MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

ACCIDENT REPORT

LESS SERIOUS MARINE CASUALTY | REPORT NO 18/2012 | JULY 2012

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MV *PRIDE OF CALAIS*

Machinery failure leading to contact with berth
Calais, France
22 October 2011

SUMMARY

At 2326 (UTC+1) on 22 October 2011, the UK registered passenger and freight ro-ro vessel *Pride of Calais* made heavy contact with No 6 berth in Calais, France, at a speed of 2.5kts. The vessel's main propulsion had failed as she approached the berth and, although the starboard anchor was let go, the vessel could not be stopped. *Pride of Calais* suffered minor damage to her bow but nobody on board was seriously injured and there was no pollution.

The MAIB investigation has identified that the clutches connecting the vessel's three main engines to their shafts had disengaged almost simultaneously as a result of a reduction in control air pressure. Contributing factors included:

- Of the vessel's two air compressors, one had recently become unserviceable, and the other was defective and operating below its intended capacity.
- The cause of the reduction in the control air pressure was not accurately diagnosed by the on-watch engineers, and their actions to maintain and then restore propulsion were ineffective.

A delay in informing the bridge team about the loss of control air, denied the master valuable time in which to assess the alternative courses of action available. The investigation also identified that the applicable onboard emergency situation check cards contained insufficient detail, and that the machinery breakdown drills that had been conducted were unlikely to prepare the crew for the scenario which unfolded on the day of the accident.

A recommendation has been made to the vessel's manager aimed at improving the effectiveness of its crews when dealing with similar situations in the future.

Image courtesy of John White, MarineTraffic.com

Pride of Calais

FACTUAL INFORMATION

Narrative

At 2158 on 22 October 2011, the passenger and freight ro-ro vessel *Pride of Calais* departed from Dover, UK for passage to Calais, France. Shortly after clearing Dover, the centre main engine (CME) was stopped in order to save fuel, leaving the port and starboard main engines (PME and SME) running for the Dover Strait crossing.

At approximately 2250, the fourth engineer officer (4EO) noticed an oily mist surrounding number 2 air compressor (AC2) during his routine rounds of the engine room. After a visual inspection, he selected the number 1 air compressor (AC1) as the running or 'lead' compressor, leaving AC2 as the standby or 'lag' compressor (**Figure 1**). He then returned to the engine control room (ECR) to report his actions.

Shortly afterwards, the third engineer (3EO) left the engine control room to investigate an alarm indicating that the lubricating oil pressure on AC2 was low. When he arrived at the air compressors AC1 was running but AC2 was stopped and its oil pressure warning light was illuminated.

The 3EO checked that the oil level in AC2 was correct and then tried to start it. AC2 immediately tripped, so the 3EO removed the compressor's crankcase door and saw that the main lubricating oil discharge pipe assembly had detached and that the bottom end bearing had overheated and failed (**Figure 2**). The 3EO, in consultation with the relief chief engineer officer (RCEO), who by then, had joined the 3EO, assessed that AC2 was unusable. The compressor was isolated and the RCEO and 3EO returned to the ECR. Once in the ECR, the engineers noticed that the air pressure in the main air receiver[1] was dropping.

At 2306, the master ordered the CME to be started. The CME was turned over on air and started at 2310. At 2314, all three engines were placed on standby in readiness for manoeuvring into port and control of the steering system was switched from 'automatic' to 'manual'. At this time, *Pride of Calais* was approaching the buoyed channel into Calais (**Figure 3**), the wind was southerly at a speed of 15kts, the sea was calm and the visibility was good. In the vicinity of the port entrance, the tidal stream was setting 070° at 0.5kt.

[1] An air receiver is an air cylinder equipped with appropriate pressure monitoring, safety and distribution devices.

