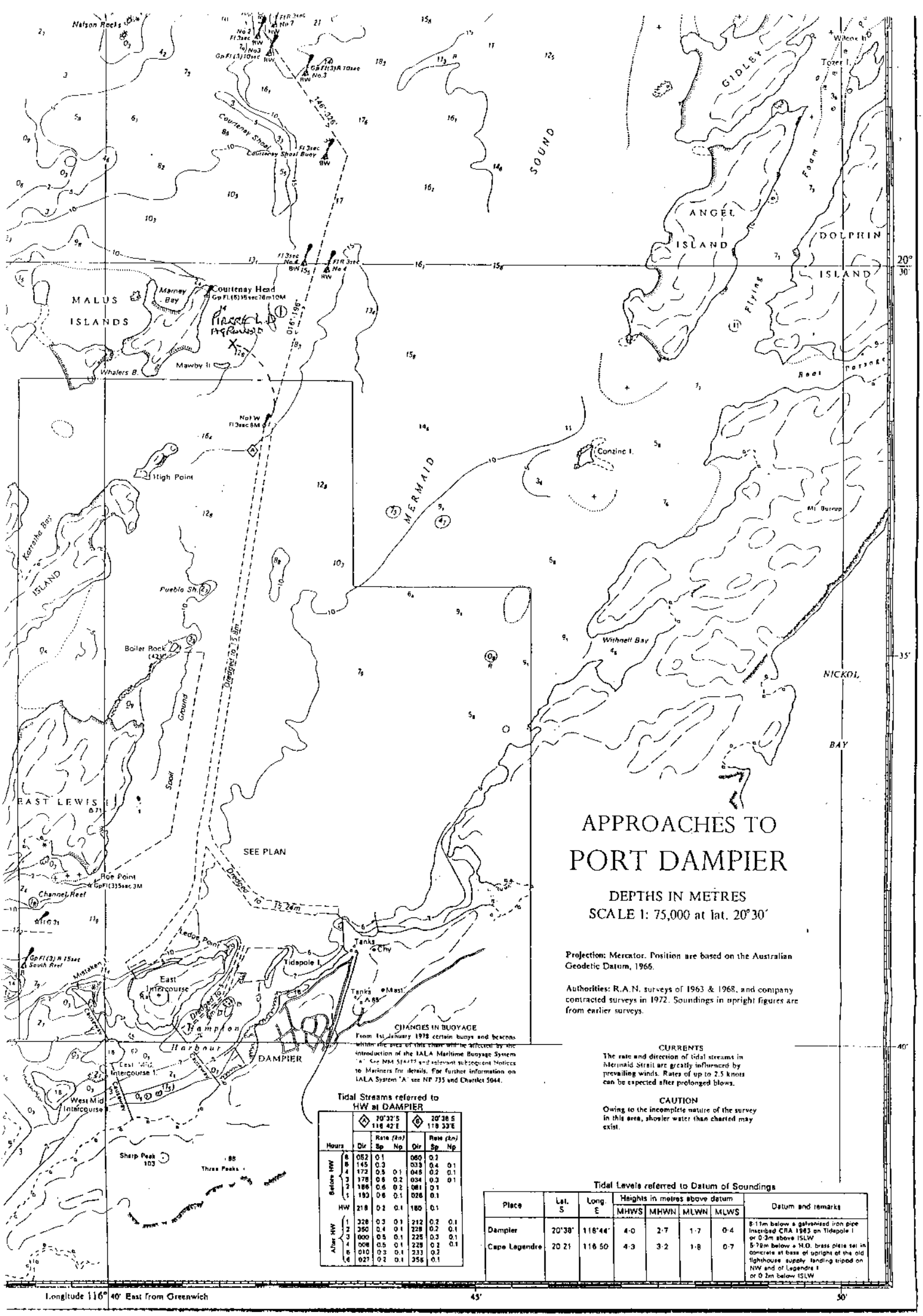
The ship's power is provided by three diesel generators, backed up by an automatically started emergency diesel generator, with emergency power provided by a 24V battery system. The 24V battery system provides power to the generator automatic/emergency stop functions. Normally, either one or two generators will be in use at any one time.

