



Australian Government

Australian Transport Safety Bureau



ATSB TRANSPORT SAFETY INVESTIGATION REPORT
Marine Occurrence Investigation No. 208
Final

Independent investigation into the lifeboat accident and
fatalities aboard the Hong Kong registered bulk carrier

Lowlands Grace

at anchor off Port Hedland, Western Australia on
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Abstract

On 7 October 2004 two crew members were killed and three others seriously injured when *Lowlands Grace*'s port lifeboat became detached from its falls during a lifeboat drill. The ship, a Hong Kong registered cape-sized bulk carrier, was at anchor off the port of Port Hedland, Western Australia, at the time of the accident.

Investigation revealed that the lifeboat's after hook had failed where it was attached to the keel while the boat was being lowered. The lifeboat's stern had then dropped and the boat rotated around the remaining forward fall before the forward hook opened under the load of the swinging boat. The lifeboat then fell upside down into the sea approximately 16 metres below.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal Bureau within the Australian Government Department of Transport and Regional Services. ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations. Accordingly, the ATSB also conducts investigations and studies of the transport system to identify underlying factors and trends that have the potential to adversely affect safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and, where applicable, relevant international agreements. The object of a safety investigation is to determine the circumstances to prevent other similar events. The results of these determinations form the basis for safety action, including recommendations where necessary. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations.

It is not the object of an investigation to determine blame or liability. However, it should be recognised that an investigation report must include factual material of sufficient weight to support the analysis and findings. That material will at times contain information reflecting on the performance of individuals and organisations, and how their actions may have contributed to the outcomes of the matter under investigation. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Central to ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. While the Bureau issues recommendations to regulatory authorities, industry, or other agencies in order to address safety issues, its preference is for organisations to make safety enhancements during the course of an investigation. The Bureau is pleased to report positive safety action in its final reports rather than make formal recommendations. Recommendations may be issued in conjunction with ATSB reports or independently. A safety issue may lead to a number of similar recommendations, each issued to a different agency.

The ATSB does not have the resources to carry out a full cost-benefit analysis of each safety recommendation. The cost of a recommendation must be balanced against its benefits to safety, and transport safety involves the whole community. Such analysis is a matter for the body to which the recommendation is addressed (for example, the relevant regulatory authority in aviation, marine or rail in consultation with the industry).

1 SUMMARY

On 6 October 2004, *Lowlands Grace* arrived at the anchorage 11.7 miles north of Hunt Point, Port Hedland, in Western Australia.

At 1500 local time on 7 October, the ship's crew mustered at the port lifeboat station for a lifeboat drill. The port lifeboat was lowered to the boat deck and four of the crew were selected to act as the boat's crew under the command of the third mate.

After the crew had entered the lifeboat and were seated with their seat belts fastened, the third mate operated the remote davit winch brake cable inside the lifeboat to start lowering the boat. When the boat had descended about two to three metres, the third mate released the brake release cable and the boat came to a stop with a jerk. At this point the crew on deck heard a 'bang' and then saw the lifeboat's stern start to fall, now detached from its fall.

The boat continued to swing forward, and rotate around the forward hook, until it had described an arc of between 200 and 220 degrees. The forward hook then released the forward fall and the lifeboat, still upside down, fell to the sea approximately 16 metres below. All five of the boat crew were injured in the fall with two dying from their injuries.

The report conclusions include:

- The port lifeboat's after hook's keel stays were wasted (corroded), around the point of attachment to the keel block.
- The momentary shock load, when the third mate halted the lowering, caused the after hook's wasted keel stays to fail releasing the stern of the lifeboat.
- The failure of the foredeck while the lifeboat was swinging led to the end of the operating cable for the forward hook being damaged which in turn contributed to the subsequent failure of the forward hook.
- The ship's planned maintenance procedures with respect to the on-load release systems fitted to the lifeboats were deficient as the condition of the wasted keel stays had not been detected and rectified.
- The lifeboat's survey regime was deficient with respect to the on-load release systems fitted to the lifeboats as the condition of the wasted keel stays had not been detected and rectified.
- The suspension rings fitted to the lifeboat davit falls were incorrectly sized and subjected the forward hook to greatly increased opening forces while the lifeboat was swinging.
- The design of the on-load release system is also implicated in the failure of the forward hook as the system of locking the hook became particularly prone to spontaneous release when the operating cable was damaged.

The report contains recommendations to ship owners, managers, crews, statutory and ISM accreditation authorities and classification societies with respect to lifeboat hook inspection and maintenance regimes. A recommendation is also made to the on-load release system manufacturer in regard to the design of the system fitted to *Lowlands Grace*'s lifeboats.

2 SOURCES OF INFORMATION

The owners, managers, master and crew of *Lowlands Grace*

Hong Kong Marine Department

Bureau Veritas

Crew of the Royal Australian Navy vessel, *HMAS Melbourne*

Laurent Giles, Naval Architects, UK

Umoe Schat-Harding (Mills Marine), UK

Australian Maritime Safety Authority

Western Australia Police Department

Port Hedland Port Authority

References

The International Convention for the Safety of Life at Sea, 1974, and its Protocol of 1988 (SOLAS), the International Maritime Organization.

International Life-Saving Appliance Code (LSA Code), combined edition 2003, the International Maritime Organization.

Maritime Safety Committee circular 1093, 'Guidelines for periodic servicing and maintenance of lifeboats, launching appliances and on-load release gear', the International Maritime Organization, June 2003.

Marine Accident Investigation Branch, Review of Lifeboat and Launching Systems Accidents, January 2001.

3 NARRATIVE

3.1 *Lowlands Grace*

Lowlands Grace is a Hong Kong registered cape-sized bulk carrier of 149 518 deadweight tonnes at its summer draught of 17.325 m (figure 1). *Lowlands Grace* is classed I 3/3 E Bulk Carrier, Strengthened for Heavy Cargos, AUT-MS, with Bureau Veritas. The vessel is owned by Atlas Marine Transportation Corporation of Hong Kong and managed by Tai Chong Cheang Steamship Company, Singapore.