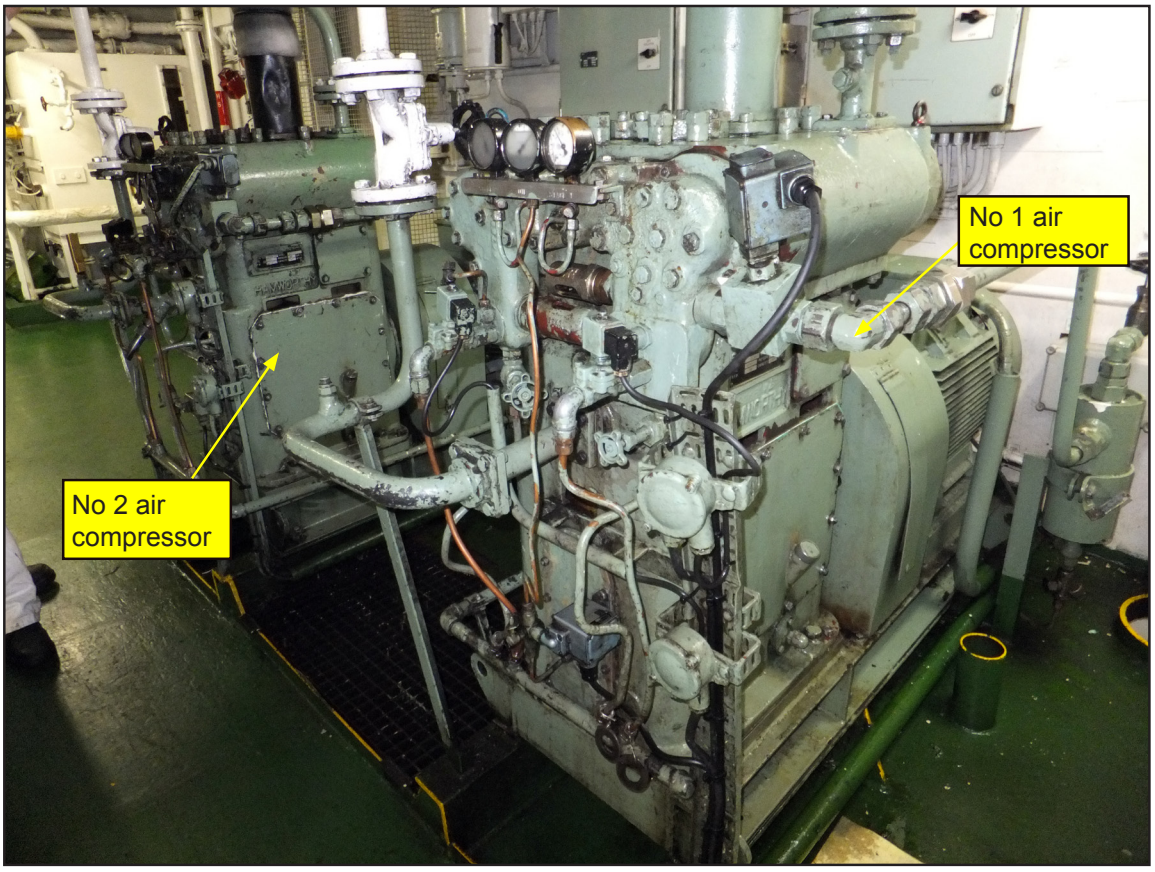

Figure 1: No 1 and No 2 air compressors

Figure 2: Damage to lubrication oil pipe and bottom end bearing

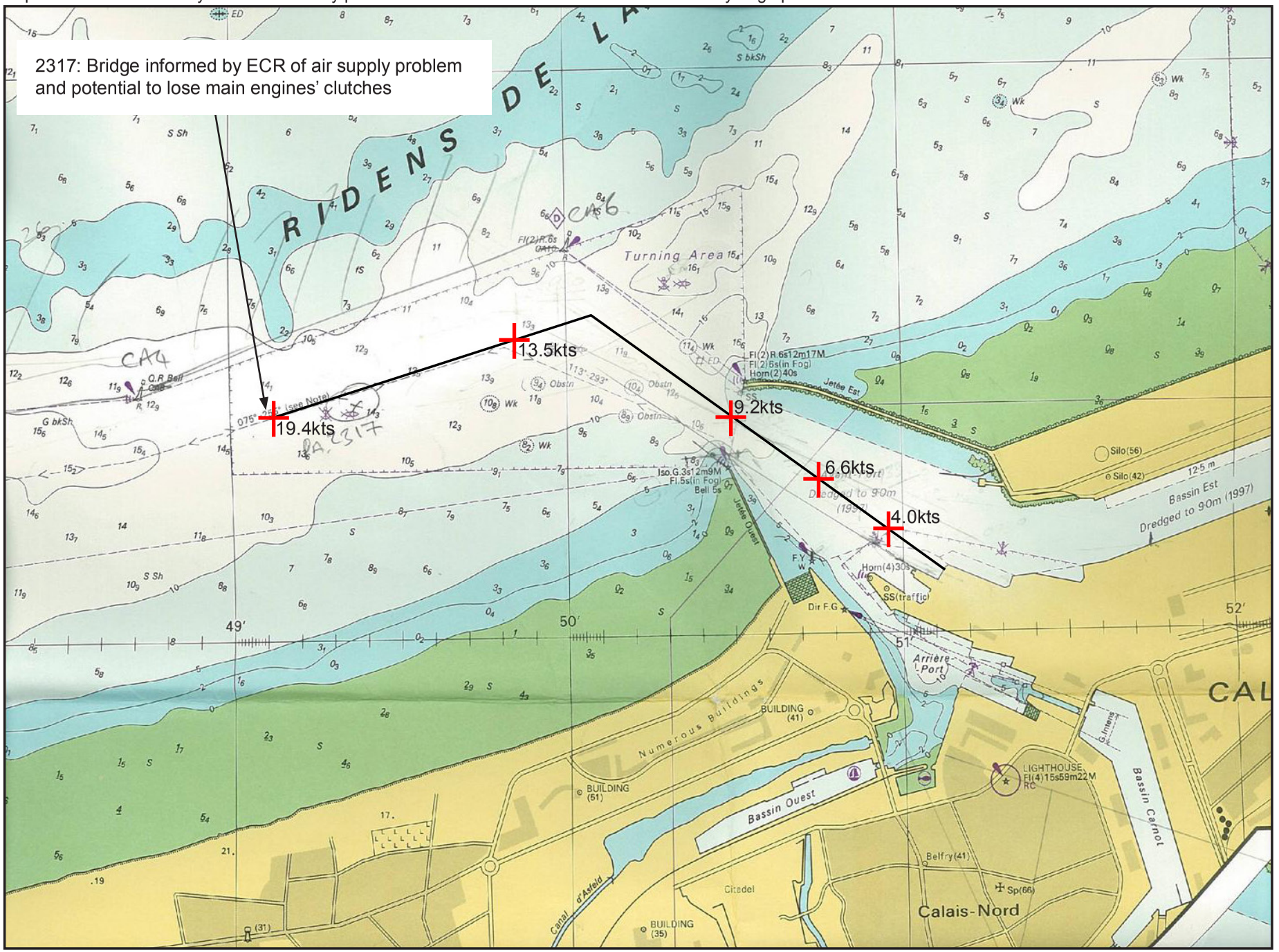

Figure 3: Approach to Calais and No 6 berth

Between 2310 and 2317, multiple low air pressure alarms sounded in the ECR. The pressure in the main air receiver had fallen to less than 15 bar, and the pressure in the control air receiver had fallen to about 8 bar. The RCEO and the 3EO left the ECR and started to search the engine room for a possible air leak.

Pride of Calais had now entered the buoyed channel and, at 2315, the master took control of the ferry from the second officer. The bow thrusters were started shortly afterwards.

At 2317, the RCEO returned to the ECR and telephoned the bridge. He informed the second officer 'we are losing air pressure', and he also raised concerns about '*losing*' the main engines' clutches. The second officer asked whether there was going to be a problem with the engines. The master was aware of the telephone conversation and he asked the second officer to tell him what was going on. The second officer replied '*we are losing air*'. The master then prompted the second officer to request that the engineers report again when they had more information.