The fuel supply to the generators is controlled by a Woodward governor fitted to each unit. The governor senses the load on the generator and controls the fuel supply in all conditions of operation, from zero load (when starting) to full load, and if the engine is overloaded it will cut off the fuel supply. In addition each generator is fitted with a mechanical over-speed trip, which will override all other systems to stop the engine if it over-speeds.

In the event of a main power failure the generator selected to "stand-by" will be started by the generator automatic/sequential start arrangement, which, with the Woodward-type electronic governor control, is supplied directly from the emergency switchboard. In the event of the "standby" generator failing to start, the sequential start program will select the next generator in sequence. This sequential starting is repeated every six seconds until main power is restored.

In addition to the generator speed governor controls, directly attached to the fuel pump rack there is an emergency stop pneumatic cylinder, which when activated shuts off the fuel supply to the generators. Electrical supply to the solenoid control for this emergency stop cylinder is fed directly from the 24V emergency batteries, via the various automatic stop relays (such as low lubricating oil pressure and overspeed) and the remote manual emergency stop switches in the wheelhouse and engine room control room.

The direct supply from the 24V emergency batteries provides an uninterrupted power supply to the automatic and manual emergency stop functions, even in the event of main and/or emergency power failure. This uninterrupted power



APPROACHES TO PORT DAMPIER

DEPTHS IN METRES
SCALE 1: 75,000 at lat. 20°30′

Projection: Mercator. Position are based on the Australian Geodetic Datum, 1966.

Authorities: R.A.N. surveys of 1963 & 1968, and company contracted surveys in 1972. Soundings in upright figures are from earlier surveys.

CHANGES IN BUOYAGE

From 1st January 1978 certain buoys and beacons within the area of this chart will be affected by the introduction of the IALA Maritime Buoyage System "A". See NM SEA(1) and relevant subsequent Notices to Mariners for details. For further information on IALA System "A" see NP 735 and Charlet 5044.

CURRENTS

The rate and direction of tidal streams in Mermaid Strait are greatly influenced by prevailing winds. Rates of up to 2·5 knots can be expected after prolonged blows.

CAUTION

Owing to the incomplete nature of the survey in this area, shoaler water than charted may exist.

Tidal Streams referred to HW at DAMPIER

Hours		◈ 20°32′S 116 42′E Dir	Rate (kn) Sp	Rate (kn) Np	◈ 20°36 S 116 33′E Dir	Rate (kn) Sp	Rate (kn) Np
Before HW	6	052	0·1		060	0·2	
	5	145	0·3		033	0·4	0·1
	4	172	0·5	0·1	045	0·2	0·1
	3	178	0·6	0·2	034	0·3	0·1
	2	186	0·6	0·2	081	0·1	
	1	193	0·6	0·1	026	0·1	
HW		218	0·2	0·1	180	0·1	
After HW	1	328	0·3	0·1	212	0·2	0·1
	2	350	0·4	0·1	228	0·2	0·1
	3	000	0·5	0·1	225	0·3	0·1
	4	008	0·5	0·1	229	0·2	0·1
	5	010	0·3	0·1	233	0·2	
	6	027	0·2	0·1	356	0·1	

Tidal Levels referred to Datum of Soundings

Place	Lat. S	Long. E	Heights in metres above datum MHWS	MHWN	MLWN	MLWS	Datum and remarks
Dampier	20°38′	116°44′	4·0	2·7	1·7	0·4	8·11m below a galvanised iron pipe inscribed CRA 1963 on Tidepole I or 0·3m above ISLW
Cape Legendre	20 21	116 50	4·3	3·2	1·8	0·7	5·79m below a M.O. brass plate set in concrete at base of upright of the old lighthouse supply landing tripod on NW end of Legendre I or 0·2m below ISLW

supply is designed "fail safe". To cater for unacceptable variations in voltage from the batteries, which are under continuous charge from the battery charger, the 24 volts are supplied through a voltage stabiliser unit. The voltage stabiliser unit was protected by an overload device.

