



Australian Government
Australian Transport Safety Bureau

Safe Transport

MARINE SAFETY INVESTIGATION
No. 202

Independent investigation into the engine room flooding
of the Panamanian registered

Harmonic Progress



in the Coral Sea
16 April 2004



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Media Release

A leaking water ballast line, and crew's unfamiliarity with the on board ballast system, disabled bulk carrier in the Coral Sea

A leak in the main water ballast line in the engine room of the Panamanian registered bulk carrier *Harmonic Progress* led to the ship becoming disabled in the Coral Sea at 1230 on 16 April 2004, according to an Australian Transport Safety Bureau (ATSB) investigation report released today.

The ATSB report into the disabling of *Harmonic Progress* states that the flow of water ballast into the engine room bilges was not sufficiently controlled before it reached a depth of 1.5 metres. At that depth, the water entered the motors for the main engine's lubricating oil pumps and caused them to short circuit. The lack of lubricating oil prevented the main engine from being able to be operated, resulting in the ship drifting westward towards the outer edge of the Great Barrier Reef for 43 hours before assistance arrived. The ship was in ballast, making for Hay Point when the incident occurred.

A harbour tug from Townsville and a large salvage tug from Brisbane were able to take *Harmonic Progress* in tow about 40 nautical miles from the Great Barrier Reef. *Harmonic Progress* was towed to the port of Gladstone, where initial repairs were undertaken in order to enable the ship to proceed under its own power to Brisbane. At Brisbane, the ship entered dry dock, where inspection, repair and testing of ballast valves and pumps took place. No one on board was injured during the incident and no pollution resulted.

The ATSB investigation report concludes that leaking valves in two water ballast tanks resulted in the main ballast line being pressurised following ballast water exchange operations which took place a week before the leak in the engine room was found. The report also concludes that the crew had failed to identify that a critical valve had been left open after the ballast water exchange when they were attempting to isolate the leak prior to the ship becoming disabled.

The entire ship's crew, with the exception of the chief engineer, had joined the vessel about two weeks before the flooding, when new owners and managers took over the ship. The crew were unfamiliar with the ballast system and did not use a systematic approach to find the source of the water leaking from the ballast line. In addition, the pre-delivery inspection of the ship prior to the change of ownership is suspected of being inadequate.

Copies of the report can be downloaded from the internet site at www.atsb.gov.au, or obtained from the ATSB by telephoning (02) 6274 6478 or 1800 020 616.

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1 SUMMARY

At about 0200 on 16 April 2004, the duty engineer on board the Panama registered bulk carrier *Harmonic Progress* discovered that the main ballast line was leaking and the engine room bilge was filling with the ballast water. Despite an immediate temporary repair and utilising pumps to try and clear the bilge, the water level continued to rise until it reached a height at which it caused an electrical short in both main engine lubricating oil pump motors, which disabled the main engine.

The master reported the engine room flooding to the ship's managers who arranged for two tugs to take the ship in tow. The ship was in the Coral Sea, approximately 90 nautical miles north of Hydrographers Passage, when it became disabled. During the 43 hours the ship drifted, prior to the arrival of the first tug, it covered 104 nautical miles in a westerly direction. During the time adrift, the ship came to within 30 nautical miles of the Great Barrier Reef.

Harmonic Progress was towed to the Queensland port of Gladstone, where initial repairs were undertaken in order to enable the ship to proceed under its own power to Brisbane. At Brisbane, *Harmonic Progress* entered dry dock, where inspection, repair and testing of ballast valves and pumps took place. No one on board was injured during the incident and no pollution resulted.

The report concludes that:

- A leak in the main ballast line caused the flooding of the engine room to a level in excess of 1.5 m, which led to the main engine lubricating oil pump motors short circuiting and the vessel becoming disabled.
- A combination of corrosion and erosion caused wastage in the main ballast line, which directly led to the leak.
- Leaking butterfly valves in numbers two and three (port) topside water ballast tanks led to the two tanks draining into the engine room via the leak.
- A crossover valve on the main ballast line in the engine room had not been closed after ballast operations.
- The crew did not isolate the leak by checking associated valves early enough to prevent disabling of vessel.
- Early action was not taken to prevent the water level rising to the point where the lubricating oil pump motors short circuited.
- The crew were unfamiliar with the ballast system and did not use a systematic approach to find the source of the water leaking from the ballast line.
- The pre-delivery inspection of the ship prior to the change of ownership is suspected of being inadequate.

The report recommends that:

- Ship operators and managers ensure sufficient time is made available for handover of information to key personnel when changes of crew or ownership take place.
- Ship owners, operators, manager and masters should revise ISM procedures for ballast operations to ensure they are specific to their ships.
- Classification societies should consider the inclusion of regular ballast line thickness testing around known risk areas, such as 'T' junctions during the enhanced survey program for bulk carriers and oil tankers. This is particularly applicable to ships over 15 years of age.
- The IMO should consider including the possibility of engine room flooding contingency in SOPEP manuals.
- Classification societies and owners acquiring existing ships should make it a condition of sale that all the ship's maintenance records are retained on board.

2 SOURCES OF INFORMATION

The master and officers of *Harmonic Progress*.

C & M Associates, Seoul, Republic of Korea

Australian Maritime Safety Authority

Rescue Coordination Centre (RCC) Australia

Adsteam Marine Limited

Nippon Kaiji Kyokai (ClassNK)

References

International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL), and amendments. International Maritime Organization.

Resolution MPEEC.54(32) Guidelines for the Development of Shipboard Oil Pollution Emergency Plans. International Maritime Organization.

The International Management Code for the Safe Operation of Ships and for Pollution Prevention [International Safety Management (ISM) Code] as adopted by the International Maritime Organization by Resolution A.741(18).

IMO Assembly Resolution A.744(18) - Guidelines on the enhanced programme of inspections during surveys for bulk carriers and oil tankers (Adopted 18 November 1993 & amended by SOLAS 4 Res 2 MSC.49(66) MSC.105(73) Amended up to 2002).

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Harmonic Progress

Harmonic Progress is a panamax¹ sized gearless bulk carrier of 69 561 deadweight tonnes at its summer draught of 13.257 m. It was built by Tsuneishi Shipbuilding in Japan and was launched in July 1986 as *Orange Phoenix*. In 1999, the ship's name was changed to *Nicholas Smile* when ownership was transferred to Lucky Victory Shipping, Cyprus.

On 29 March 2004, Primary Marine of Panama took over the ownership of *Nicholas Smile* in Incheon, South Korea. The ship was transferred to the Panamanian flag on 30 March, renamed *Harmonic Progress* and its management was taken over by C & M Associates of Seoul, Republic of Korea. *Harmonic Progress* was built under Nippon Kaiji Kyokai (ClassNK) design rules and has been classed with ClassNK since its launch.

The ship has an overall length of 225 m, a beam of 32.2 m and a moulded depth of 18.3 m. The distance from the ship's stem to the bridge front is 192.33 m and the distance from the bridge front to the stern, 32.67 m. The ship has seven cargo holds forward of the accommodation superstructure and is strengthened for the carriage of heavy cargoes. The ship's navigation bridge comprises a combined wheelhouse and chartroom, separated by a curtain. The vessel is equipped with a range of navigation equipment in accordance with SOLAS² requirements.

Propulsive power is provided by a Mitsui B&W 5L70MC main engine of 7 106 kW, which drives a single propeller shaft and a fixed-pitched propeller. Normal service speed of the ship is 13 knots when loaded.

All of the ship's officers were appropriately qualified and held the necessary certificates. Navigating officers maintained the standard 'four on, eight off' watchkeeping routine at sea. The engineering officers worked a twenty-four hour duty roster with the engine room unmanned outside normal working hours. At the time of the incident, the ship's complement was 20. The master and the chief engineer were South Korean and the remainder of the officers and crew were Filipino.

All of the officers and crew, with the exception of the chief engineer, joined *Harmonic Progress* in Incheon on 29 March. The chief engineer joined the ship in the middle of February.

Harmonic Progress's master has been at sea since 1980. He gained his foreign-going master's certificate in 1994. *Harmonic Progress* was his first employment opportunity with C & M Associates. The mate has been at sea since 1971, initially as a seaman. He gained his foreign-going master's certificate in 1989. During his time at sea, he has sailed mainly on bulk carriers, including 'panamax' sized vessels similar to *Harmonic Progress*. The chief engineer has been at sea since 1984. He gained his engineer class

¹ Size limited by the dimensions of the Panama Canal.

² The International Convention for the Safety of Life at Sea, 1974 as amended, Chapter V

one (motor) certificate in 1998. *Harmonic Progress* was the first ship on which he had served as chief engineer.

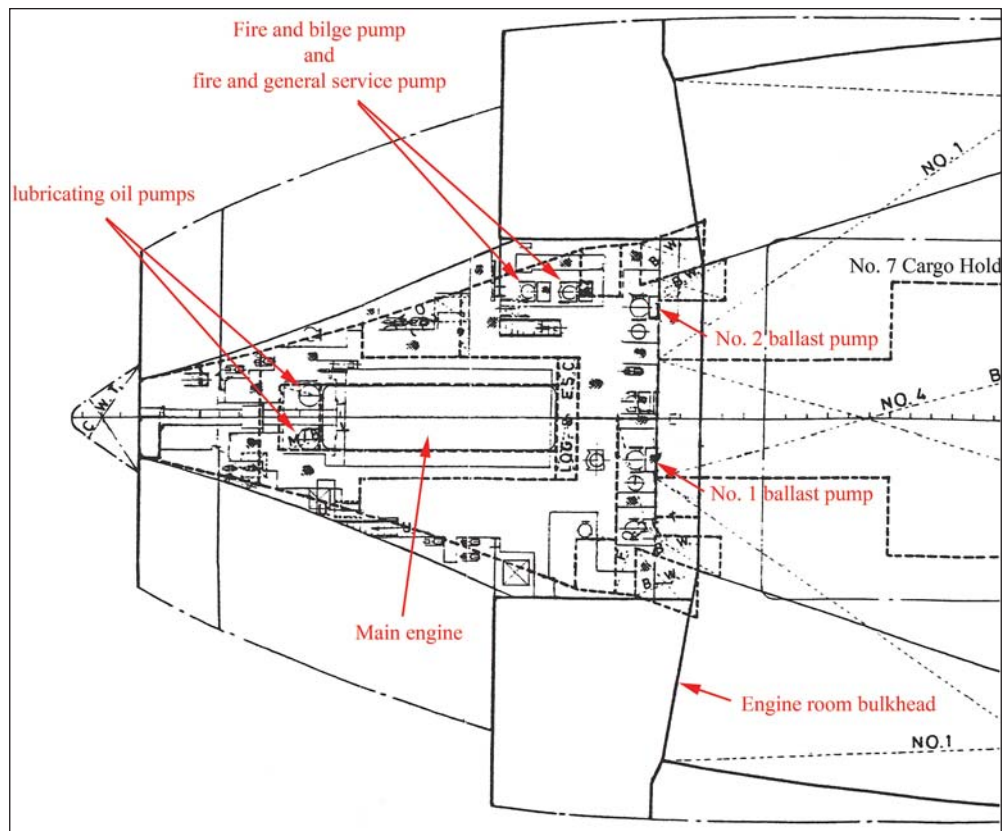
All statutory certificates required by *Harmonic Progress* were issued by ClassNK on behalf of the Republic of Panama on 30 March, and all took the form of interim certificates. Primary Marine's Document of Compliance (DoC) and the ship's Safety Management Certificate (SMC), both required under the ISM³ Code, were issued on behalf of the Republic of Panama by the Korean Register of Shipping (KR) on 3 March and 30 March respectively.