Pride of Calais was now 8 cables from the entrance to Calais and had passed the planned 'abort' position, so the master decided to continue the entry into the port as normal. Meanwhile, the RCEO called the senior chief engineer officer (SCEO), briefed him about the loss of air pressure, and asked him to come to the engine room to assist.

At 2321, the master ordered an announcement to be made instructing the passengers to remain in the accommodation and not to proceed to the stairways leading to the vehicle decks. *Pride of Calais* was now 3.2 cables from her intended berth **(Figure 3)**, travelling at a speed of 7.3kts.

In the engine room, the 3EO was closing non-essential air supply line valves when the main engines' clutches started to slip. Smoke began to fill the engine room, which activated the fire alarm. The 3EO and 4EO quickly rigged local air lines adjacent to each main engine clutch and used the main working air to try and keep the clutches engaged. However, the air pressure continued to fall and, at 2323, the PME and SME clutches disengaged, quickly followed by the CME clutch.

At 2324, *Pride of Calais* was just over a ship's length from the berth travelling at a speed of 4.3kts (**Figure 4**). At 2325, an announcement was made on the main broadcast system instructing everyone on board to brace for an impact. The master then ordered the starboard anchor to be let go. At about the same time, the 4EO opened the isolating valve on the reserve air receiver and the PME clutch engaged. However, this was not noticed by anyone on the bridge or in the ECR. Seconds later, at 2326, *Pride of Calais* struck her berth at a speed of 2.5kts and the PME again disengaged. The starboard side of the bow spade and the forward steering compartment were damaged. There were no injuries to passengers, but one crew member sustained a minor injury to his chest.

Post contact

Following contact with the berth, *Pride of Calais* rebounded off the berthing pads. The starboard anchor failed to hold and the vessel drifted slowly to the east into safe water. The master requested tug assistance; and a tug arrived on scene at 2337.

The SCEO arrived in the engine room shortly after *Pride of Calais* struck the berth. He was briefed that AC1 was unable to keep up with the demand for air and that AC2 had overheated and had a defective bottom end bearing. The pressure in the main air receiver was 11 bar and the pressure in the control air receiver was 8.3 bar, both pressures were steady. At 2340, the SCEO engaged the PME clutch from the ECR and control of the PME was transferred to the bridge, shortly followed by one bow thruster. The SCEO did not try to engage the clutches for the SME and CME because he was concerned that this would reduce the air pressure and cause the PME's clutch to disengage yet again.

At 2348 a second tug arrived on scene and, using the PME and the tugs available, the master manoeuvred *Pride of Calais* onto her berth 10 minutes later.

Subsequent examination of the air compressors highlighted that the locking nut on the bolt holding the plates in the low pressure discharge valve on AC1 had worked loose. This had resulted in partial disintegration of one plate (**Figure 5**) and debris entering the low pressure cylinder, causing damage to the cylinder head and piston. The failure of the lubricating oil pipe on AC2 **(Figure 2)** was attributed to the repeated tightening of the securing nut against the olive which had resulted in 'work hardening' and weakening of the copper pipe.