In the event of this 24V power source failing for any reason, the emergency stop control will be activated.

Sequence of events

Pierre LD sailed from the East Intercourse Island iron ore loading berth, Dampier at 1903 on 21 November 1992, with a crew of 19. The ship had loaded a full cargo, 158,757 tonnes of iron ore, for the French port of Fos sur Mer. The ship's draught on departure was 17.65m even keel. Before sailing the main engine and the steering gear had been tested, in accordance with standard, on-board operational procedures, and found to be satisfactory.

On the bridge were the Master, the Second Officer, two seamen (one of whom was at the wheel) and a Dampier Harbour Pilot. The weather was fine, with the wind from the north-north-west at 15 knots.

Prior to leaving the berth the Pilot had discussed procedures with the Master, explaining that the critical depth area was at No 4 buoy, one-and-a-half hours from the berth, which had to be passed within 45 minutes of high water. Time of high water was 2011, therefore the latest the Pierre LD needed to be off the berth, to ensure sufficient depth of water at No 4 buoy, was 1926.

Once clear of the berth the Pilot judged that further tug assistance was not necessary and the two tugs were dismissed, so as to be able to assist in the berthing of another ship.

While Pierre LD was proceeding down the dredged channel, the Pilot noted that even at slow speed it was quick to respond to helm movement. However, the ship was slow to increase engine speed and he became a little concerned about making No 4 buoy at the requisite time. He expressed his concern to the Master, who increased the engine speed, which was still at "Half Ahead", to "Full Ahead". The Pilot noted an increase in the ship's speed and was then satisfied that the ship would be on time.

The ship passed Channel Beacon No 1, at the outer end of the dredged channel, at 2036, when the Pilot noted the ship's speed as being indicated at 10.2 knots. At this point the Pilot ordered starboard helm to alter course from 008 to 016 degrees, but the ship over-shot to 018 degrees, so he ordered Port 20 and then Port 10 when the heading was 017 degrees.

At this moment, at a time noted in the engine-room as 2040, a complete power loss occurred.

The Pilot immediately ordered starboard helm, but the helmsman reported that there was no response, the rudder remained at Port 10. The Master put the engine control to full astern and switched on the emergency steering system, but the rudder still did not respond. With the rudder locked at Port 10, the ship veered to port, towards East Malus Island, one mile to the west of the channel.

Realising the gravity of the situation the Pilot advised the Port Control at 2043, advising that tug assistance was urgently needed.

The Master ordered the Second Mate and the Bosun to go forward, to let go the starboard anchor, and to hold on at three shackles. This was done, but the ship's speed was too great and the windlass brakes would not hold. The Master then ordered the Second Mate to let go the Port anchor, but the ship grounded shortly after this, at approximately 2050, on a heading of 287 degrees.

When electrical power was lost at 2040, the emergency diesel generator automatically started and coupled into the emergency switchboard within about eight seconds. This provided power for selective lighting, control consoles on the bridge and in the engine-room, and certain navigational equipment, including the emergency steering system.

While the engineers were looking for the cause of the blackout, the Master telephoned to advise the Chief Engineer that the emergency steering system was not working and requested he fix the steering first. A green indicator lamp on the console indicated that the emergency steering hydraulic pump motor was operating and no system faults were indicated, therefore the Chief Engineer considered his priority was to get the main generators working.