Lowlands Grace was built in 1991 by China Shipbuilding Corporation, in Kaohsiung, Taiwan. The ship has an overall length of 270.07 m, a moulded breadth of 42.99 m and a moulded depth of 23.90 m. Propulsive power is provided by a 5-cylinder MAN B&W 5L80 MCE, single acting, direct reversing 2-stroke diesel engine of 12 430 kW. The main engine drives a single fixed-pitch propeller, which gives the ship a service speed of 13.9 knots.

The ship is of standard bulk carrier design with nine cargo holds located forward of the accommodation superstructure.

At the time of the incident, *Lowlands Grace* had a crew of 25, comprising a master and three mates, chief and four engineers including an electrician, boatswain and seven deck ratings, seven engine room ratings and a cook. Twenty two of the crew were Filipino nationals, including all of the officers, with the remaining three Chinese.

At the time of the incident, the master held a foreign-going master's certificate of competency and had 28 years experience at sea, the last sixteen years in command. He had been master on *Lowlands Grace* for the previous six months. The mate held a chief officer's certificate, had been at sea for 22 years and, like the master, had joined the vessel six months previously.

Figure 1: *Lowlands Grace* at anchor off Port Hedland



3.1.1 Lifeboats

Lowlands Grace is equipped with two 32-man totally enclosed lifeboats (Figure 2). Both lifeboats are Blue Sea 24LE type, designed by Laurent Giles Naval Architects, UK, and built by Blue Sea Industrial Company, Taiwan. The lifeboats are stowed in gravity davits on the port and starboard sides of the first deck of accommodation above the main deck. The starboard lifeboat is the designated rescue boat.

Figure 2: Starboard lifeboat



Figure 3: After bulkhead inside the boat with access door open



The lifeboats are constructed of fibre reinforced plastic and each boat is 7.3 m in length, has a breadth of 2.6 m and a depth of 1.2 m. The unladen weight of each boat is 3 265 kg with a fully laden design weight of 5 665 kg. Their internal configuration is typical of many modern totally enclosed lifeboats. The coxswain's thwart is located at the stern of the boat and is raised to allow all-round vision from a small 'conning' bubble in the top of the canopy. All of the lifeboat's controls are accessible from this position, including the davit winch brake remote release cable and the on-load release operating mechanism, which is located on the port side of the coxswain's console. Seating for the rest of the crew is provided forward of the coxswain's seat and around the periphery of the boat.

Normal embarkation takes place with the lifeboat in the housed position at the davit head. Boarding hatches are located on the port and starboard sides of each lifeboat's canopy. Smaller hatches are located at the forward and after ends of the canopy to allow the crew access to the on-load release hooks.

Plywood bulkheads are fitted to the forward and after ends of each lifeboat. The forward bulkhead encloses the keel stays and keel attachment for the forward lifting hook. The after bulkhead encloses the tiller mechanism, a section of the engine exhaust pipe and the after lifting hook's keel stays and attachment (Figure 3). Both bulkheads are fitted with doors which allow for the inspection of the enclosed spaces.

Propulsive power is provided by a Yanmar 3JH30A, 4-stroke diesel engine which gives each lifeboat a speed in excess of six knots when fully laden.

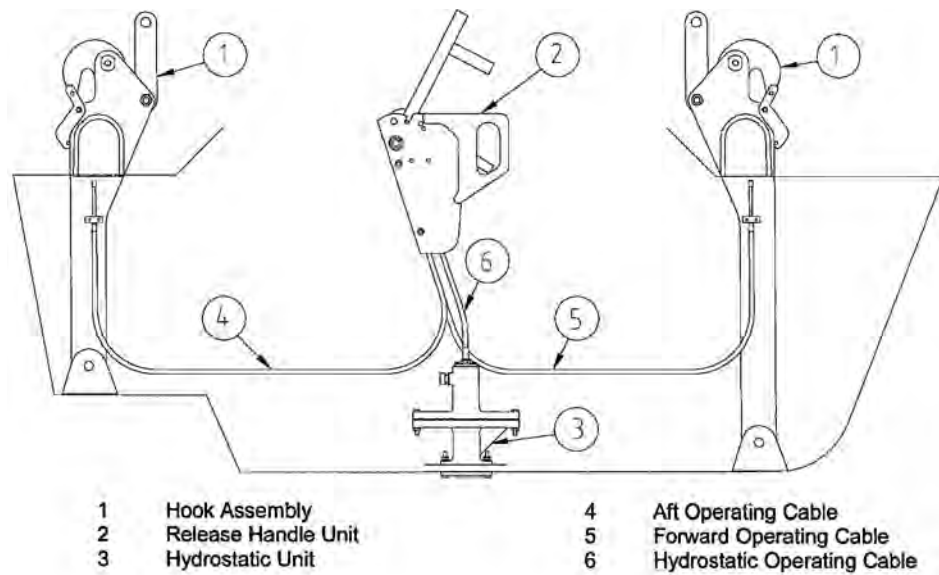
3.1.2 The on-load release system

Lowlands Grace's lifeboats are fitted with a William Mills 'Titan' on-load release system (Figure 4) complying with the International Maritime Organization's Safety of Life at Sea Convention (SOLAS) 1974, as amended. The Titan system is currently manufactured by Umoe Schat-Harding (Mills Marine) of the United Kingdom and is similar to many other types which use a rotating cam to lock the tail of the hooks in the closed position. The system is fitted with an hydrostatic interlock with a manual override.

The main components of the Titan on-load release system are:

- the release handle unit adjacent to the coxswain's seat
- the forward and after hook assemblies
- the hydrostatic interlock unit, and
- the flexible operating cables which connect the operating mechanism to the two hooks.