Ballast and engine room bilge arrangements

Ballast and bilge piping and valves in the engine room are located just above the tank top, under the lowest level of floor plates. The valves are manually operated from the plates by extended spindles.

All of the ship's main pumps are located on the lowest level of floor plates. Two ballast pumps, each with a capacity of 1000 m³/h, are located at the forward end of the engine room, just aft of the bulkhead separating the engine room from number seven hold. Number one ballast pump is located on the starboard side of the engine room, with number two ballast pump located on the port side (Fig. 1). Both ballast pumps have discharge/suction lines which terminate at sea chests. An eductor for stripping the water ballast tanks is located aft of number one ballast pump.

FIGURE 1:
Engine room layout



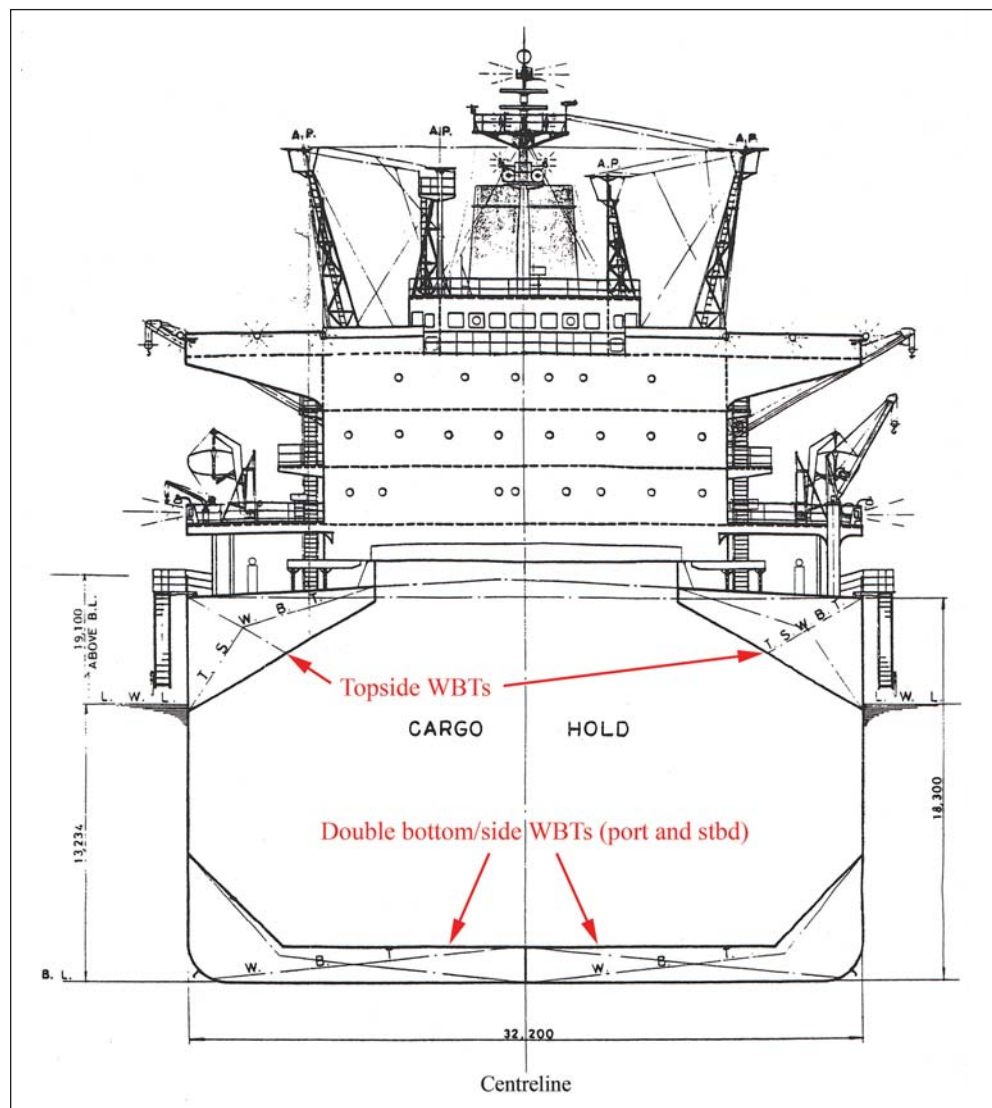
³ International Safety Management.

Another two pumps, a fire and general service pump and a fire and hold/engine room bilge pump, are located aft of number two ballast pump. These pumps have a capacity of 235 m³/h. Both of these pumps can be used to pump the engine room bilges using emergency suction connections (Fig. 10). The engine room bilge pump, with a capacity of 2 m³/h, is located towards the after end of the engine room, on the port side. The main bilge line has an internal diameter of 200 mm and the branch bilge suction lines have an internal diameter of 100 mm.

Ballast tank and piping arrangement

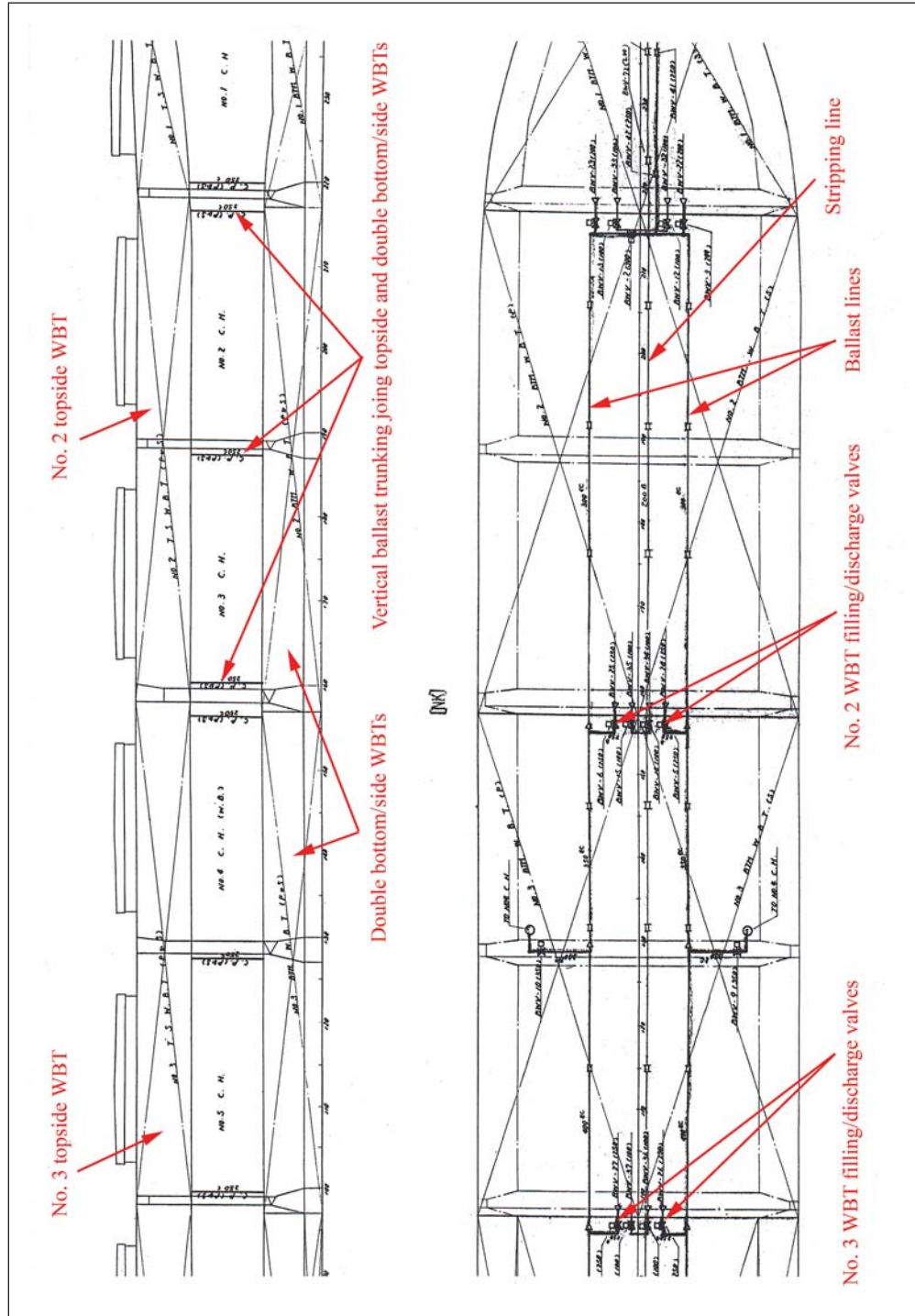
Harmonic Progress has a forepeak water ballast tank (WBT) and eight topside WBTs. These topside tanks are located at the top of the cargo holds on each side of the vessel. The ship also has six double bottom/side WBTs (numbers one, two and three, port and starboard). These large tanks are located beneath cargo holds one to five and are divided into two (port and starboard) at the keel (Fig. 2). A centre double bottom WBT (number four) is located beneath number six and seven holds. This centre tank is smaller than the other double bottom tanks because a heavy fuel oil tank is located on either side of it. An after peak tank is located at the stern of the vessel.

FIGURE 2:
Cargo hold and ballast tank cross section



Harmonic Progress' topside and double bottom/side WBTs are joined by lengths of vertical ballast trunking and share filling/discharge lines, butterfly valves and sounding pipes. The ballast trunking connects the tanks at the forward, middle and after parts of the tanks and, in effect, makes the double bottom tanks and topside tanks a single tank (Fig. 3).

FIGURE 3:
Ballast tank arrangement plan section



Harmonic Progress does not have a duct keel. Two filling/discharge ballast lines for the forward ballast tanks run from the engine room the length of the ship through the double bottom tanks. Each double bottom/side WBT is filled or emptied via a combined filling/discharge line, connected to one of the ballast lines, and butterfly valve. The WBT valves are manually operated from the main deck, using extended spindles. All WBTs, except number four topsides, have to be deballasted through the ballast line running through the engine room.

Number four topside and four centre WBTs have their own filling/discharge lines and butterfly valves. The valves for these filling/discharge lines are located in the engine room and not on the main deck. Number four topsides can also be discharged directly over board using dump valves operated from the main deck.

The ship's number four cargo hold is designed to be able to be filled with ballast water. Ballasting this hold assists in reducing the stresses on the ship's structure when the ship is sailing in ballast. It also assists in managing the stability of the ship and in making the movement of the ship more comfortable for the crew. There is a separate branch line off the main ballast line for filling and emptying this hold.

A separate, smaller diameter, ballast stripping line connects an eductor in the engine room to the ballast tanks and ballast hold. This stripping line runs through the double bottom tanks, to starboard of the centreline of the ship.

Valves on the ballast lines and stripping line are manually operated. The ship is not fitted with a system to remotely monitor the levels of ballast water in the tanks. All ballast tank soundings have to be taken manually by a member of the ship's crew from the main deck.