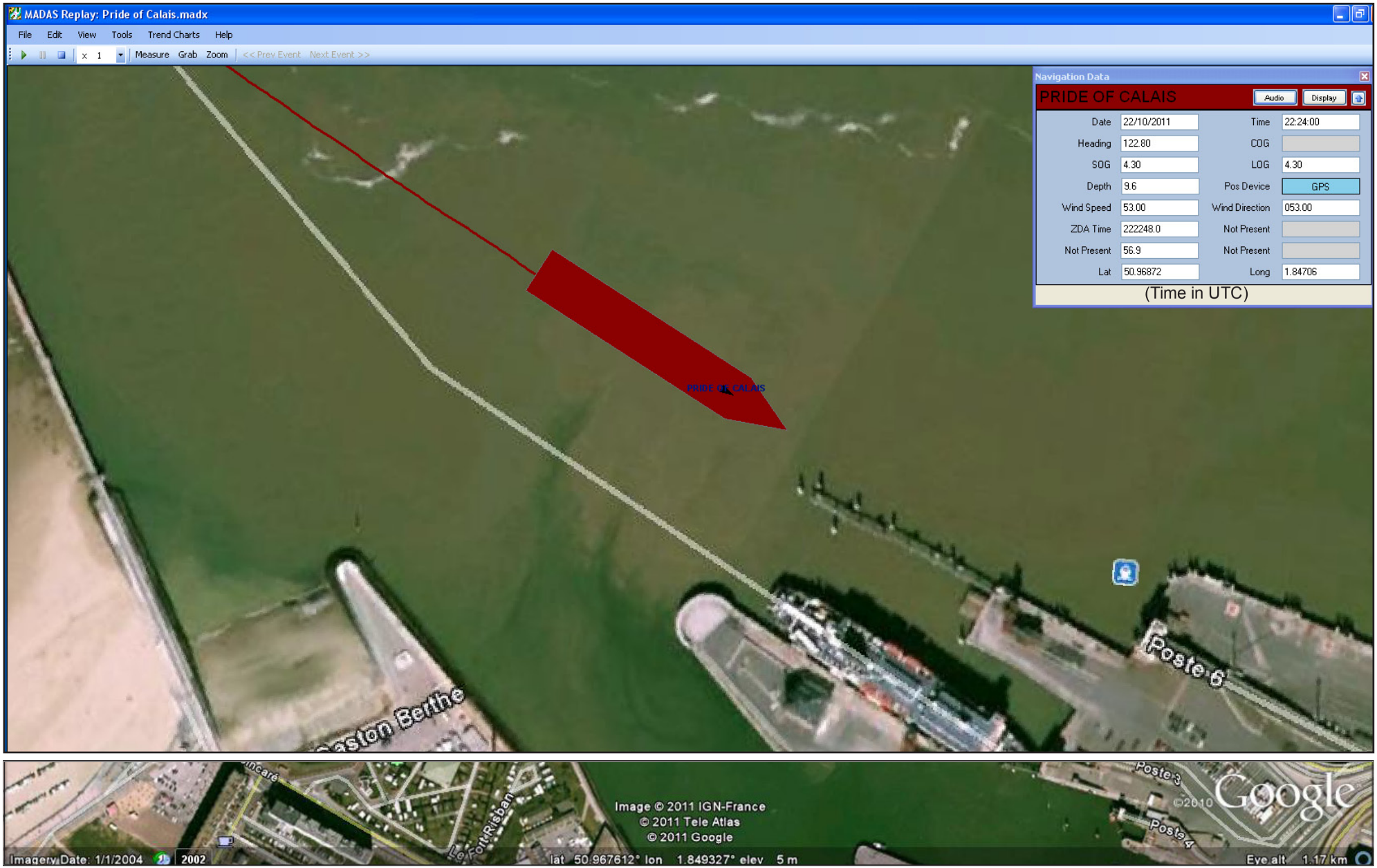

Figure 4: Approach to No 6 berth Calais at the time of port and starboard main engines' clutches disengaging

Figure 5: Damage to No 1 compressor, low pressure discharge valve

The compressed and main engine clutch systems

The ship's compressed air system comprised two Hamworthy Mk V air compressors rated at 141 cubic metres per hour at a pressure of 30 bar. The compressors supplied a main and a reserve air receiver to a pressure of 22 bar. One compressor was selected as the running or 'lead' compressor and the other as the standby or 'lag'. The lag compressor was intended to start automatically when the lead compressor was unable to maintain the required air pressure in the main receiver during periods of high demand. The compressed air system was designated as a critical system in the onboard operating instructions.