Figure 4: Typical Titan on-load release system (note: hooks shown in the opposite orientation to *Lowlands Grace's* lifeboats)



The operating mechanism is shown in Figures 5 and 7. The normal hook release procedure when the boat is waterborne (and the hydrostatic interlock is disengaged) involves removing a locking pin from the operating mechanism, lifting the actuating lever and moving it to the release position. The movement of the actuating lever rotates two quadrants, which are attached to the operating cables for each hook locking mechanism. As the operating quadrants are turned, the tripping motion is simultaneously transmitted to the forward and aft hook assemblies by the operating cables.

Each hook is held closed by a cam release pin, which bears on the tail of each the hook (Figures 6, 8 and 23). The tripping motion transmitted by the operating cables to each hook mechanism, rotates the cam release pin, via the operating lever (a bell-crank keyed onto the cam release pin shaft), until the tail of each hook clears the cam. The hooks are then free to rotate open and release the suspension rings (long links) attached to each davit fall.

Resetting the system involves moving the hooks to the closed position, moving the re-cocking lever attached to each cam release pin to the locked position, and then moving the actuating lever to the locking position. The locking pin is then inserted to complete the operation. To be fully reset, each cam release pin must be rotated through approximately 75 degrees so that the flat face on the cam bears fully on the tail of each hook (Figure 23).