The incident

At 1306 on 31 March 2004, *Harmonic Progress* departed Incheon, South Korea, for Australia, where it was to load coal at the Queensland port of Hay Point. The ship was in ballast, with a draught forward of 3.75 m and aft of 7.41 m, which gave *Harmonic Progress* a trim⁴ of 3.66 m by the stern. The freeboard⁵ at midships was about 12.7 m.

On departure, the condition of the ballast tanks was:

Fore peak	No. 1 TS/DB (P)	No. 1 TS/DB (S)	No. 2 TS/DB (P)	No. 2 TS/DB (S)	No. 3 TS/DB (P)	No. 3 TS/DB (S)	No. 4 hold	No. 4 TS (P)	No. 4 TS (S)	No. 4 Centre	After peak
Full	Full	Full	Full	Full	Full	Full	Empty	Full	Full	Full	Full

At about 0230 on 4 April, the ship made an unscheduled call at Naha, on the Japanese island of Okinawa. While at Naha, the crew took on board engine room spare parts and carried out some repairs in the engine room.

Harmonic Progress departed Naha at 0012 on 5 April to continue its voyage to Hay Point.

⁴ The difference, or relationship, between the forward and after drafts of a ship. A ship with the same forward and after drafts has no trim and is said to be on an even keel.

⁵ Distance from the waterline to the upper deck.

On 7 April, the mate began to exchange the ship's ballast water while in the Pacific Ocean between Guam and the northern islands of Papua New Guinea. On reading the soundings recorded in the WBT sounding book, he observed that the level of water in number two water ballast tank (port) had dropped from a full sounding of 18 m to only 4.8 m. He thought that this could have been the reason for a starboard list he had observed when the ship departed Incheon. He didn't investigate the matter further, to see why the sounding had dropped to the level recorded on 6 April.

The ballast water exchange was carried out using the ship's starboard ballast pump, the number one pump. The tanks were firstly emptied and then refilled, overflowing the tanks onto the main deck. Prior ballasting had been carried out using both ballast pumps, but during the ballast water exchange only one pump was used as the mate was under the impression that engine room staff were working on the second pump. The process took longer than he expected, but because he was new to the ship and there was no-one else on board who could tell him how quickly the ballast exchange usually took, he didn't think too much of it. The exchange of ballast water was completed by 8 April.

From 9 April to 13 April, as the ship travelled towards, and then through, the islands of Papua New Guinea, it experienced moderate to heavy sea and swell conditions. This resulted in the ship rolling and pitching heavily. The ship's movement prevented any ballast tank soundings being taken as crew members did not, in the interests of safety, venture onto the ship's main deck forward of the accommodation.

At 1000 on 14 April, when *Harmonic Progress* cleared Jomard Passage and entered the Coral Sea, the weather and sea conditions became worse. At 1800, the master implemented 'special shipboard arrangements for storm weather', formalising the earlier action where no crew members had been allowed to access to the main deck.

The rolling and pitching continued as *Harmonic Progress* travelled through the Coral Sea towards Hydrographers Passage⁷. Winds were logged as being south to south easterly, between force six and seven⁸. The ship's speed was reduced from twelve knots to between seven and ten knots. As the ship rolled, ballast water from the full topside tanks was seen to be overflowing from the air vents on the main deck.

At midnight on 15 April, *Harmonic Progress* was in position 06° 31.0'S 151° 23.0'E, making good a course of 193°(T) at ten knots. It was 210 nautical miles⁹ from Hydrographers Passage and 53 nautical miles to the north of the entrance to Diamond Passage, which separates East Diamond Islet and Lihou Reef.

The flooding of the engine room

At 0200 on 16 April, the duty engineer was awoken by a UMS¹⁰ alarm sounding in his cabin. He made his way to the engine room control room where he found that the

⁶ The exchange of ballast water taken on board ships in overseas ports with 'fresh' seawater is required by Australian quarantine authorities to prevent the importation of foreign organisms into Australian waters and ports.

⁷ A navigable passage through the Great Barrier Reef (GBR) used by ships trading to and from Hay Point.

⁸ Beaufort wind scale – winds force seven are near gale force, blowing at thirty knots, with a probable maximum wave height of 5.5 metres.

⁹ One nautical mile equals 1852 metres.

¹⁰ Unmanned Machinery Space - A monitoring system that allows the machinery spaces of a ship to be unmanned during certain periods and remotely alarmed.

alarm had been activated by a high bilge level in the engine room. He entered the engine room and discovered that the main ballast line, just forward of number one ballast pump, was leaking. He informed the chief engineer immediately by telephone and, a short time later, the chief engineer joined him in the engine room.

Together they set about putting a temporary repair in place in an attempt to stop the flow of water from the ballast line. This initial repair consisted of a rubber patch held in place by metal bands around the ballast line. The patch reduced the flow of water from the leak but it did not stop it. The duty engineer started the engine room bilge pump to reduce the amount of water in the bilge. The bilge water was pumped overboard via the oily-water separator. Neither officer made any attempt isolate the leak and no valves on the ballast line on either side of the leak were closed or even checked. The bilge pump was left running and both engineers returned to their cabins at about 0245.

Harmonic Progress entered Diamond Passage at 0516 on 16 April.

At 0800, the chief engineer informed the master that there was a leak in the main ballast line and that the leak did not appear to be large. He told the master what repairs he had put in place earlier that morning and what he planned to do that day. He also requested that some of the ship's deck crew be made available to assist in the engine room.

At 0830, the chief engineer returned to the engine room and with the assistance of all the engine room ratings and the necessary engineering officers, began to put a more substantial repair in place. A wooden wedge was inserted into the hole but this was unsuccessful – the hole actually increased in size and more water flowing into the bilge. The chief engineer decided to make a substantial patch out of rolled steel plate and the plan was to clamp this in place over the area of the leak. He assigned one of the engineers to make up the patch.

At 0930, the chief engineer informed the master that the leak was worse and the water in the engine room bilge was rising. The ship's crew were mustered in the engine room control room and were advised of the situation. The mate instructed the crew to set up a 17 m³/hr capacity portable air-operated pump on the bottom plates of the engine room to assist the engine room bilge pump to remove the water. The air-operated pump's discharge hose was connected to the fuel oil overflow tank and later, into number one fuel oil tank (starboard). The air pump was operating by 1130.

The flow of water into the bilge continued. By about 1200, the level had risen to the bottom of the propeller shaft, a depth of 1.5 m. With the bilge water at this depth, the main engine's flywheel was throwing a large amount of water around at the after end of the engine room and over critical operating machinery. The chief engineer stopped the main engine at this time and almost immediately the running main engine lubricating oil (L.O.) pump motor stopped as a result of a short circuit in its motor. The stand-by L.O. pump started but also stopped with a motor short circuit a short time later. With the loss of both L.O. pumps, *Harmonic Progress* was without main engine power and unable to continue the voyage without assistance.

At about 1230 the vessel was adrift in position 18° 27.0'S 150° 52.0'E, The ship was about 90 nautical miles north of Hydrographers Passage, in water with a depth of over 1000 m and adrift. This depth of water prevented the ship from anchoring until tugs could arrive and take the ship in tow.

FIGURE 4:
Air-operated pump



At about 1340 on 16 April, the master informed ship's management company of the situation. At 1346, he sent an INMARSAT-C telex to the Rescue Coordination Centre in Canberra (RCC Australia), through the Australian Ship Reporting (AUSREP) System, informing the RCC that:

'ENGINE ROOM FLOODING DUE TO LEAKING OF BALLAST MAIN LINE IN ENGINE ROOM. SITUATION: ABOUT 30 MT BILGE WATER INGRESS IN ENGINE ROOM. STOPPED HER ENGINE TO GIVE EMERGENCY TREATMENT AT POS. 1827S/15052E AT 160230UTC.'

RCC Australia advised relevant Australian authorities, including the Australian Maritime Safety Authority's (AMSA) Environment Protection Response group, of the situation. The RCC requested *Harmonic Progress* send hourly position reports so the ship's progress and position could be monitored. The master complied with this request.

At 1400, the engine room bilge pump stopped when its pinion gear failed. This left only the air-operated pump transferring the water from the bilge into the fuel oil tank, via the tanks manifold filling line in the engine room.

At 1530, the rolled metal plate was put in position over the hole in the ballast line and tightened in place using metal bands fitted around the pipe. Initially, it appeared that this plate was working as the flow of water slowed and then appeared to stop. This still left over 1.5 m of water in the engine room bilge and only the air-operated pump reducing the depth.

At 1630, the master made a formal request to the ship's managers for tug assistance.

Also at 1630, AMSA's Environment Protection Response group, in accordance with the National Plan¹¹ and with a view to possibly using Australian intervention legislation¹², contacted United Salvage. They informed United Salvage of the situation and advised that if AMSA considered that *Harmonic Progress* required any assistance to prevent it from grounding on the GBR, they would be advised. United Salvage placed two tugs on stand-by, one in Townsville and the other in Brisbane, in case assistance was required.

At about 1715, the Environment Protection Response group contacted United Salvage and informed the company that *Harmonic Progress*'s condition had deteriorated, with the main engine now disabled and that the ship was drifting towards the GBR at a rate of about 3.3 knots. United Salvage was, however, already in communication with the ship's managers regarding tug assistance. The tugs in Townsville and Brisbane were in the process of being mobilised and their crews were preparing for departure.

At about 2300 on 16 April, *Harmonic Progress*'s chief engineer observed that the level of the bilge water had reduced by a small amount and he ordered that a watch on the level be maintained over night.

At 0020 on 17 April, the 64 tonne bollard-pull ocean-going salvage tug *Austral Salvor* departed Brisbane for the 580 nautical mile voyage to reach *Harmonic Progress*. At 0120, the smaller 47 tonne bollard-pull harbour tug *Giru* departed Townsville and, transiting through Flinders Passage in the GBR, had a distance of approximately 260 nautical miles to sail to reach the position of the ship. Both tugs were tasked to rendezvous with *Harmonic Progress*. *Giru* would be the first tug to reach the ship and its primary task was to keep the ship from running aground on the eastern edge of the GBR and to await the arrival of the larger salvage tug, which was to tow the ship to a port of refuge. RCC Australia passed hourly position reports from the ship to *Giru* to assist with the rendezvous.

At 0800 on 17 April, *Harmonic Progress*'s chief engineer returned to the engine room and found that the water level had risen and the air-operated pump was not operating. After repairing the pump, the transfer of water resumed at 1000 and the chief engineer reported a possible slight drop in the water level.

During 17 April, United Salvage conducted negotiations with the managers and master of *Harmonic Progress* regarding the conditions of the salvage claim. That evening, the parties signed a Lloyd's Form of Salvage Agreement¹³, commonly known as 'Lloyd's Open Form (LOF)'.

At 1715 on 17 April, *Giru* established VHF radio communications with *Harmonic Progress*. At about 1900, *Giru* arrived to standby *Harmonic Progress* in position 18° 29.1'S 149° 29.0'E, having travelled a distance of 160 nautical miles from Townsville. The ship was 40 miles to the east of the GBR's outer edge and had drifted 104 nautical miles, at an average drift rate of 2.38 knots in a westerly direction over the previous 43 hours.

11 The National Plan is a national integrated Government and industry organisational framework enabling effective response to marine pollution incidents.