The engineers found there was no 24V DC supply to the generators or to the main engine safety circuits, without which the machinery could not be restarted. A 24V DC supply was jury rigged from another source and all three main generators started, only to immediately stop again. All three generators were found to have tripped on mechanical overspeed and to gain access to reset this mechanical overspeed cut-out trip required the removal of a plate from the side of each engine. While this was being done, the Chief Engineer went to the 24V DC emergency supply control room, on the second accommodation deck level, where he found that the No 2 battery-charging unit voltage stabiliser had tripped out on overload. He pressed the overload reset button and the 24V DC supply was restored. As soon as the mechanical overspeed cut-outs on the generators had been reset, the engineers were able to restart the generators and couple them to the switchboard.

However, main power was not restored until after the ship had grounded.

The crew was detailed to sound round the tanks and from the tank soundings it was ascertained that No 4 double-bottom water-ballast tank was taking water. All other tanks were sound.

The port anchor was hove home, but the starboard anchor, with seven

shackles out, was fast and was believed to be under the ship.

The Assistant Harbour Master boarded at 2115 and assumed control, summoning the tugs which had just completed berthing another ship. As soon as the tugs arrived they were made fast and attempts were made to refloat the ship. However, these attempts were unsuccessful.

The Assistant Harbour Master then set in train preparations to try to refloat the ship at High Water (2100) the next day. Seven tugs were employed on this occasion and although the ship was moved about 20m astern, the attempts to refloat the ship on 22 November also failed. However, further attempts on 23 November were successful and the ship was taken to anchorage seaward of the sea buoy. The ship owners responded to the incident by sending a senior superintendent and every co-operation was extended to the Australian authorities

Initial inspection by divers on 24 November revealed two large holes in the bottom plating in way of No 4 double bottom ballast tank. Further underwater examination on 27 November revealed a third large hole, plus a smaller hole, also in way of No 4 double bottom ballast tank. No iron ore discharge facilities are available at Dampier, therefore appropriate temporary repairs had to be considered. Although there were concerns for the safety of the port should a cyclone develop, and moving the ship to Fremantle was considered, temporary repairs were carried out at the anchorage off Dampier.

Temporary patch plating repairs were carried out to the requirement of the ship's Classification Society, Bureau Veritas, but these were found to be not capable of preventing ingress of water into No 4 starboard ballast tank, and an internal inspection of this tank was not possible. However, after careful consideration by, and agreement of Bureau Veritas and the Australian Maritime Safety Authority, Pierre LD was permitted to sail on 19 December, to proceed to Fos sur Mer, France, under escort of the off-shore supply vessel Pacific Taipan.

Immediately the grounding of Pierre LD was reported to the ship's owners, a senior superintendent was sent to represent the company. Every cooperation was extended by the company to the Australian authorities and Bureau Veritas surveyors.

Comment

There are two main occurrences that need to be considered in this incident, the main power failure and the emergency steering gear failure.