Figure 5: Release mechanism schematic

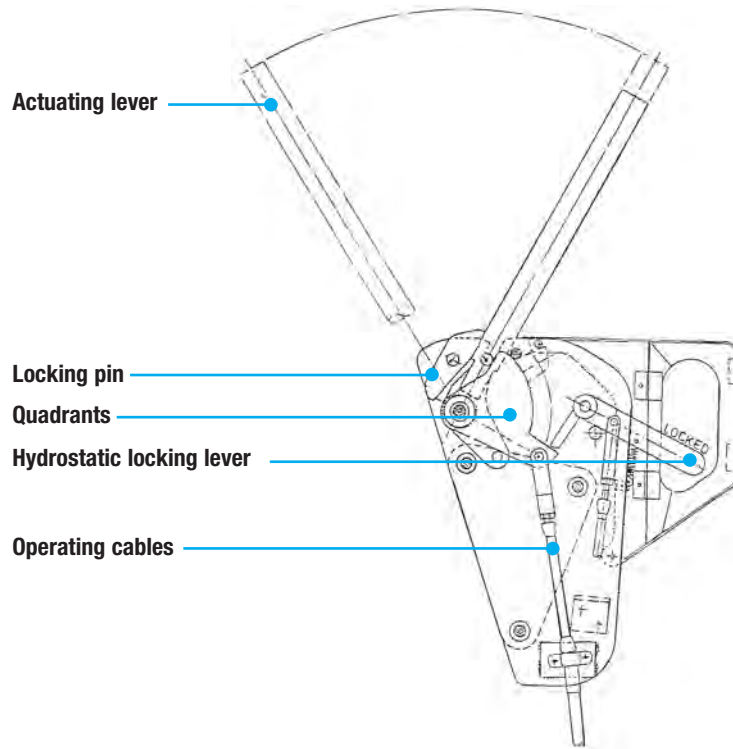


Figure 6: Hook mechanism schematic

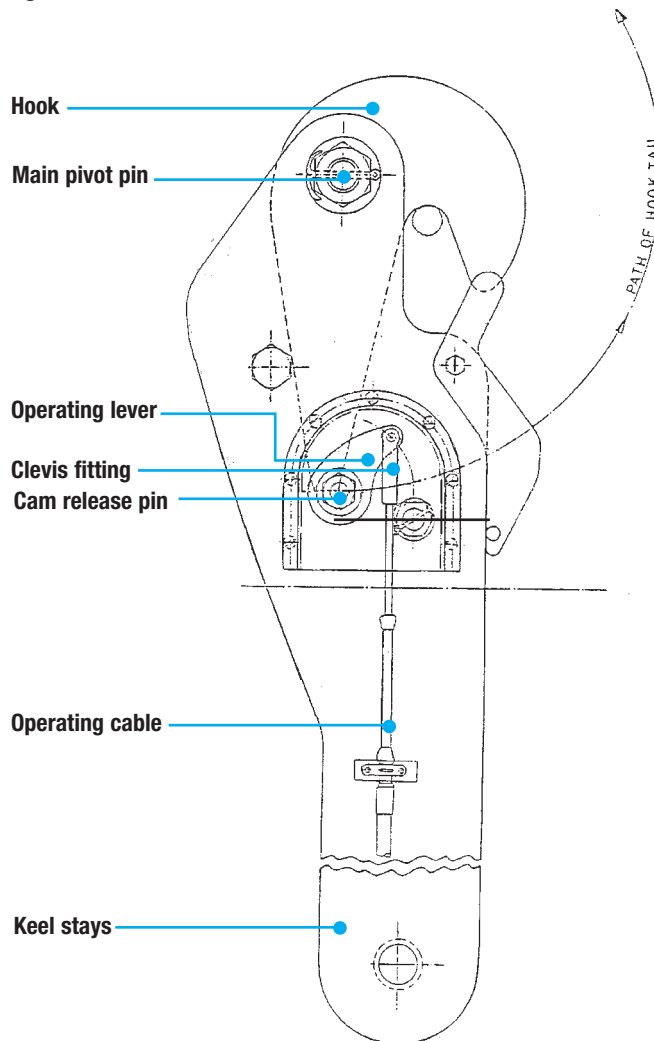


Figure 7: Operating mechanism



Figure 8: Hook mechanism

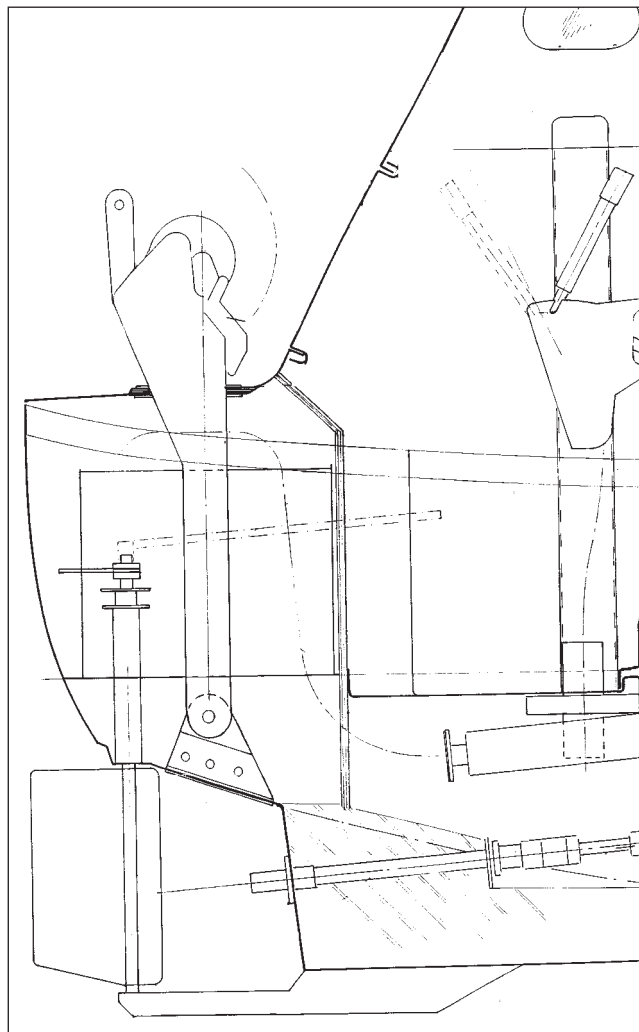


Operating cables: The cables, which operate each of the hook mechanisms, are a teleflex cable (sometimes referred to as a bowden or morse cable) attached to the quadrants of the operating mechanism. The cables consist of an outer polyethylene sheath over an inner flexible steel cable. The inner cable is designed to slide freely inside the outer sheath. There is a short rod attached to both ends of the inner cable which slides through a metal ferrule and gland seal at each end of the outer sheath.

The teleflex cables are fixed at each end adjacent to the operating and hook mechanisms. At the operating mechanism end, the cable is fixed by a saddle clamp fitted over the metal ferrule on the outer sheath, which is secured by two bolts to the mechanism's mounting plate. Similarly, the operating cables are secured adjacent to each hook by saddle clamps secured to each hook's keel stay (Figures 5 and 6).

Keel attachment: The cheek plates of each hook mechanism extend to form keel stays, which are through bolted to keel blocks fixed to the keel. The keel stays are fabricated from 15 mm galvanised mild steel plate and are attached on either side of the 20 mm galvanised mild steel keel block by a 30 mm stainless steel bolt (Figure 9).

Figure 9: Schematic showing after hook keel attachment



3.2 The incident

Lowlands Grace anchored at 0615 on 6 October 2004, 11.7 miles north of Hunt Point, Port Hedland, in position 20 07.1S 118 33.9E. The ship was in ballast and was to load a cargo of iron ore in Port Hedland for carriage to Yantai, China. The arrival draughts were 7.10 m forward and 7.84 m aft.

Early in the morning of 7 October 2004, the master contacted the harbour control tower to enquire about the ship's loading schedule and was informed that the ship

would not be berthing that day. As the weather forecast was good, he decided to take the opportunity to conduct a lifeboat drill while the ship was at anchor.

At 0820, the master contacted the control tower again and requested permission to conduct a lifeboat drill at 1500 that afternoon. Permission was granted, and the master informed the crew that there would be a drill that afternoon.

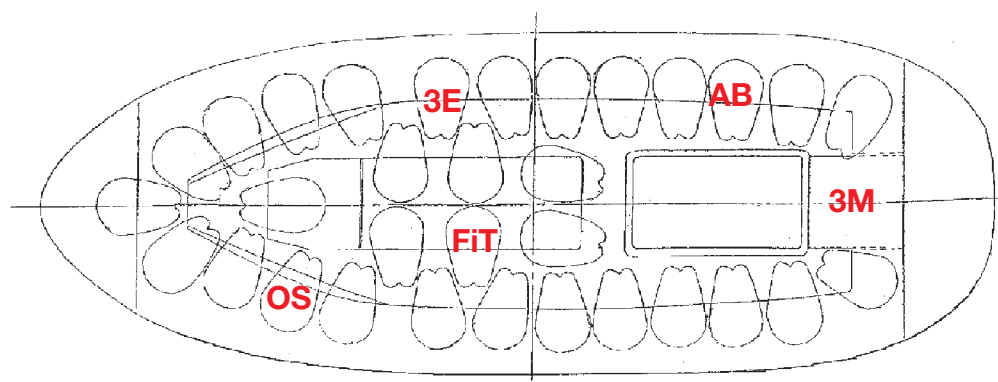
At 1445, the master contacted the ship's local agent to inform them of the lifeboat drill. During the conversation, the master was advised that he needed to report the start and finish times of the drill to the control tower. After the telephone conversation, the master relieved the second mate, who was keeping the anchor watch on the bridge, so that the second mate could attend the drill. The master then moved out onto the port bridge wing so he could observe the drill on the boat deck below. Weather conditions for the drill were good as the day was fine and warm with the wind from the north-north-west at about 10 knots.

By 1500, all of the ship's crew had arrived at the port lifeboat muster station. The first mate gave a briefing on safety procedures and the crew's duties in the event of an emergency.