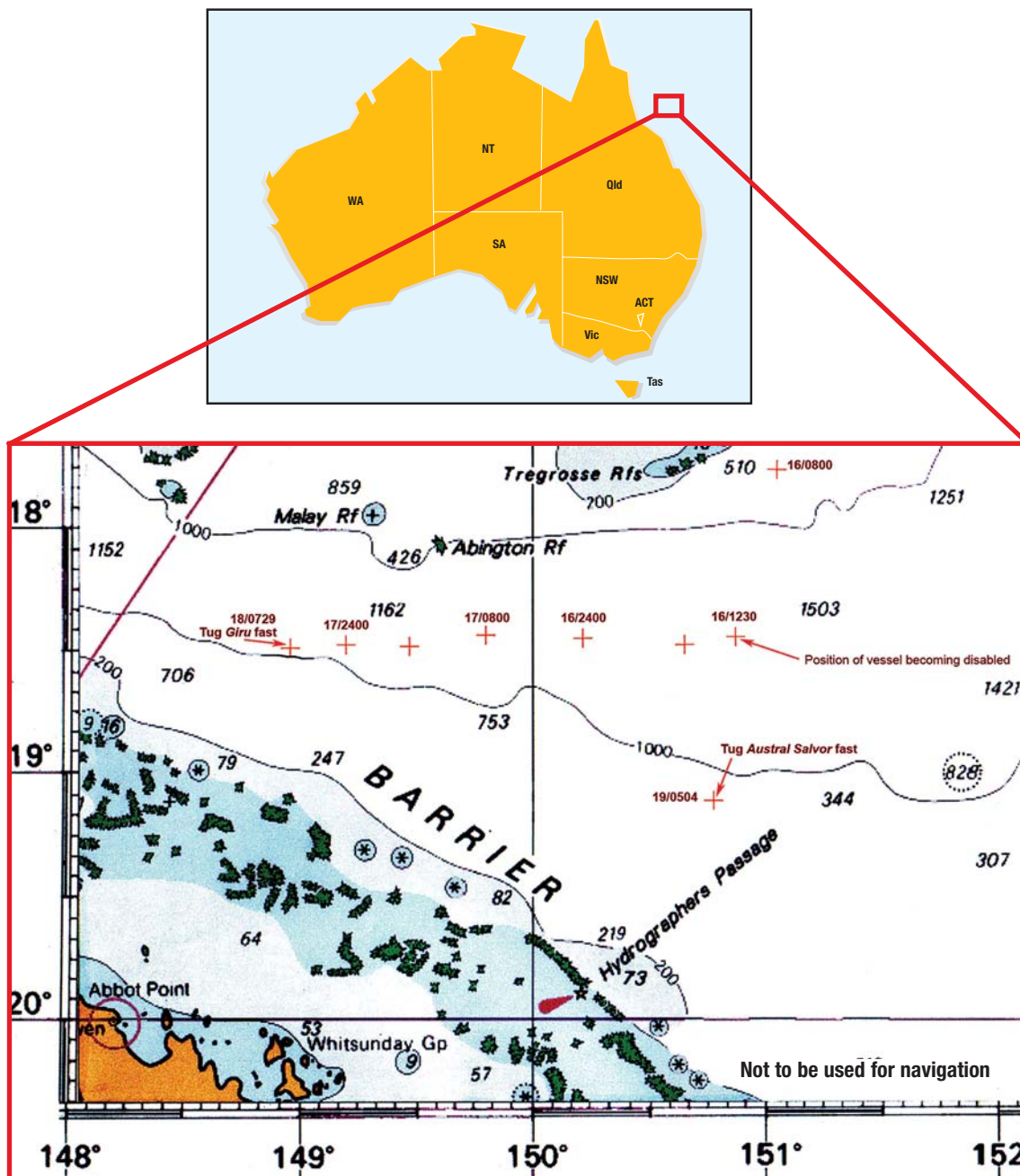
12 Protection of the Sea (Powers of Intervention) Act 1981– Sect 8 – Taking of measures under the Convention to prevent pollution of sea by oil.

13 The most widely used 'no cure-no pay' salvage contract – in return for successful salvage services, the salvor claims a proportion of the 'salved value' (the value of the ship, its bunkers and cargo).

As weather and sea condition moderated on 17 April, the ballast tanks were able to be sounded. The mate saw that the level of ballast water in number two (port) and three (port) topside WBTs had dropped from about 1200 m³ in each tank to empty. The two double bottom WBTs remained full, with a soundings of 5.27 m and 5.87 m being recorded in the number two and three tanks respectively. The ship had been pitching and rolling significantly in the sea and swell conditions encountered in the Coral Sea, so no apparent starboard list had been observed.

Giru passed a towline to the ship at 0720 on 18 April in position 18° 29.4'S 148° 58.3'E and the tow commenced at 0726. The ship was 29 nautical miles northeast of the GBR outer edge. Initially, *Giru* towed the ship in a direction of about 100°(T) and then altered the course of the tow to 115°(T), towing the ship parallel to the GBR's outer edge at a distance off of about 50 nautical miles.

FIGURE 5:
Portion of chart Aus 4604 showing vessels positions



On 18 April, the ballast valves in the engine room were checked to see whether they were fully closed.

Attempts to lower the level of water in the engine room bilge continued throughout 17 and 18 April, but there was no significant reduction in the level. It was not until 19 April that the mate informed the chief engineer that there had been a significant loss of ballast water from number two and three port topside ballast water tanks.

At 0540 on 19 April, *Austral Salvor* arrived at *Harmonic Progress*'s position of 19° 07.0'S 150° 46.0'E and took over the tow from *Giru*, 55 nautical miles northeast of Hydrographers Passage. *Austral Salvor* had travelled about 560 nautical miles from Brisbane. *Giru* had towed the ship for a distance of about 105 nautical miles.

When *Austral Salvor* took over the tow, the decision regarding a final destination port had not been made. *Giru* remained in company with the ship for the remainder of the voyage in the event that additional assistance was required.

On the morning of 19 April, the chief engineer was still concerned about the amount of water entering the engine room and could not understand why the actions taken to stop the leak had been unsuccessful.

At about 1300 on 19 April, after securing the tow, the chief engineer and two crew members from *Austral Salvor* boarded *Harmonic Progress* in an attempt to assist the crew with the situation on board. After assessing the situation, and consulting with the ship's chief engineer, he suggested that all ballast line valves in the engine room be rechecked to ensure that they were tight and that the ballast water in number two and three port topside ballast water tanks be discharged in an attempt to reduce any head on the system from these tanks. On rechecking the valves, it was found that several could be tightened further. After this action was carried out, combined with reducing the amount of water remaining in number two and three port topside ballast water tanks, the flow of water from the leak in the main ballast line was reduced significantly.

Weather and sea conditions improved during the period 17 to 19 April. The wind speed dropped to between ten and fifteen knots and the sea state eased to moderate to slight, although a three metre long, southeasterly swell continued. At about midday on 19 April, *Austral Salvor* advised RCC Australia that the destination of the *Harmonic Progress* would be Gladstone. The ship was to be towed to Gladstone via Capricorn Channel and not through Hydrographers Passage, the shorter distance. The towing distance via Capricorn Channel was to be about 510 nautical miles. The tow proceeded without any problems being encountered, reaching speeds of up to eight knots.

At about 0500 on 20 April, when the water level in the engine room dropped to the point that the area of the leak could be seen clearly, it was observed that there was an older repair patch welded on the ballast line adjacent to the leak (Fig. 6). The chief engineer adjusted the new patch he had made so that it better sealed the entire area near the leak. He then tightened the bands holding it onto the ballast line. This had the effect of finally stopping the leak.

By 1200, the engine room bilge was almost dry. Ship's staff estimated that about 536 tonnes of water had been pumped into the fuel oil tank, using the air-operated pump, during the period.

At 0830 on 22 April, the Gladstone harbour pilot boarded *Harmonic Progress*. With the assistance of the two accompanying tugs, the ship berthed at Auckland Point number two wharf, where it underwent temporary repairs.

Repairs carried out after the flooding

While the ship was in Gladstone, shore contractors carried out temporary repairs to the ballast line and the engine room bilge pump. The two L.O. pump motors were also repaired and an insulation test was carried out on all the electrical motors in the engine room, at the lower floor plate level.

A ClassNK surveyor carried out an inspection of the length of the ballast pipe that had been holed, on several butterfly ballast valves in the engine room and in the empty water ballast tanks and the ship's overboard valves and the sea chest valves. As the ship was afloat and still had ballast water in some of the ballast tanks, the surveyor was not satisfied that the inspection was sufficient, as the valves could not be opened up and inspected internally. ClassNK imposed a 'Condition of Class' on the ship and it was granted permission to proceed on a single voyage from Gladstone to Brisbane, where it could be dry docked and the necessary valves opened and inspected.

The ship was dry docked at the FORGACS Cairncross Dockyard in Brisbane (an 85 000 deadweight tonne panamax graving dock). During the time the ship was in dock, the ballast line in the engine room was permanently repaired and all butterfly valves in the ship's ballast tanks were removed from the tanks and opened for inspection and cleaning. The rubber seal in the valve in number two port topside/double bottom WBT was replaced. All the WBT butterfly valves were operationally tested and refitted to the ballast lines.

Additionally, overboard valves for: the ballast discharge line; the main engine cooling seawater line; the fire and general service pump line; and the high and low sea chest valves were opened, inspected internally and subjected to operational tests. In addition to this work on the valves, a large section of the suction line manifold on the number one ballast pump was replaced.

FIGURE 6:
Area of leak and patch



Evidence

On 22 April, two marine investigators from the Australian Transport Safety Bureau (ATSB) attended *Harmonic Progress* when it berthed in Gladstone. The master, mate and chief engineer were interviewed and each provided accounts of the incident and for the period of time preceding it. On the morning of 23 April, the investigators interviewed a representative from C & M Associates. Copies of relevant ship's documentation was obtained including: written statements on the incident, deck and engine room logbooks, position information during the period of drift, INMARSAT-C messages from the ship, ballast tank sounding book, engine room pump specifications, various operating procedures and statutory survey records.

ClassNK Tokyo provided copies of the plans of the ship's ballast lines and general arrangement details to assist in the analysis of the incident. ClassNK in Brisbane was able to provide details of the repair work which was carried out while *Harmonic Progress* was in Gladstone and Brisbane.

Although several requests were made to C & M Associates for a copy of any pre-purchase/delivery inspection report, it was not forthcoming.

The incident

On 16 April 2004, *Harmonic Progress* became disabled after ballast water caused both main engine L.O. pump motors to short circuit. The ballast water had entered the engine room bilge via a leak in the ship's main ballast line, which ran under the lower floor plates towards the forward end of the engine room. Leaking ballast tank valves and a crossover valve, which had been left open following ballast operations, caused the ballast line to be pressurised. The area of the leak had been weakened as a result of corrosion and erosion during the life of the ship and had been repaired sometime in the past. This earlier repair consisted of a small doubling plate welded over a section of the pipe adjacent to the leak discovered on 16 April.