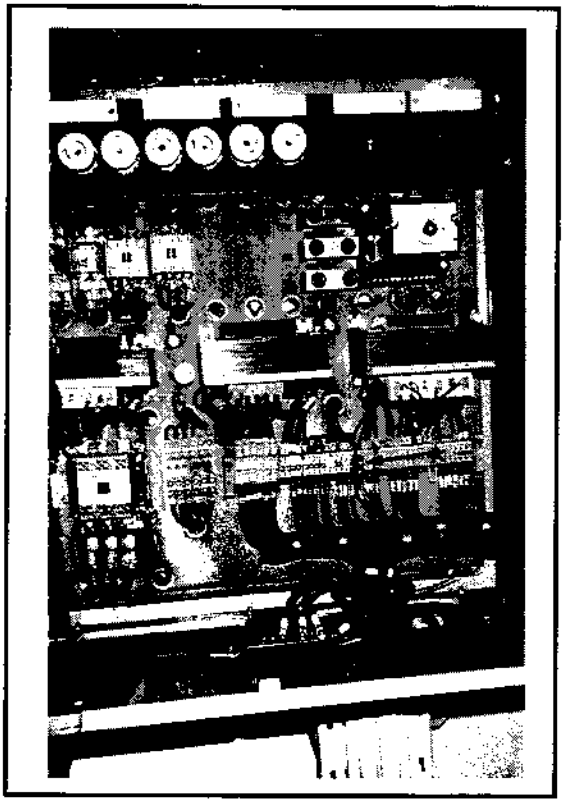
The emergency steering system failure

Pierre LD is designed to be "fail safe". With the loss of the main power, the emergency generator automatically starts within eight seconds and provides power to the emergency steering system. The emergency steering system can be selected by a switch on the navigating bridge and is available within 45 seconds. Therefore, even with a main power failure, the ship can be steered until main power is restored, or until such time as the ship loses steerage way, whichever occurs first. Pierre LD is said to steer well at slow speeds and, therefore, steerage could have been expected to be maintained for possibly two or three miles before steerage way was lost.

In the event, although the emergency generator worked as designed, the emergency steering system did not, the grounding occurring as a result of that failure.

When requested by the Master to get the emergency steering system running, the Chief Engineer checked the indicators on the console, the green light indicating that the system was running and no faults were indicated. He, therefore, decided his priority was to regain main power, and did not go to the steering gear compartment.

The fault in the emergency steering system was eventually traced to a loose electrical cable connection in the emergency steering system control panel, located in the steering gear compartment. This loose connection affected the starboard rudder demand only, and although more port rudder could have been applied, the rudder could not be moved from port 10 to midships or to a starboard position.



Emergency steering system control panel

★ — Bridging contact inserted at loose connection

Since the maiden voyage, a number of electrical malfunctions had occurred on board as a result of loose electrical connections. Rectification of electrical problems was exacerbated by the non-availablity of technical documents in the French language and because some electrical drawings did not clearly reflect the "as fitted" condition.

In line with common practice, for the first six months the Owners had provided additional engineering staff to help cope with "teething problems". The manning was subsequently reduced to the standard complement of three engineers, with the designated Radio Officer also performing the duties of a technical/electrical officer.

Experience has shown that loose electrical cable connections are a common occurrence on new ships and are generally reflective of the quality-control measures in the ship yards.

The main power failure

The cause of the main power failure was traced to the functioning of an overload cut-out switch on a voltage stabiliser unit on the 24V DC supply to the safety circuits of the main engine and generators. The stabiliser unit is provided to ensure a stabilised voltage, with minimum variation, and to eliminate voltage fluctuations caused by the effect of the batteries being in a continuous supply-and-charging mode.

The continuous 24V DC supply from the batteries to the main engine and diesel generator safety systems is designed as a fail-safe system, to ensure uninterrupted supply from the batteries in the event of a main power failure. However, that supply is passed through the voltage stabiliser, which is not designed to be fail safe and is, therefore, a weak link in the chain. Also, there was no indication on the engine-room console to indicate that the stabiliser unit had tripped, and it was only when the Chief Engineer went to the control cabinet, on the second accommodation deck level, that he became aware of the cause of the power failure. These are both aspects of the original design which were important factors that helped create the situation for the grounding.

The reason for the overload cut-out switch on the stabiliser unit operating was not ascertained, but the effect was that the emergency shut-down procedures were initiated, which included the activation of the emergency stop pneumatic actuators on the fuel racks of the generators.

When the emergency generator started automatically, power was provided to the main generator automatic sequential start system. This system is designed to start each of the three main generators in turn, on a continuous six-second sequential start program. Had this operated as designed, power would have been restored within a minute and power to all the ships systems,

including the main steering, would have been restored. However, the machines would not start because the fuel was cut off by the activated emergency stops on the fuel rack. The engineers had tried levering the fuel valves open, but had been unable to do so against the pneumatic control.

When an alternative 24V DC supply was arranged, allowing the emergency stops to be cancelled, the generators still failed to start. Each time an attempt was made to start one of the generators, the mechanical over-speed control over-rode all other controls, stopping the engine.