At about 1520, the crew cleared the port lifeboat's gripes and lowered it from the stowed position to the boat deck level. The chief mate then selected the fitter, an ordinary seaman, an able seaman and the third engineer to act as the boat's crew under the command of the third mate. The chief mate and third mate then gave the boat crew a final short briefing on their duties for the remainder of the drill.

After the briefing, the boat crew entered the lifeboat and took their positions. The third mate took the coxswain's position, the able seaman sat facing inboard at the starboard aft end of the boat adjacent to the third mate. The ordinary seaman sat facing inboard on the port side at the forward end of the lifeboat with the fitter facing outboard on his right hand side (with his back to the centreline). The last to enter the boat was the third engineer, who sat on the starboard side facing inboard just inside and forward of the entry hatch (see Figure 10). All of the men were wearing hard hats and lifejackets and fastened their seat belts when they were seated.

Figure 10: Seating plan



The boarding hatch was closed and the third mate called the chief mate using his hand held radio to indicate that they were ready to lower the boat. The chief mate

told him to lower away and the third mate operated the remote davit brake release cable inside the boat.

When the boat had descended about two to three metres, the third mate released the brake release cable to ensure the davit brake was operating correctly.

The boat came to a stop with a jerk and simultaneously the crew on the ship heard a 'bang' and then saw the lifeboat's stern start to drop, now detached from its fall. About this time the boatswain, who was standing on the boat deck, saw the after hook assembly fall to the water below.

The lifeboat continued to swing forward, and also rotate around the forward hook, until it had described an arc of between 200 and 220 degrees. The forward hook then opened and released the forward fall. During this time, the fitter inside the lifeboat heard two noises which sounded to him like "fibreglass breaking". The boat, still upside down, then fell to the sea approximately 16 metres below hitting the surface of the water with the bow slightly down.

When the crew on deck looked over the side, they could see that the lifeboat was floating upside down, still secured by painters alongside the port quarter of the ship. The chief mate and boatswain quickly organised the remaining deck crew to lower the ship's port gangway in order to assist the crew in the lifeboat.

While the deck crew were lowering the gangway, the third mate escaped from inside the boat and lay himself over the keel of the upturned lifeboat. The third engineer and the able seaman were the next to escape from the lifeboat. By this time the gangway had been lowered over the top of the upturned lifeboat and some of the other crew had climbed down onto the boat. The fitter was next to escape from the lifeboat and both he and the third engineer were assisted onto the upturned boat by the other crew. The ordinary seaman was the only man still inside and so one of the other able seamen swam into the boat to assist him. The able seaman emerged from the boat a short time later and told the rest of the crew that he thought that the ordinary seaman had drowned.

By this time the third engineer, lying on the upturned boat, was having severe difficulty breathing.

Meanwhile the master, who had witnessed the accident, called the port control tower, using VHF radio, to inform them of the accident and request assistance. The call was logged at 1535. The operator in the control tower immediately set about notifying the harbour master, pilot vessel and the emergency services.

At 1545, the control tower contacted *HMAS Melbourne*, a Royal Australian Navy frigate, which had just left its berth and was proceeding out of the harbour. They were told of the situation aboard *Lowlands Grace* and their assistance was requested.

The Port Hedland pilot helicopter en route to another vessel overflew *Lowlands Grace* at 1555 to check on the situation and report to the control tower.

At 1600 *Lowlands Grace's* master again called the port control tower to check on the progress of the rescue operation and to request divers for the man trapped in the boat. Four minutes later the master called again and further clarified his request for medical assistance. By this time the third engineer had loss consciousness and some

of the other crew on the upturned lifeboat started to administer cardio-pulmonary resuscitation (CPR).

Around this time, the third mate, who had sustained cuts abrasions, bruises and associated swelling to his left thigh, abdomen and face, climbed off the lifeboat and walked up the gangway to his cabin. The remaining lifeboat crew stayed on the upturned boat with the ordinary seaman still trapped inside the boat.

At 1630 HMAS Melbourne arrived on the scene and lowered a rigid hull inflatable boat (RHIB) to assist the lifeboat crew. The RHIB was manned by six naval personnel including two divers and a medic.

When the RHIB arrived at the side of the lifeboat, the divers entered the water and swam into the upturned lifeboat. They found the ordinary seaman at the forward end of the boat floating face down still in his lifejacket. He showed no signs of life. The divers cut the ordinary seaman's lifejacket free then passed him through the lifeboat's forward hatch and took him over to the RHIB.

The navy medic then entered the water and swam over to the lifeboat where he checked the injured crew and prioritized their care. The third engineer was checked and showed no signs of life. He was subsequently moved from the lifeboat to the RHIB by the divers.

During this time, a second RHIB from *HMAS Melbourne* arrived at the scene.

After the third engineer, the medic then checked able seaman who was complaining of back pain. The medic treated him as having a suspected spinal injury in addition he had a broken left arm and a large bruise on his forehead. The able seaman was subsequently moved from the lifeboat, put on a spinal board, and loaded aboard the first RHIB. The RHIB, with the ordinary seaman, third engineer and able seaman on board, then left the accident scene to transport the men back to *HMAS Melbourne*.

The medic then checked the fitter who was lying on the upturned lifeboat on his stomach. While in severe pain due to a leg injury, the medic assessed none of his injuries as life threatening and the fitter was later loaded aboard the second RHIB.

Onboard *HMAS Melbourne* a doctor from the Port Hedland hospital, who had been transferred to the vessel by helicopter, checked the ordinary seaman and the third engineer and pronounced both men dead. The doctor then started to treat the able seaman's injuries.

The medic from the first RHIB went onboard *Lowlands Grace* and checked the condition of the third mate in his cabin and assessed his injuries as not appearing to be serious. The second RHIB then returned to *HMAS Melbourne* with the injured fitter onboard. The RHIB was landed onboard at approximately 1740.

At 1755, the third mate was airlifted from *Lowlands Grace* and transferred to the Port Hedland hospital for a complete medical evaluation.