When the leak was discovered, the crew concentrated their efforts on stopping the leak. Evidence indicates that at no time, prior to the ship becoming disabled, did the crew, either individually or collectively, take time to establish where the water was coming from. Evidence also indicates that efforts to check the integrity of ballast valves were unsuccessful as water continued to enter the engine room bilge until the area of pipe which was leaking was properly isolated, three days after the leak was discovered. By that time, the ship had been disabled and was under tow. The mate had suspected that there was a leak in at least one of the ballast tanks filling/discharge valves but he did not raise this with any other officer when he knew of the leak in the engine room.

Harmonic Progress's officers and crew, except the chief engineer, had joined the ship only two weeks before the incident. The chief engineer had been on board for about eight weeks, familiarising himself with the operation of the main engine and engine room systems. None of the crew were sufficiently familiar with the ballast system.

The ship's new owners had carried out a per-delivery inspection of *Nicholas Smile*, (*Harmonic Progress's* previous name). However, it would appear that the inspection was inadequate as the problem with the leaking WBT valves and previous repair on the main ballast line were not identified. There were no maintenance records left for the new crew when they took over *Harmonic Progress* and no mention was made to them about any problems with the ballast system. In addition to the lack of maintenance records, the ISM procedures on board were not specific to the ship and proved to be of no assistance during the incident.

Ballast operations

Harmonic Progress's engine room staff carried out the ballasting at the request of the mate. At the time of the incident, the mate had some typed instructions that stipulated which valves to open to fill particular tanks and the locations on the main deck of the valve spindle handles and sounding pipes (Fig. 7). These instructions also briefly explained which ballast pumps to use, when to use gravity to fill tanks and which valves in the engine room to use to ballast or deballast the ship (Fig. 8). There were no specific operating procedures that the crew could reference to correctly operate the ballast system.

FIGURE 7:
Mate's plan of ballast tank valves and sounding pipes

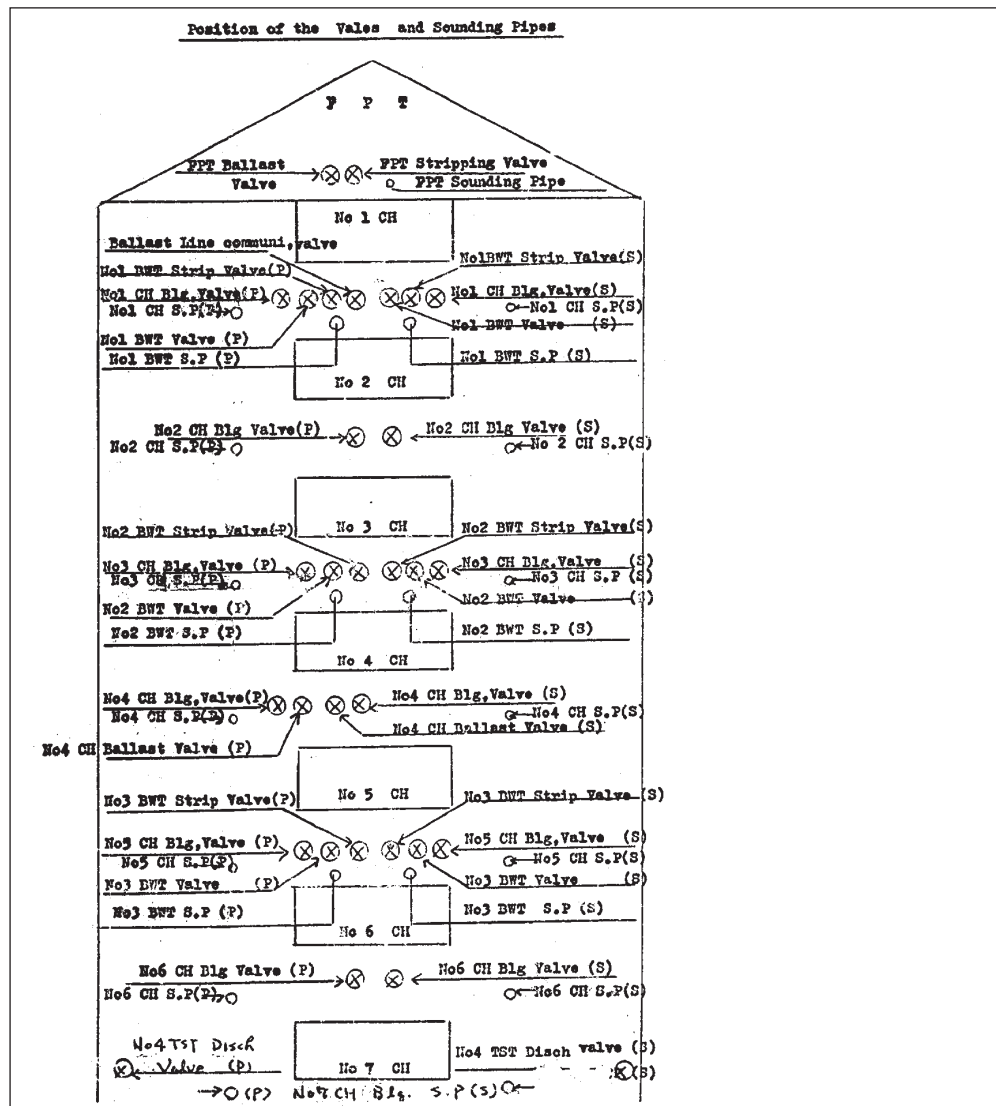
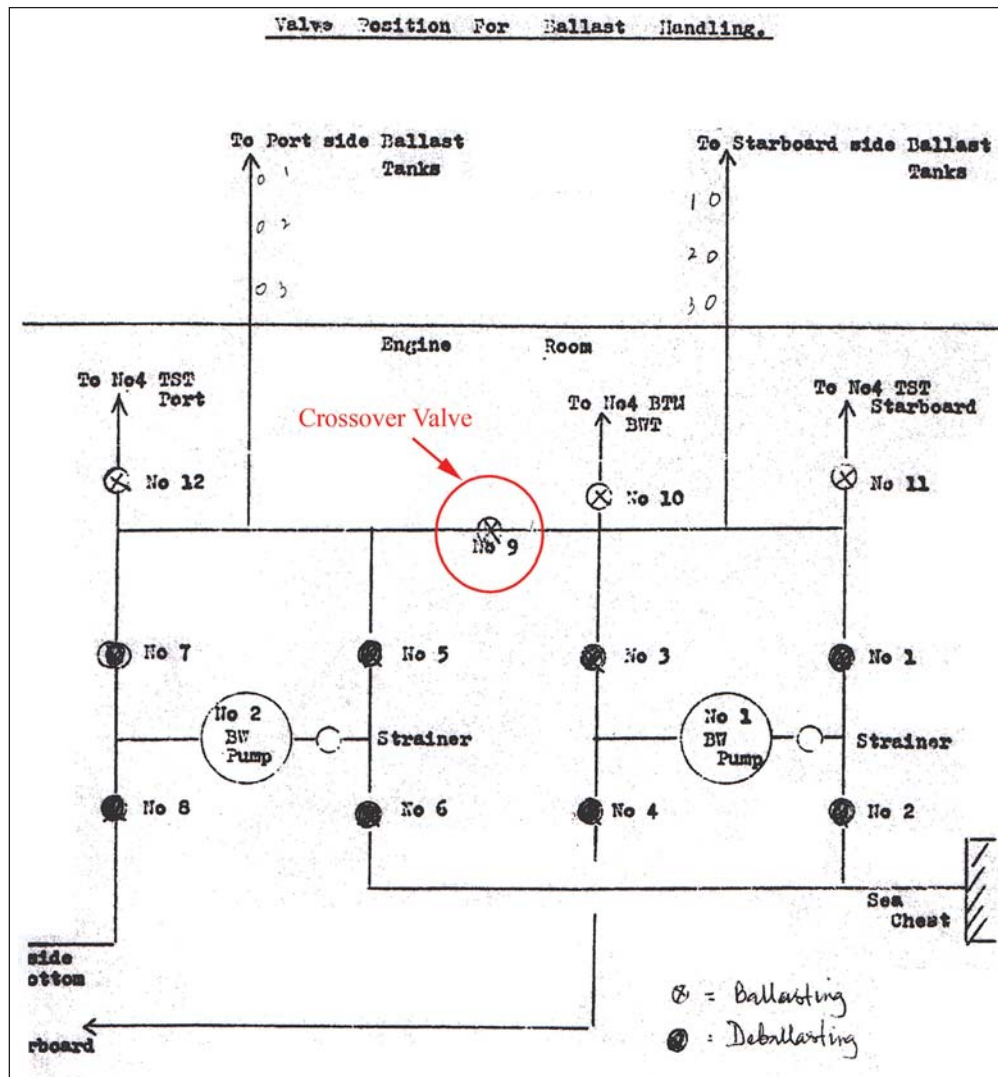
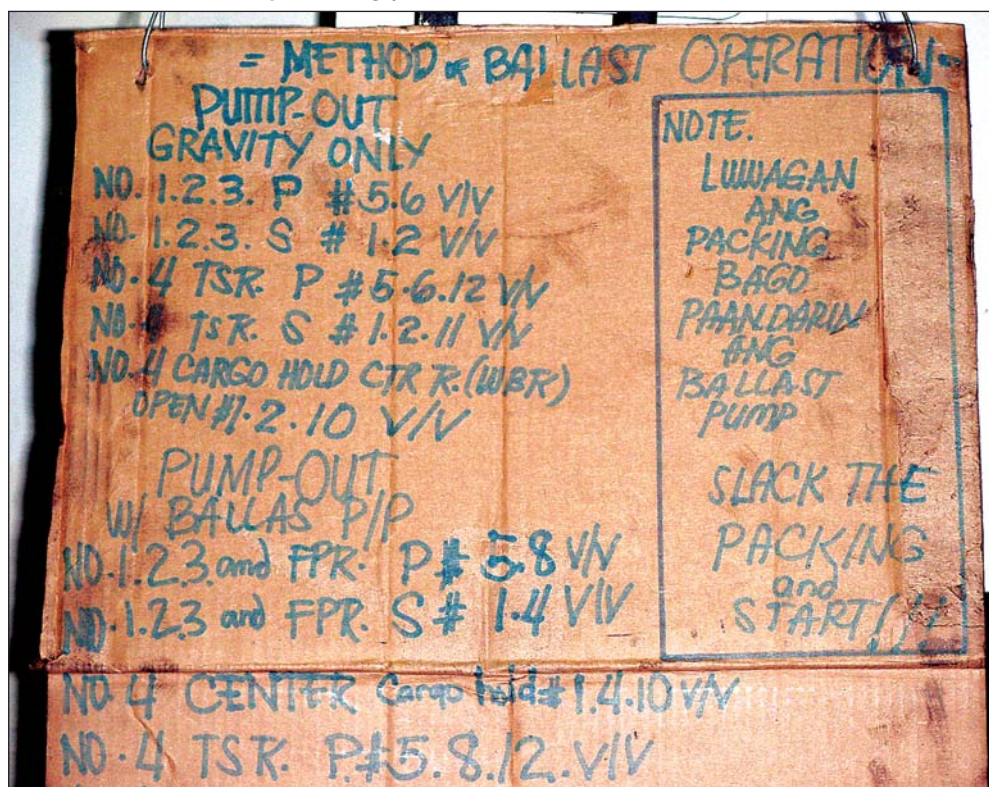


FIGURE 8:
Portion of mate's ballast instructions



Instructions for the engine room staff on which valves to use to perform the required ballasting operation requested by the mate were located adjacent to number two ballast pump. These instructions were written on a piece of cardboard, hanging from a valve (Fig. 9). There was no reference to the crossover valve in these instructions (valve number nine in Fig.8).