The main receiver supplied air, via a dryer and reducer, to a control air receiver, kept at a pressure of 10 bar, as well as to other systems requiring compressed air. Air from the control air receiver, at a pressure of 8 bar, was used to keep the main engines' clutches engaged. The main engine clutches were usually operated from the ECR, although local operation was possible by connecting flexible air lines to each clutch from the main air system.

Technical emergency situation check cards, detailing the actions to be taken in the event of the loss of main control air and the total or partial loss of clutch control air, were available. Both of the check cards included:

Inform Bridge of possible loss of Propulsion

Press Engineroom Call Button

Check status Clutches

Send Assistant Watchkeeper to investigate

Inform Chief Engineer

Check Pressures at Air Control Station by Main Air Receivers

Check pressures at Control Air Receiver and status of outlet Valves

Check that all system relief valves are holding

Check for other sources of leakage

Report to Bridge

Neither of the check cards was used on 22 October 2011, although many of the actions included on the cards were carried out. The actions to be taken in the event of the loss of control air were discussed during routine training drills.

Compressor maintenance

AC1 had been overhauled during *Pride of Calais*'s refit in March 2011. Maintenance records showed that the compressor's valves, lubricating oil and filter had been changed annually since 1991. The compressor's valves were last overhauled in September 2011. A low lubricating oil pressure fault required the lubricating oil and filter to be changed 1 month later. AC1 had run for 5365 hours.

AC2 had followed a similar maintenance regime as AC1, with its valves, lubricating oil and filter last changed in March 2011. AC2 had run for 2155 hours. Both compressors had been maintained in accordance with the planned maintenance system; but the following maintenance history is of note.

In November 1996, the lubricating oil discharge pipe in AC2 was replaced after it had sheared. It was replaced again in July 2004, when it was found to be loose and its olive worn. The 12mm copper lubricating oil discharge pipes had also been replaced for similar reasons on identical compressors fitted to other P&O vessels. The pipe was connected at each end by a compression fitting, sealed by a brass olive. It was recognised that the compression fitting occasionally vibrated loose, and it was tightened as a matter of course during routine maintenance.

The compressor's running hours were recorded but were not monitored or analysed. There was no formal onboard policy regarding which of the compressors should be running as the 'lead' or the 'lag' compressor at any given time, or on the balancing of the compressors' running hours.

Crew

Pride of Calais had 81 crew on board. Of these, her master had over 31 years of ferry experience and held an SCTW II/2 Certificate of Competency (CoC). He completed a Bridge Team Training course in 1999, and was promoted to master in the same year. The master first took command of *Pride of Calais* in December 2010.

The SCEO had 37 years of ferry experience and held an STCW III/2 CoC. He had served on board *Pride of Calais* for 13 months, and was on duty between 0600 and 1800. In December 2009 he had completed P&O's Maritime Resource Management training, which was accredited by the Maritime and Coastguard Agency (MCA).

The RCEO had over 26 years' experience in short sea ferry operations and had been promoted to RCEO in 2007. He held an SCTW III/2 CoC and was on duty between 1800 and 0600. The RCEO had spent 1 week shadowing the vessel's previous RCEO before formally joining the vessel on 19 October 2011. He had previously sailed on board *Pride of Dover*, a sister vessel, between 1987 and 2007, and again for 1 week in 2010.

ANALYSIS

Contact with berth

Pride of Calais lost propulsion when all three main engine clutches disengaged in very quick succession. The loss of propulsion came at a critical point as the vessel was still making good 4.3kts and was only about one ship's length from her berth. Although letting go the starboard anchor reduced the vessel's speed to 2.5kts, it did not prevent her striking the berth. The use of both anchors might have been more effective.

Loss of air pressure

The main engines' clutches disengaged as a result of the control air pressure falling to below the minimum of 8 bar required to keep the clutches engaged.

The vessel's air compressors were not supplying the main air receiver as intended. The output from AC1 had been reduced by the mechanical failure of the low pressure discharge valve components **(Figure 5)**, and subsequent damage to the cylinder head and piston. AC2 was unusable due to the recent failure of the lubricating oil pipe **(Figure 2)** and the resulting damage to the bottom end bearings. From around 2250, when AC1 became the only compressor that was running, the pressure in the main air receiver started to fall.