HMAS Melbourne returned to Port Hedland where the *Lowlands Grace* crew members were transferred to the Port Hedland hospital by the local ambulance service. The able seaman was later transferred to Royal Perth Hospital for further treatment.

3.3 Immediate safety action

The Australian Transport Safety Bureau's preliminary evaluation of *Lowlands Grace's* lifeboats and witness accounts of the accident, strongly suggested that the failure of the port lifeboat's after hook was as a result of corrosion of the keel stays in the area of the bolt which secured the stays to the keel block. This was of significant concern given the number of similar lifeboats and on-load release systems in service worldwide, and, the likelihood that another accident could occur as a result of a similar failure. The ATSB decided to immediately alert members of the International Association of Classification Societies, various P&I Clubs, the Australian Maritime Safety Authority, the Australian Shipowners Association, the lifeboat designer and the on-load release system manufacturer. These organisations were provided with information regarding the circumstances surrounding *Lowlands Grace's* lifeboat accident including the likelihood that the after hook's keel attachment had failed as a result of corrosion.

4 COMMENT AND ANALYSIS

4.1 Evidence

On 9 October 2004, investigators from the Australian Transport Safety Bureau (ATSB) arrived on board *Lowlands Grace*, at anchor off Port Hedland, to conduct an investigation into the circumstances of the lifeboat accident. At the time, the port lifeboat was still afloat, upside down, alongside the port side of the ship tethered by painters. Attempts were made during the day of 9 October to recover the lifeboat by righting it and pumping it dry so that it could be towed ashore. These attempts proved to be unsuccessful. The following day another attempt to recover the lifeboat was made by lifting the lifeboat clear of the water using slings passed around the boat, which were then attached to the lifeboat davit falls. This attempt was successful and the lifeboat was loaded on board a small landing barge for transport to a shore facility in Port Hedland (Figure 11).

Figure 11: Port lifeboat being recovered



The master and mate were interviewed on board the ship while it was at anchor on 9 October. Various documentary evidence was obtained including the operations and maintenance manuals for the ship's lifeboats, the lifeboat maintenance schedules, maintenance procedures and records of past maintenance. The injured third mate and fitter were interviewed in Port Hedland hospital on 10 October.

On 12 October, other evidence was obtained after the ship had berthed in Port Hedland. The second engineer, boatswain and machinist were interviewed and provided eyewitness accounts of the accident. The starboard lifeboat was also inspected.

The injured able seaman was interviewed at Royal Perth hospital on 15 October.

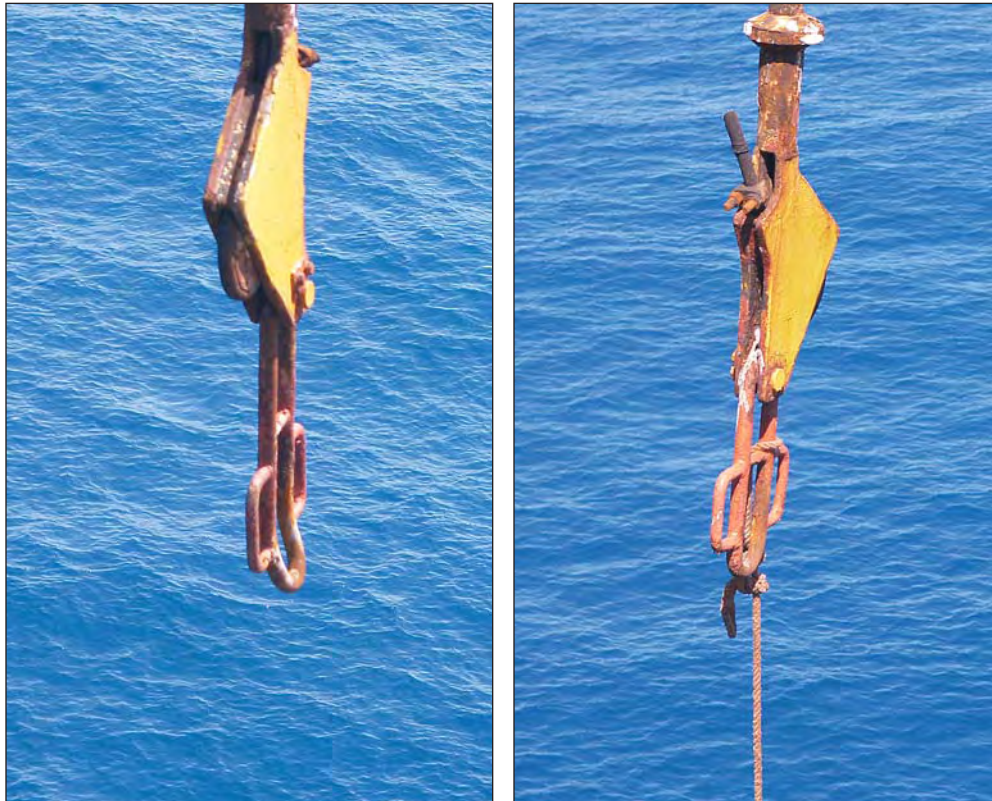
Port Hedland police were contacted and provided the statements taken from the crew of *HMAS Melbourne*. The post mortem reports for the third engineer and ordinary seamen were later provided to the ATSB. The reports list the third engineer's cause of death as 'chest injuries' and the ordinary seaman's cause of death as 'multiple injuries' including a fractured skull and multiple chest injuries.

The Port Hedland control tower provided recordings of radio traffic around the time of the accident and access to the port's vessel traffic system.

4.1.1 Port lifeboat falls

While on board *Lowlands Grace*, investigators inspected the port lifeboat's falls. The suspension ring (long link) attached to the end of the lifeboat's forward fall was slightly bent on the end normally attached to the hook. The after suspension ring was also still attached to its fall and did not exhibit any apparent damage or marks (Figure 12). The davit and falls did not reveal anything else of significance.