FIGURE 9:
Hand written ballast instructions in engine room (valve numbers reference the mates ballast instructions and not the ship's drawings)



After the ship changed owners and name in Incheon, the mate was asked by the P&I Club¹⁰ surveyor to ballast all tanks to full. After this was done, a check was made on the integrity of the WBTs to ensure they were not leaking, either into the holds or onto the main deck. No leaks were observed, however the mate thought that number two and three (port) topside WBTs were slow to fill, in comparison to the other tanks.

In that time between the handover of the vessel and the incident, the ballast system had been used once while the ship was alongside in port, and again when the ballast water exchange took place, one week before the incident. This meant that the crew on board the ship at the time of the incident were not familiar with the operation of the ballast system. The ballast system, however, was not complicated.

The owners, in submission, stated:

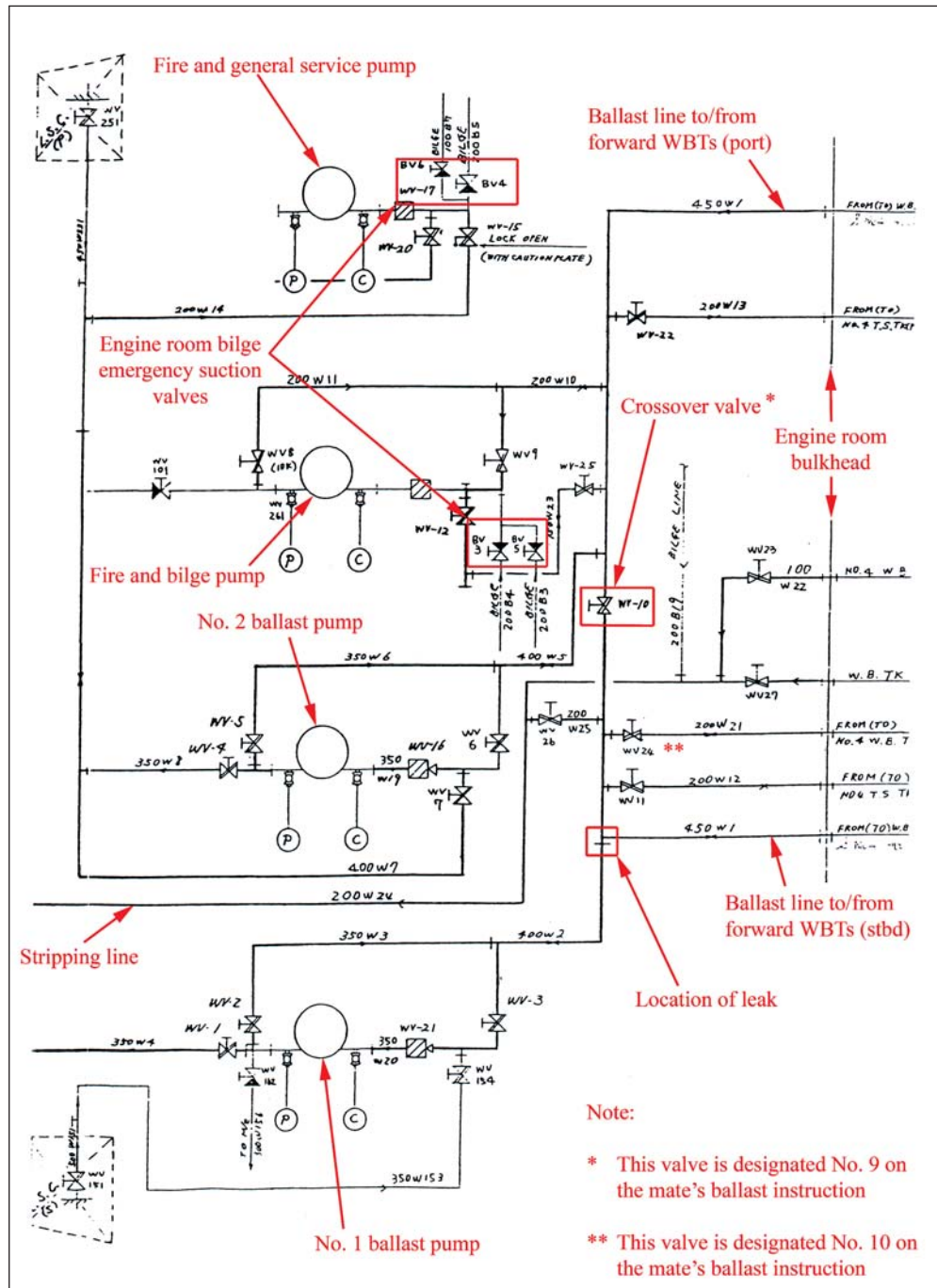
All the crew were properly certificated and experienced. The crew were all very familiar with the operation of ballast systems.

Normal ballasting operations took place using both ballast pumps. When the two pumps were used, number one pump was used to move water to and from the starboard tanks and likewise with number two ballast pump and the port tanks. During this two pump operation, a crossover valve (WV-10 in Fig. 10 and valve number nine in Fig. 8) was kept closed. However when the mate performed the ballast water exchange, he requested that only one pump be used. According to the instructions that the mate had, when one pump is used in ballast operation, the

¹⁴ Protection and Indemnity Club – A 'mutual association' formed by ship owners to provide protection against financial loss of one owner by the combined contributions of other owners in the association. The clubs cover third party claims not covered by the ship owner's hull and machinery policies.

crossover valve must be opened. There was no mention made in the instructions to close that valve after ballast operations are finished. However, it would be reasonable to assert that a seafarer with any experience in ballast operations would return the system to its pre-existing state, or at least, close any major valves in the system, on completion of ballast operations.

FIGURE 10:
Schematic drawing of ballast arrangement in engine room



This crossover valve proved critical to the flooding of the engine room. Had it been closed, the water from the leaking port side WBT valves would not have flowed to the leaking section of the ballast main.

After the ship sailed from Korea, the mate noticed that the ship had developed a slight list to starboard. According to his statement, he wondered why the list had developed but he did not investigate it. When he started the ballast exchange operations, he observed after looking at the WBT sounding book, that the water level recorded for number two port topside/double bottom WTB (one of the joined tanks) had dropped from 18 m to 4.8 m. He believed this to be the cause of the list he had observed after departing Incheon. He then commenced the ballast exchange without attempting to find out why approximately 1200 m³ of ballast water in number two (port) topside WBT had drained from the tank. He did not mention the loss of ballast water to the master.

The mate stated that he had spent most of his seagoing career on bulk carriers. He therefore would be aware of the basic operations regarding bulk carriers and the problems that type of vessel may encounter with its ballast system. It would be reasonable to expect that the mate would have investigated why such a significant amount of ballast water had been lost from the WBTs after the ship departed Naha.

Additionally, he should have discussed the possibility of leaking water ballast valves with the master and chief engineer as soon as he became aware of the leak.

Ballast line cross-sectional wastage

The area at which the leak developed was at the bottom of a 'T' junction in the main ballast line (Fig. 11). This junction was where the 450 mm diameter starboard ballast line to/from the forward WBTs joined the main 450 mm diameter main ballast line in the engine room. Evidence shows that this area had been the subject of repairs in the past. Previous repairs were not sufficient to ensure that the problem did not recur.

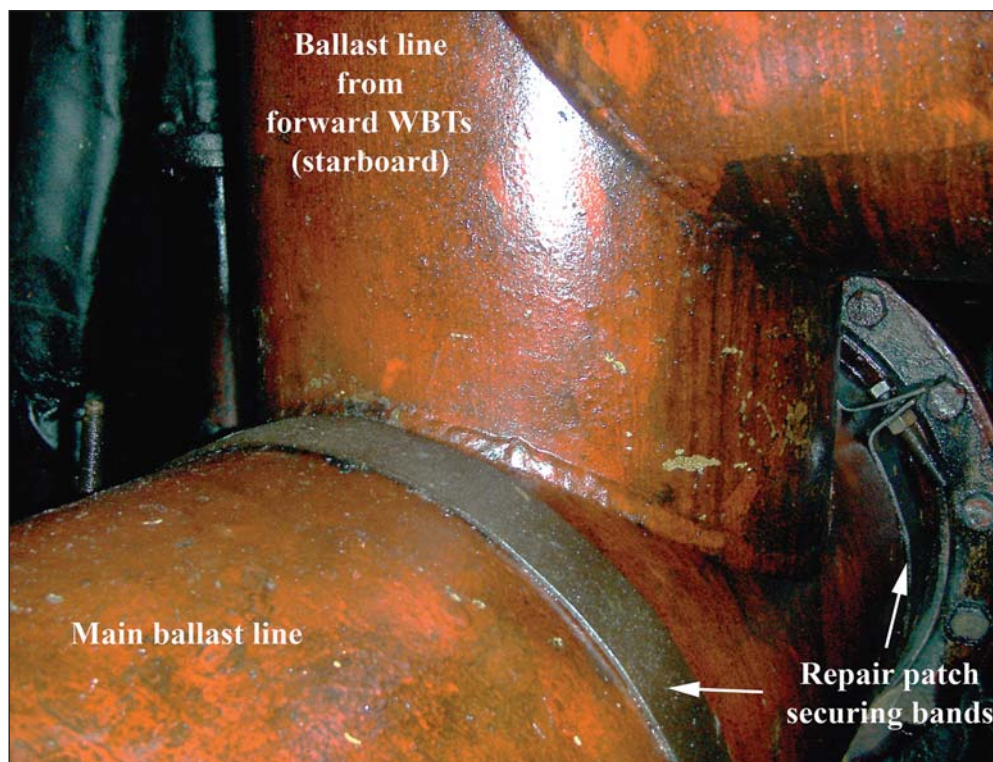
The bottom of 'T' junctions on all salt water piping has been proven to be prone to problems with regard to corrosion and erosion. On this particular section of ballast piping, the problem has arisen because of the aeration, and the impact and redirection of the water coming from the forward ballast tanks during normal operations. These areas of salt water piping are not required to be the subject of regular, close-up inspection or thickness testing during surveys. Under current enhanced survey programs for bulk carriers greater than 15 years of age, there is no requirement for thickness measurement of any part of the ballast piping system that is outside cargo or fuel oil tanks; cofferdams; pump-rooms; pipe tunnels, void spaces within the cargo area and all ballast tanks¹⁵. Class societies only visually inspect sections of ballast lines.

Importantly, however, these areas present an identifiable risk in older ships, and should be subjected to regular thickness measurement and examination.

The presence of an existing repair on the area of the leak in the ballast line was not visually identified during surveys prior to the incident.

¹⁵ IMO Assembly Resolution A.744(18) – Guidelines on the enhanced programme of inspections during surveys for bulk carriers and oil tankers (Adopted 18 November 1993 & amended by SOLAS 4 Res 2 MSC.49(66) MSC.105(73) Amended up to 2002).