The demand for air would have increased between 2306 and 2310 when the CME was turned over and then started. The defective AC1 could not cope with the increased demand and, by 2317, the pressures in the main and control air receivers had fallen to 15 bar and 8 bar respectively. Indeed, the air pressure in both the main and control air receivers continued to fall to the point where the main engines' clutches disengaged at 2323.

Fault diagnosis

Given the nature of the defect on AC1, it is possible that the compressor had been unable to meet its required output for some time. However, because AC1's output was not checked by the 4EO when he selected it as the lead compressor, or by the RCEO and 3EO when they isolated AC2, the engineers on watch were not aware of its deficiency. These were missed opportunities to identify the potential loss of air to the main engines' clutches before the CME was started, and before the master had committed the ferry to her approach into Calais.

In addition, when the RCEO and the 3EO noticed that the pressure in the main air receiver was dropping, which was followed by the sounding of multiple low air pressure alarms in the ECR, the officers assumed there was an air leak on the distribution side of the main air receiver. However, as AC1 was the only compressor running, more attention to the possibility that there was a problem with the compressor, was warranted.

It is possible that the provision of two air compressors had led to a view among the engineers that there was sufficient redundancy for the system to operate as intended, even when one of the compressors was out of action. Such confidence in the compressors was misplaced. Although the compressors had operated successfully for 25 years, the control system was designated as a critical system, and it is therefore surprising that the compressors' running hours were not balanced to ensure that they shared equal time as 'lead' and 'lag', or effectively monitored to provide early indication of a deterioration in the system.

Attempts to restore propulsion

Once the main engines' clutches started to slip, the engineers tried to keep the clutches engaged by rigging local air lines supplied from the main air receiver. This action was unsuccessful, but the 4EO was quick to try and re-engage the clutches by opening the reserve air receiver, which was still charged to a pressure of 22 bar.

Unfortunately, the reserve air receiver was opened without first isolating the main air receiver. Consequently, the air pressures in the receivers equalised at about 11 bar. Moreover, the air pressure continued to fall as the engineers tried to re-engage the SME and CME clutches, and therefore the PME clutch remained re-engaged for only a short period. Had the engineers focused on re-engaging a single engine, as the SCEO did following the contact, the probability of restoring at least some of the vessel's propulsion would have been increased considerably.

Overall response

The bridge team's actions in warning passengers and letting go the starboard anchor undoubtedly helped to prevent more serious injuries and reduced the damage to the ship. Nevertheless, the circumstances of this accident clearly indicate that the crew's overall response to the loss of the control air and the resulting disengagement of the main engines' clutches, lacked direction and co-ordination. In particular:

- The on-watch engineers were unable to diagnose the reason for the loss of control air pressure. They were also unable to maintain, or restore, the vessel's propulsion in time to prevent contact with the berth.

- The RCEO committed himself to assisting the 3EO in the engine room instead of overseeing and analysing the situation from the ECR, and liaising directly with the bridge.

- The technical emergency situation check cards which should have prompted earlier reports to the master and SCEO were not used.

- The master was not aware of the potential loss of the control air pressure until over 10 minutes after the fall in air pressure was first noticed. The delay denied the master valuable time to assess the courses of action available, such as reducing speed, anchoring, continuing to the east, or requesting tug assistance.

- Communication between the ECR and the bridge was via telephone, rather than the 'talkback' system, which would have enabled the master to maintain an awareness of the developing engineering problems without having to rely on relayed messages.

- The master's decision to continue to the berth at close to the normal speed of approach of 5kts was made quickly and without understanding the full implications of the problems the engineers were dealing with.