Figures 12: Lifeboat forward and after hook suspension rings after the accident



4.1.2 Examination of the port lifeboat

The port lifeboat was inspected in Port Hedland after it had been recovered and transported to a facility ashore. The boat had sustained extensive damage, in particular to its canopy, which exhibited numerous cracks, pieces missing etc. and had been almost completely detached from the hull (Figure 13). The foredeck in way of the forward hook mechanism was completely missing. Inside, the lifeboat was filled with debris, buoyancy foam and equipment which had broken free when the lifeboat impacted the water (Figure 14).

Figure 13: Port lifeboat after recovery



Figure 14: Port lifeboat interior after recovery



The on-load release system was inspected in its 'as found' condition. The operating mechanism for the on-load release system was found to be in the fully reset position. The safety pin was in place and hydrostatic locking lever was in the locked position with the operating quadrants for both hooks locked in the reset position below it. The forward hook was found to be in a tripped condition with the clevis fitting between the operating cable and the operating lever and the housing covering the operating lever missing (Figure 14).

Figures 14: Forward hook, forward hook attached at keel block



The after hook assembly was found to be completely missing with the keel block and keel stay securing bolt still in place (Figure 15). The after deck was structurally intact with the damaged operating cable end still evident in its normal position leading through its opening in the deck (Figure 16). (The top locating plate for the hook mechanism is not in place in the photograph as it had been dislodged during the lifeboat recovery operation.)

Figure 15: Port lifeboat after hook keel attachment



Figure 16: After deck



4.1.3 After hook attempted recovery

The discovery that the after hook assembly was completely missing when the lifeboat was recovered raised several questions regarding its mode of failure. While the condition of the after hook's keel attachment and its operating cable were indicative of the sequence of events, the hook assembly would provide conclusive evidence regarding the cause of the accident if it could be recovered. As a result, an attempt to find and recover the hook assembly was undertaken.

The position of the ship, and the likely position where the port lifeboat had fallen into the water at the time of the accident, were ascertained using Port Hedland harbour control's vessel traffic system. The area where the ship was anchored is subject to significant tidal flows so dives were organised for times of slack water on the days of 12 and 13 October. Four dives were subsequently conducted in water depths of approximately 20 m in the position where the after hook assembly was likely to be. Unfortunately, the hook assembly could not be located during the dives despite the dive vessel being accurately positioned using harbour control's radar system. The sea bottom in the area of the dives was found to be sandy. It was concluded after consultation with the divers that it was likely that the heavy hook assembly had been buried by shifting sand in the five days between the accident and when the dives took place. Further attempts to recover the assembly were abandoned.

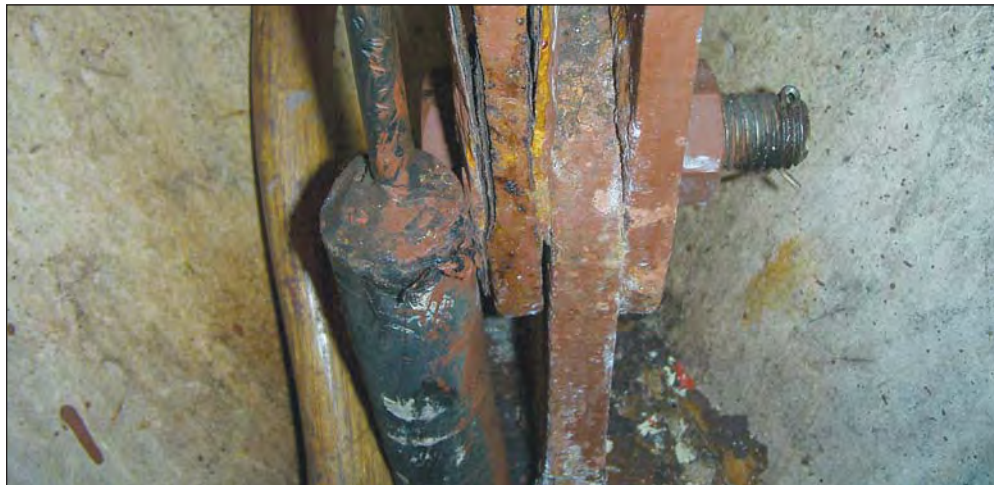
4.1.4 The starboard lifeboat

On 12 October, while *Lowlands Grace* was alongside, the starboard lifeboat was examined, in particular the connections between the on-load release hooks keel stays and their keel blocks in the forward and after compartments. Both forward and after hook assemblies exhibited a significant amount of exfoliating corrosion and wastage of their keel stays where they were attached to the keel blocks (Figures 17 and 18). The class surveyor inspecting the stays at the time estimated approximately 25 per cent wastage. It was also evident that the keel stays had been painted at some time in the past in an apparent attempt to inhibit the corrosion. Although both the forward and after compartments were dry when inspected, both sets of keel stays showed signs that moisture had been regularly running down the keel stays from the decks above.

Figure 17: Starboard lifeboat after hook keel attachment



Figure 18: Starboard lifeboat forward hook keel attachment



4.1.5 Examination of the port lifeboat on-load release system components

The forward hook assembly, operating cable ends and the operating mechanism were removed from *Lowlands Grace's* port lifeboat. In addition, the lifeboat's fall suspension rings were removed from their falls and all of these components were shipped to the ATSB's Canberra office for detailed inspection and analysis.

The operating mechanism was stripped and its components were subjected to a detailed inspection. None of the components showed any significant faults or marking. However an inspection of the forward hook operating cable (still connected to the operating mechanism) revealed the end of the cable was slightly buckled. The deformation made little difference to the operating length of the cable but indicated that the cable had probably been subjected to a large compressive force at some time.

The forward hook assembly was disassembled to enable inspection of the individual components. The cam release pin showed no signs of wear in its bush. The face of the cam release pin showed signs of pitting corrosion in line with the point of contact with the hook tail. The wear on the hook tail was within normal limits.