An emergency shut-down test was conducted at the anchorage, while the ship was undergoing repairs, in which the full emergency generator automatic restarting system operated as designed.

However, no test was conducted with the 24V power supply to the emergency stop pneumatic activators on the fuel racks disconnected and, therefore, the exact conditions at the time of the power failure were not simulated. No reason could be identified for the sequence of starting failures due to the mechanical over-speed controls. However, it was found that the fuel indicators on the Woodward governors showed that the maximum amount of fuel was being supplied to the generators, as if the units were on maximum load.

Given all the evidence, it would seem that the continuous automatic sequential starting of the generators, followed by an immediate shut down due to lack of fuel, caused the governors on all three main generators to progressively try to supply more fuel. Which in turn led to a situation whereby, when the fuel supply was restored, the generators started with maximum fuel supply and, without load placed upon them, were immediately over-speeding and were mechanically closed down.

This scenario would support the fact that the fuel indicators on the Woodward Governors showed maximum fuel supply, although the generators were being started and were not under load conditions. It is considered that this point requires further investigation.

Actions

When the power failure occurred, the Master responded quickly to change over to the emergency steering system and when it was realised that the rudder was not responding to the starboard helm demands, he asked the Chief Engineer to provide steering capability as soon as possible. He then sent the Second Officer forward to let go the starboard anchor, in an effort to stop the ship swinging to port. On the Pierre LD it is normally possible to let go the anchors remotely from the bridge. However, the remote control system is electrically operated, powered only from the main switch board, therefore in this instance remote letting go of the anchors was

not available to the Master. Even had it been possible to let go the anchors from the bridge, at the speed at which the ship was proceeding, in all probability the anchors and cables would have been lost. As it was, when the starboard anchor was let go by the Second Officer, the brake was unable to hold the weight on the cable. The speed just prior to the grounding was noted as being just over four knots and possibly only the grounding prevented all of the cable from running out.

It is considered that the Master did all within his power to prevent the grounding. After the black-out occurred, the Chief Engineer and his staff were engaged in finding out why the main diesel generators were failing to restart and why the blackout had occurred. On being advised of the apparent emergency steering system failure, because of the positive indicator light on the control console, he considered his priority to lie in regaining main power. Had someone with full knowledge of the main and emergency steering systems been despatched to the steering gear compartment, it is possible that person may have appreciated the problem and used the direct solenoid controls on the hydraulic rams to put the rudder hard to starboard. However, the three engineers were fully occupied and even had such action been initiated it is a matter of conjecture whether the grounding would have been averted.

Onboard Procedures

When the Pilot boarded, prior to the ship sailing, he was aware of the main engine being tested. On board procedures were for the main engine and various systems, including the emergency steering system, to be tested prior to each sailing. However, as the change-over method to the emergency steering system was by means of a switch on the navigating bridge, a deck officer did not go to the steering gear compartment for the test. It is not known therefore, how familiar the deck officers were, even if at all, with the solenoid direct control steering.

Conclusions

It is considered that:-

1. Although a sequence of failures occurred, the grounding was the result of the failure of the emergency steering system.

2. The failure of the emergency steering system was due to a faulty electrical connection to the starboard solenoid control valve.

3. The loose electrical connection is reflective of the quality control measures in the shipyard.

4. The power failure was due to a 24V DC voltage stabiliser unit tripping out on overload, activating the emergency stops to the main engine and diesel generators.