FIGURE 11:
'T' junction above leak



Actions taken after leak identified

Neither the duty engineer nor the chief engineer initially attempted to isolate the area of the leaking ballast line. The water leaking from the ballast line could have originated from only two sources, the ballast tanks or the sea. However, neither the master nor the officers of *Harmonic Progress* seemed to query where the water was coming from. It would be reasonable to expect the crew to immediately close every valve on the ballast line on either side of a leak as soon as the leak was identified.

It was not until 18 April that the surrounding valves were tried, to establish if they were shut. However, any action taken to check valves on 18 April was not successful as water continued flowing from the leaking section of pipe until the valves were rechecked on the afternoon of 19 April. Evidence indicates that it was at this point that the crossover valve (WV-10 in Fig. 10) was found to be still open. This valve was allowing water leaking from the forward ballast tanks to flow back through the ballast main and into the section of pipe which was leaking. Closing this valve stopped the flow of water into the bilge.

When the duty engineer and the chief engineer became aware of the leak in the main ballast line on 16 April, they attempted to control it and started the engine room bilge pump. They then returned to their cabins, leaving the pump on and the water level raised in the bilges. Prudent engineering practice is to establish a watch, or to ensure that the bilges are empty and the alarms operations before going back into UMS. Had they done so, it would have become apparent that the water level was not reducing, but getting higher. More substantial action could have been taken earlier to identify the severity of the problem and not wait until after 0800 that morning.

Use of other pumps

In their statements to the ATSB investigators, both the master and chief engineer said that they did not consider it necessary to use the emergency bilge suction (shown in Fig. 10) to remove the water in the engine room. By connecting either the fire and general service pump or the fire and bilge pump, to the engine room bilge line, the water level would have been reduced far more quickly than having to rely on the small capacity air-operated pump or the small capacity engine room bilge pump.

Annex 1, Regulation 11 of the International Convention for the Prevention of Pollution from Ships, 1973 as amended (MARPOL), states:

Exceptions

Regulations 9 (Control of discharge of oil) and 10 (Methods for the prevention of oil pollution from ships while operating in special areas) of this Annex shall not apply to:

- (a) the discharge into the sea of oil or oily mixture necessary for the purpose of securing the safety of a ship or saving life at sea; or
- (b) the discharge into the sea of oil or oily mixture resulting from damage to a ship or its equipment:
 - (i) provided that all reasonable precautions have been taken after the occurrence of the damage or discovery of the discharge for the purpose of preventing or minimizing the discharge; and
 - (ii) except if the owner or the master acted either with intent to cause damage, or recklessly and with knowledge that damage would probably result; or

Under part (a) of the above regulation, if it is considered necessary for the safety of the ship and its crew, the discharge of oil or an oily mixture into the sea, is permitted without any penalty. Under the circumstances, *Harmonic Progress*'s crew would have been justified in using the large capacity pumps. In their statements, both the master and chief engineer said that they did not consider the vessel to be in sufficient danger to warrant the discharge of the oily bilge water into the sea. They both considered the proximity of the GBR in arriving at this decision. However, by failing to do so, the vessel became disabled and therefore presented a much greater danger to the GBR.

After the incident, the master said that about 536 m³ of oily bilge water was pumped into number one fuel oil tank. When soundings were taken of the forward WBTs, two were found to have lost about 2600 m³ of ballast water. When asked about the 2000 m³ discrepancy the master stated that this was lost overboard during the ship's movement through the air vents on the main deck. While it is possible that some ballast water was lost through the air vents, it is not possible for the two tanks to lose the majority of their contents that way.

The engine room bilge pump operated for only about 12 hours before it failed. In that time, it would have discharged about 24 m³ of oily bilge water overboard, via the oily water separator. According to the ship's staff, the air-pump operated for about 90 hours (the time at which it stopped during the morning of 17 April is not known). In that time it would have pumped about 1530 m³ from the engine room bilge into the fuel oil tanks. Together this indicates that about 1555 m³ of oily bilge water was pumped out of the engine room using these two pumps. If 536 m³ went into the fuel oil tanks and 24 m³ went overboard through the oily water separator, then about 995 m³ of bilge water is unaccounted for.

Evidence suggests that the crew of *Harmonic Progress* did use the large capacity pumps to reduce the level of water in the engine room bilge, but after the ship was disabled. Why the master and chief engineer did not say that these pumps were used is not known. It is possible they feared prosecution for discharging oily water into the sea near the GBR, a designated Particularly Sensitive Sea Area (PSSA)¹⁶.

Crew familiarisation

With the exception of the chief engineer, all the crew on board at the time of the incident joined the ship on 29 March and received only a short handover from the previous owner's crew. The chief engineer had joined the ship in Taiwan in the middle of February to receive a handover from the outgoing chief engineer. This was the first ship he had joined as the chief engineer. During his time on the ship, he was primarily concerned with the operation of the main engine and other machinery in the engine room. He did not familiarise himself to any extent with the ballast system in the engine room.

The master and mate joined the ship with the rest of the crew. The short time between joining the ship, and when it sailed from Incheon, did not allow the mate sufficient time to adequately familiarise himself with the ballast system operations, location of valves and lines, the state of the ballast tanks and their associated valves and the operations of the deck machinery in general.

In submission, the ship's owners stated:

That the master actually joined *Harmonic Progress* at the same time as the chief engineer in mid February. This was specifically so that he would be able to become familiar with the vessel prior to its handover.

Despite several requests for documentary evidence from the owners or managers to substantiate when the master joined the vessel, at the time this report was published this evidence has not been received.

In addition to these key ship's personnel, no other crew member on board *Harmonic Progress* at the time of the incident was familiar with the ship, including the operation of the ballast system. Therefore, no other crew member could reliably offer any specific ship knowledge when it was necessary to identify any potential areas on board which could be causing the ballast water to leak from the tanks.

Evidence points to the fact that neither the mate nor the chief engineer was sufficiently familiar with the operation of the ballast system when the leak became apparent on 16 April. They were, therefore, unable to immediately put strategies in place to identify where the water was coming from or to isolate the leak. However, neither the master nor officers appear to have made any effort to familiarise themselves with the ballast system as the incident developed.

Pre-delivery inspection

When interviewed in Gladstone, the company's representative was hesitant about providing a copy of the pre-delivery inspection report without senior management's approval. Without having access to the inspection report, speculation can only be

¹⁶ An area that needs special protection through action by IMO because of its significance for recognised ecological, socio-economic or scientific reasons, and which may be vulnerable to damage by international shipping activities. GBR was designated a PSSA by IMO in 1990 (Resolution MEPC.44(30)).

made about the quality of any inspection and the items which were examined during the inspection. Despite several requests made directly to the company's Seoul office, no pre-purchase/delivery report was provided to the ATSB.

The fact that the ship made an unscheduled stop at Naha to effect some engine room repairs, and that it had to be dry-docked to have repairs carried out so soon after it had changed ownership, suggests that the pre-delivery inspection of *Harmonic Progress* may not have been adequate.

In submission, the owners stated that:

However detailed an inspection may be, it cannot be guaranteed that all potential problems would be identified. The source of the leak and the previous repair were not obvious on any reasonable visual inspection at the time.

When purchased by Primary Marine, *Harmonic Progress* was an 18 year old bulk carrier. The fact that the international shipping industry has been concerned about the safety of bulk carriers older than 15 years must be taken into consideration when an inspection is carried out for a new owner, or for a survey by the classification society or flag state.

Maintenance records

When the crew of the ship took over the operations from the outgoing crew, no maintenance records for any of the machinery or on board systems was left behind for their use and reference. The ATSB investigators were told by *Harmonic Progress's* officers and the management company's representative that what records there were had been destroyed prior to the change of ownership and crew. The result was that when asked what problems or work had been carried out on the equipment needed to deal with the flooding, there could be no answer. The absence of maintenance records also meant that the crew were not able to reference which, if any, ballast system valves had caused problems in the past.

It is not uncommon practice by outgoing crews on ships worldwide that undergo a change in ownership and/or crew to destroy maintenance records prior to the handover. The new owner/operators of a ship, through discussions with the organisations they are taking the ship over from, should discourage this practice.

ISM procedures

The introduction of ISM to the world's shipping industry has seen improvements in the way many operations are conducted on board ships. The ISM Code requires all ship's to 'develop, implement and maintain a safety management system (SMS).....'. In Section 1.2 of the Code, it states:

- 1.2.1 The objectives of the Code are to ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment, in particular to the marine environment and to property.
- 1.2.2 Safety-management objectives of the Company should, inter alia¹⁷:
 - .1 provide for safe practices in ship operation and a safe work environment;
 - .2 establish safeguards against all identified risks; and

¹⁷ Among other things.

- .3 continuously improve safety management skills of personnel ashore and aboard ships, including preparing for emergencies relating to safety and environmental protection.

Many shipping companies have well documented SMS operational procedures, tailored specifically to each vessel on which those procedures are used. However, many companies provide 'off the shelf' procedure packages available to ship owners and managers which are not ship specific. These packages are designed to meet the minimum requirements of the ISM Code, thus enabling SMC and DoC certificates to be issued, but they serve only limited practical benefit.

Harmonic Progress's safety management system was of a generic type and not specific to the ship. The procedure it contained could be applied to any ballast operation on virtually any bulk carrier and offered no guidance to the crew of *Harmonic Progress* when they needed it the most.

Additionally, the master said that *Harmonic Progress* was the first ship on which he had served with C & M Associates. As a result of this, he was unfamiliar with the procedures and systems of the company that did exist.

In submission, the ship's owners stated that:

Before the master joined *Harmonic Progress*, he undertook a three month training program provided by the managers, C & M Associates. This emphasised the company's procedures with which was therefore familiar prior to joining the vessel.

Procedures are put in place to assist people to perform tasks, especially when they are unfamiliar with those tasks. Good procedures are a defence against mistakes or lapses which may manifest themselves in times of emergency or during periods of high stress on board ships.

Had specific procedures, which detailed the valves to check before and after ballast operations, been available to the crew of *Harmonic Progress*, the flooding could have been limited and the ship not disabled.

SOPEP manual

The Shipboard Oil Pollution Emergency Plan (SOPEP) on board *Harmonic Progress* was approved by the Isthmus Bureau of Shipping¹⁸ (IBS) on 15 March 2004. The plan was issued a provisional approval, valid for five months. The plan was written in accordance with the requirements of regulation 26 of Annex I of the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL), as modified by the Protocol of 1978.

According to the introduction section in the plan, it contains all the information and operational instructions required by the IMO 'Guidelines for the development of shipboard oil pollution emergency plans' (MEPC.54(32)) and the amendment document to those guidelines (MEPC.86(44)). Carriage of a SOPEP is mandatory for all SOLAS vessels and these plans must contain the information contained in the guidelines and its amendments.

¹⁸ A Panamanian company authorised to issue statutory certificates and approvals on behalf of a number of flag states.

The IMO guidelines (MPEC.54(32)) and amendments (MEPC.86(44)) for the development of SOPEP do not specifically list the requirement to cover the eventuality of flooding of the engine room.

The SOPEP manual for *Harmonic Progress* did not cover actions to take in the eventuality of flooding in the engine room. Had it done so, additional direction could have been provided to a crew unfamiliar with the operation of the ship.