In order for emergencies of this nature to be dealt with effectively, it is essential that all of the crew involved are properly trained to accurately establish the facts, to communicate and delegate effectively, and to decide on an appropriate course of action. In this case, although the senior officers involved were highly experienced, only the SCEO had completed P&O's Maritime Resource Management training. In addition, although reactions to scenarios involving the loss of control air had been discussed by the ship's engineers, it had not been properly drilled. The technical emergency check cards available did not require the output from the compressors to be checked, explain the procedure for using the reserve air receiver, or emphasise the need to co-ordinate the local engagement of clutches to ensure that at least one main engine could be made available.

It is recognised that the opportunities to conduct realistic machinery breakdown drills on board *Pride of Calais* are severely restricted by the vessel's operation in the congested waters of the Dover Strait. Nonetheless, 'hands on' drills are unquestionably the best way to train crews to deal effectively with emergency situations and to verify the logic and usefulness of the check cards provided. Therefore, further consideration on how realistic drills can be achieved is warranted.

CONCLUSIONS

- The contact with the berth resulted from a loss of propulsion when *Pride of Calais* was in the final stages of approach.

- The loss of propulsion was caused by the near- simultaneous disengagement of the vessel's main engines' clutches.

- The main engines' clutches disengaged due to the reduction in the pressure of the control air.

- The reduction in the pressure of the control air was caused by AC1 operating at a reduced output due to a material failure of a discharge valve, and by AC2 being unserviceable due to the recent fracture of a lubricating oil pipe.

- The situation was further exacerbated by the inadvertent equalization of pressure between the main and reserve air receivers.

- The on-watch engineers were not aware that AC1 was operating at reduced output and their consequent diagnosis that the reduction in control air pressure was due to an air leak was incorrect.

- A delay in informing the master about the reduction of control air pressure denied him valuable time to assess the courses of action available.

- The total loss of propulsion was avoidable.

- The overall response to the reduction of control air pressure and the subsequent loss of propulsion lacked direction and co-ordination.

ACTION TAKEN

P&O Ferries Holdings Ltd has:

Conducted its own investigation into the accident and issued a fleet circular promulgating the navigational and technical lessons learnt, which includes:

- Navigational guidance for aborting an approach to a berth.
- The use of anchors to stop the vessel.
- The need for alerting the officer of the watch immediately a potentially serious situation arises.
- Air compressor test procedures to ensure system integrity.
- Improvements in design to ensure that there is sufficient redundancy in the control air system.
- Implemented a policy of replacing all defective copper air compressor lubricating oil pipes with steel equivalents.
- Facilitated the senior master's completion of its Maritime Resource Management course.

RECOMMENDATIONS

P&O Ferries Holdings Ltd is recommended to:

2012/127 Take steps to improve the effectiveness of its crews when dealing with mechanical emergencies, taking into account the need to drill machinery breakdowns as realistically as possible, and the importance of technical emergency situation check cards being accurate, fully considered and verified.

SHIP PARTICULARS

Vessel's name	*Pride of Calais*
Flag	UK
Classification society	Lloyd's Register
IMO number	8517748
Type	Passenger and freight ro-ro vessel
Registered owner	P&O Ferries Limited
Manager(s)	P&O Ferries Holdings Ltd
Construction	Steel
Length overall	169.6m
Registered length	161.95m
Gross tonnage	26433
Minimum safe manning	20
Authorised cargo	2290 passengers/585 cars or 85x15m freight units

VOYAGE PARTICULARS

Port of departure	Dover
Port of arrival	Calais
Type of voyage	Short International
Cargo information	399 passengers
Manning	81 crew

MARINE CASUALTY INFORMATION

Date and time	22 October 2011 at 2326 BST
Type of marine casualty or incident	Less Serious Marine Casualty
Location of incident	Berth 6, Calais, France
Place on board	Bow
Injuries/fatalities	Minor injury to a crewman
Damage/environmental impact	Damage to the vessel's bow 'spade' and forward steering compartment
Ship operation	Berthing
Voyage segment	Arrival
External & internal environment	Wind: south - at 15kts Sea state: calm Visibility: good
Persons on board	480