5. The 24V DC stabiliser unit was not fail safe, and was therefore a weak link in an otherwise fail safe system.

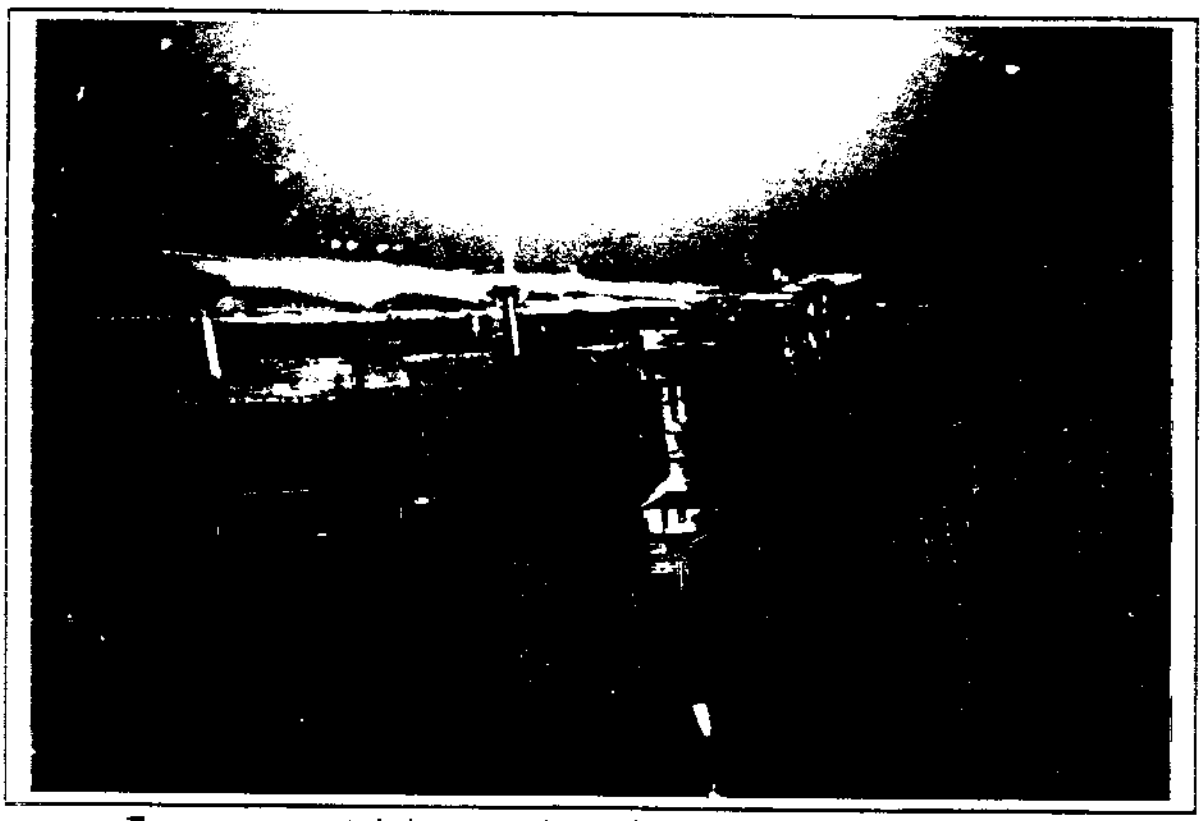
6. The lack of a stabiliser unit remote alarm indicator in the control room is a design fault.

7. Even had it been possible to let go the anchors from the bridge, at the speed at which the ship was proceeding, in all probability both anchors and cables would have been lost.

Attachment 1

Photographs of damage due to grounding

Bottom damage caused by the ship sitting on the anchor



Temporary patch-late repair work performed off Dampier

Attachment 2

Details of ship

Name:	Pierre LD.
Lloyd's Number:	8800391
Ship type:	bulk carrier.
Flag:	French.
Owner:	CETRAMAR
Operator:	CETRAGPA
Charterer:	Nordstroem and Thulin AB.
Crew:	7 French 11 Turkish.
Year of build:	1992
Yard:	Stocznia im. "Komuny Paryskiej" Gdynia.
Main engine:	Sulzer 6RTA76 13300kW.
Gross tonnage:	91642
Nett tonnage:	45116
Summer deadweight:	165239
Length overall:	281.84m
Beam:	44.9m
Moulded depth:	25.4m
Summer draught:	17.825m
Number of holds:	9
Classification Society:	Bureau Veritas