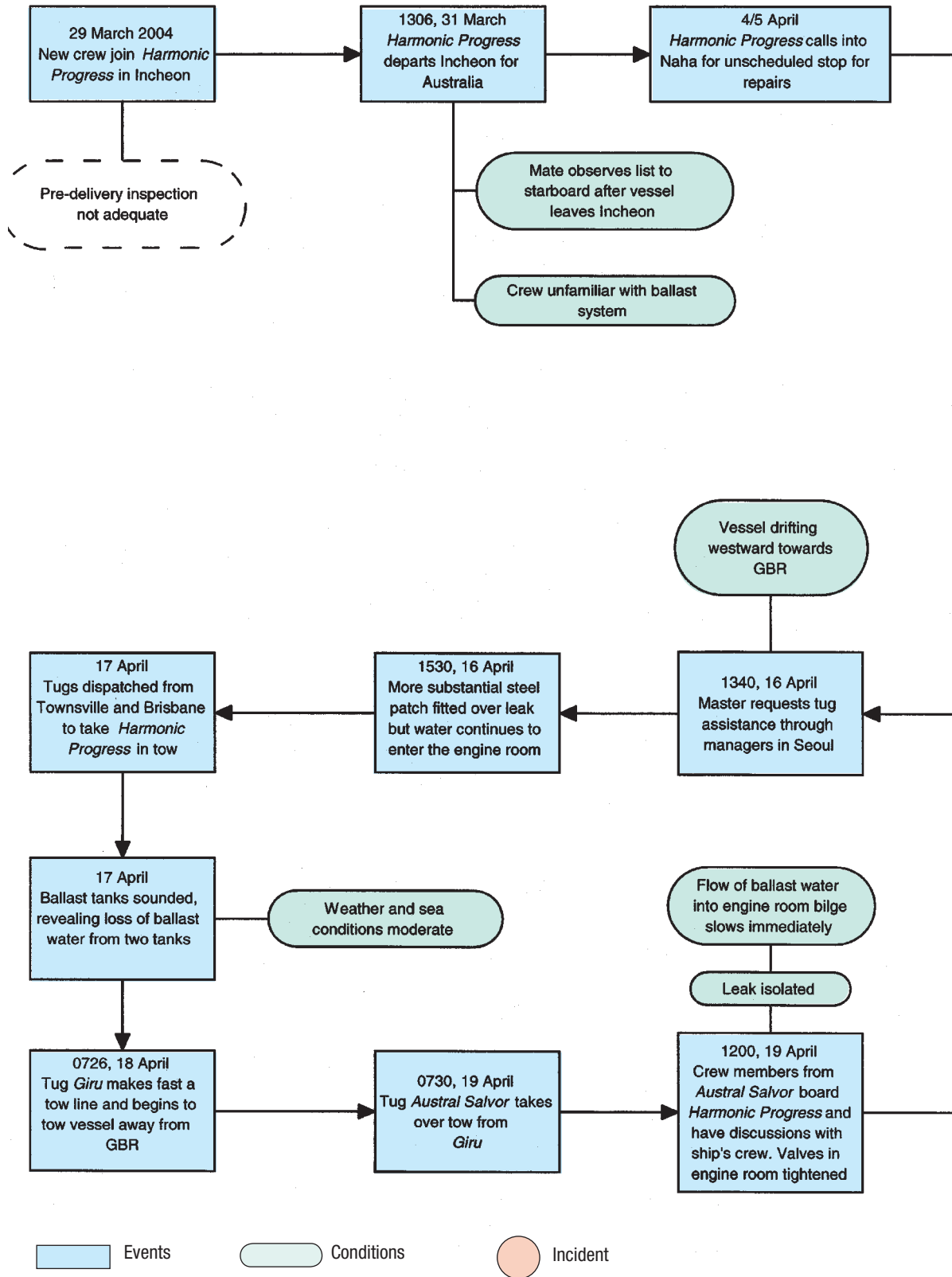
5 CONCLUSIONS

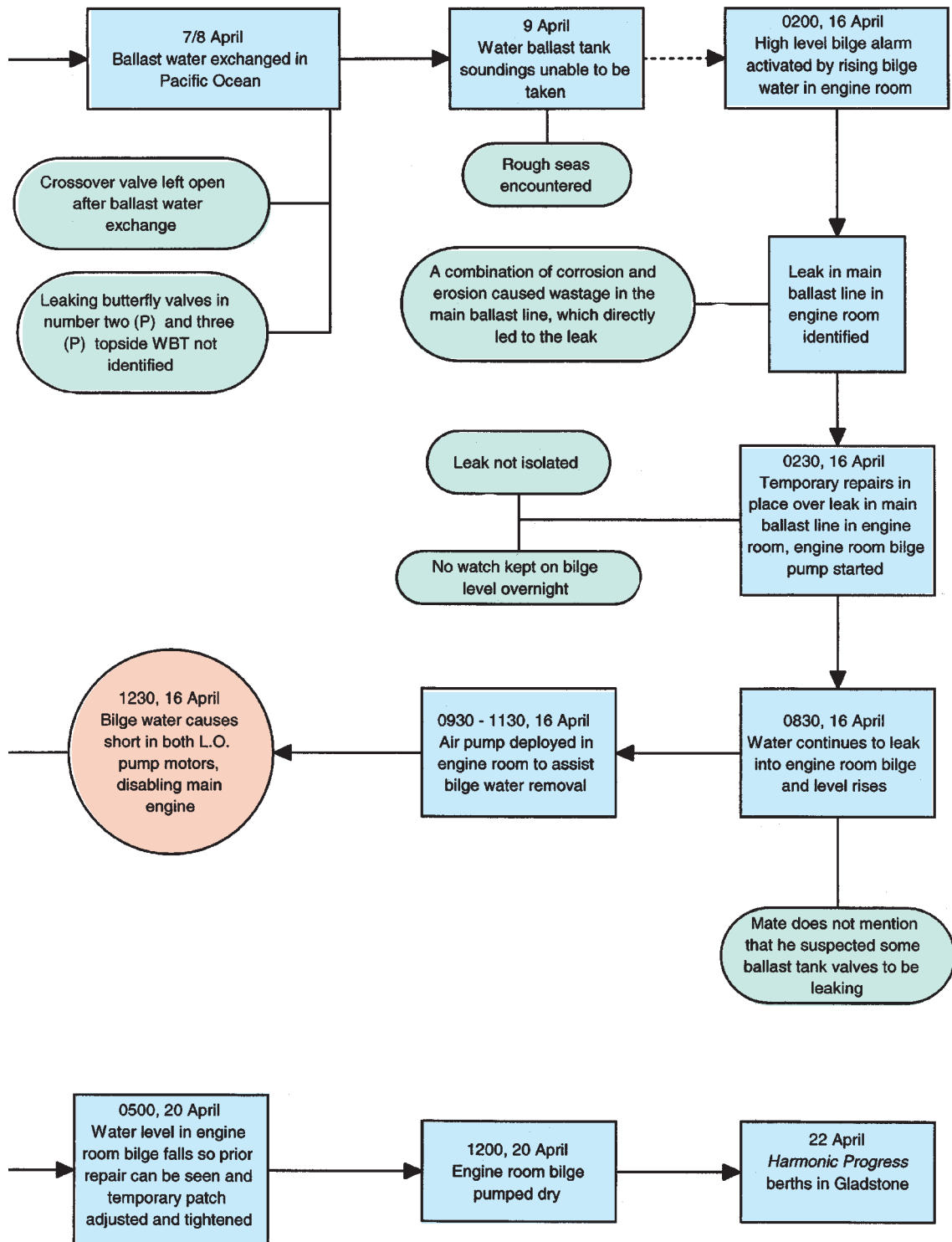
These conclusions identify the different factors that contributed to the incident and should not be read as apportioning blame or liability to any particular individual or organisation.

Based on the available evidence, the following factors are considered to have contributed to the flooding of the engine room on 16 April 2004:

1. A leak in the main ballast line caused the flooding of the engine room to a level in excess of 1.5 m, which led to the main engine lubricating oil pump motors short circuiting and the vessel becoming disabled.
2. A combination of corrosion and erosion caused wastage in the main ballast line, which directly led to the leak.
3. Leaking butterfly valves in numbers two and three (port) topside water ballast tanks led to the two tanks draining into the engine room via the leak.
4. A crossover valve on the main ballast line in the engine room had not been closed after ballast operations.
5. The crew did not isolate the leak by checking associated valves early enough to prevent disabling of vessel.
6. Early action was not taken to prevent the water level rising to the point where the lubricating oil pump motors short circuited.
7. The crew were unfamiliar with the ballast system and did not use a systematic approach to find the source of the water leaking from the ballast line.
8. The pre-delivery inspection of the ship prior to the change of ownership is suspected of being inadequate.

FIGURE 12:
Harmonic Progress: Events and causal factors chart





6 RECOMMENDATIONS

MR20050001

Ship owners, operators and managers ensure sufficient time is made available for handover of information to key personnel when changes of crew or ownership take place.

MR20050002

Ship owners, operators, manager and masters should revise ISM procedures for ballast operations to ensure they are specific to their ships.

MR20050003

Classification societies should consider the inclusion of regular ballast line thickness testing around known risk areas, such as ‘T’ junctions during the enhanced survey program for bulk carriers and oil tankers. This is particularly applicable to ships over 15 years of age.

MR20050004

The IMO should consider including the possibility of engine room flooding contingency in SOPEP manuals.

MR20050005

Classification societies and owners acquiring existing ships should make it a condition of sale that all the ship’s maintenance records are retained on board.

7 SUBMISSIONS

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

The final draft of this report was sent to the owner, managers, master, mate and chief engineer of *Harmonic Progress*, the Australian Maritime Safety Authority and United Salvage.

Submissions were included and/or the text of the report amended where appropriate.

8 HARMONIC PROGRESS

Previous names	<i>Orange Phoenix</i> (1986), <i>Nicholas Smile</i> (1999)
IMO number	8501684
Call sign	H3QC
Flag	Panama
Port of registry	Panama
Classification society	Nippon Kaiji Kyokai (ClassNK)
Ship type	Bulk carrier, strengthened for heavy cargoes (with holds 2, 4 and 6 empty)
Builder	Tsuneishi Shipbuilding, Japan
Year built	1986
Owners	Primary Marine, Panama
Ship managers	C & M Associates, Seoul, Republic of Korea
Gross tonnage	36 537
Net tonnage	22 996
Deadweight (summer)	69 561 tonnes
Summer draught	13.257 m
Length overall	225.00 m
Length between perpendiculars	215.00 m
Breadth	32.20 m
Moulded depth	18.30 m
Engine	1 x Mitsui B&W 5L70MC
Total power	7 106 kW
Service speed	13 knots
Crew	20 (South Korea, Philippines)

9 ABBREVIATIONS, TERMS AND DEFINITIONS

Definition

Deadweight	The weight of cargo, fuel, fresh water and stores that a vessel can carry at a relevant draught.
Gross tonnage	Measurement of total internal volume of a vessel, including all underdeck tonnage and all enclosed spaces above tonnage deck. (One gross tonne = 40 m ³)
Net tonnage	Measurement derived from gross tonnage by deducting certain spaces allowed for crew and propelling power.
Length overall (LOA)	The length of a vessel, measured from the extremities at the stem and stern.
Length between perpendiculars (LBP)	The distance, at the summer waterline, from the forward side of the stem to the after side of the rudder post.

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