The inspection of the hook end of the operating cable revealed a significant bend (buckle) with a series of indentations on the inside radius of the bend (Figure 19). A bend in the top plate and witness marks in the keel stay slots in the mounting plate where the forward hook's keel stays passed through the foredeck was also noted (Figure 20).

Figure 19: Forward hook operating cable end



Figure 20: Top mounting plate



Figure 21: Forward suspension ring on hook



Examination of the forward suspension ring revealed a bend of approximately 10 degrees on its hook end and witness marks on the inside radius of the bend. When the suspension ring was re-attached to the hook and rotated through approximately 45 degrees (from its normal loaded position), the witness marks coincided with the position of the main pivot pin's head and nut (Figure 21). This indicated that the suspension ring had made hard contact with, (and been bent around), these parts of the main pivot pin.

Measurements indicated that first contact between the main pivot pin and the forward suspension ring would have occurred when the lifeboat's stern had fallen to be approximately 4.5 metres below the horizontal plane (a rotation of approximately 35 degrees about the fixed point of the forward hook).

Measurements were taken of the suspension ring and its point of contact with the main pivot pin. The ring had internal length (the effective length between points of loading) of 480 mm with the point of contact with the bolt, centred 410 mm from the top of the ring. This meant that the suspension ring had formed a lever, with the pivot pin acting as the fulcrum, effectively multiplying the component of the fall load acting at right angles to the suspension ring by a factor of 5.8. Thus the hook opening force due to the action of the suspension ring lever would have progressively increased as the lifeboat rotated past 35 degrees and probably reached a maximum when the lifeboat had rotated a further 90 degrees with respect to the forward fall (125 degrees in total). The significant deformation of the 26 mm section suspension ring is indicative of the amount of force to which the forward hook assembly was subject before it opened under load.

4.2 The probable sequence of failure

Based on various witness statements, physical evidence and inspections of the starboard lifeboat, it is considered that the following sequence of events led to *Lowlands Grace's* port lifeboat falling to the water on 7 October 2004:

- The port lifeboat's after hook's keel stays were wasted (corroded), around the point of attachment to the keel block, to the point where they had little remaining strength.
- During the drill, there was a momentary shock load on the lifeboat's hooks when the third mate halted the lowering process with the lifeboat approximately 2–3 m below the boat deck level (the boat was seen to 'jerk' at the time).
- The momentary increase in load was sufficient to cause the after hook's wasted keel stays to fail and separate from the keel block.
- As the after hook assembly pulled out of the boat, its operating cable came under tension thereby unlocking the hook mechanism and causing the hook to open.
- When the after hook failed, the lifeboat's stern still had some residual downward momentum. The stern of the boat fell with the boat swinging forward and at the same time rotating about the forward hook (still attached to its fall). At this time the boatswain saw the detached after hook assembly fall to the water below.

- When the lifeboat had rotated through approx 35°, with respect to the forward fall, the forward suspension ring made contact with the main pivot pin and from this point further rotation of the lifeboat progressively increased the opening force on the forward hook mechanism.
- As the lifeboat rotated, the load on the forward hook assembly acted increasingly in the horizontal plane (rather than the vertical plane). This component of the load was transmitted by the hook's keel stays to the mounting plates fitted to the fore deck. When the lifeboat had swung and rotated to be just past vertical it appears that the structural strength of the foredeck was insufficient to carry the maximum dynamic load of the swinging boat. The foredeck failed at this point, and was broken up as the forward hook mechanism was pulled towards bow of the boat, rotating about the point where the keel stays were attached to the keel block. This hypothesis is supported by the fitter's statement that he heard sounds like fibreglass breaking at the time.
- When the foredeck failed the screws attaching the mounting plates to the deck sheared and the lower plate either fell entirely or more likely became cocked (lower at the after end). The forward end of the top locating plate was then bent upwards as the hook assembly was pulled towards the bow of the boat. More critically, the section of the operating cable running through the 'mouse holes' in the mounting plates (now loose) was damaged. This section of cable was probably bent by the cocked lower mounting plate and/or the section of deck between the plates as the hook mechanism rotated forward. (This theory is supported by the damage to the cable as the inside 'radius' of the bend showed a succession of marks/indentations made by hard contact.) It is also likely that the bolts securing the cam release pin cover were sheared when the deck failed (which allowed the cover to fall away).
- When the operating cable was damaged (bent), the forward hook's cam release pin was rotated some way towards its tripping position.
- The lifeboat continued to swing forward and rotate (to approximately 220 degrees) with the forward hook being subjected to increasing opening loads by the suspension ring acting as a lever. At this point, the remaining stiffness in the forward hook's operating cable was insufficient to counteract the increased tripping force being transmitted from the now partly rotated cam release pin. The operating cable subsequently buckled further, which allowed the cam release pin to rotate until the hook opened.
- The lifeboat, now detached from both falls, then fell approximately 16 m to the water, inverted, striking the surface of the water in a slightly bow down attitude.

4.3 Failure of the after hook

Although the after hook assembly was not recovered after the accident, the intact condition of the keel block and keel stay securing bolt (including the nut and split pin), is clear evidence that the after hook's keel stays failed where they were connected to the keel block. The failure of the after hook's keel stays was the event which initiated the accident and the evidence strongly suggests that they failed as a result of wastage due to corrosion. The condition of the keel stays in the starboard

lifeboat was indicative that there was an ongoing problem with corrosion and wastage of the keel stays at the point of attachment (Figures 21 and 22). One of the keel stays on the forward hook of the port lifeboat, while in significantly better condition than the stays in the starboard lifeboat, also exhibited a significant amount of wastage due to corrosion. This was measured at approximately 4 mm in the area adjacent to the keel block bolt hole, which is 25 per cent of the total thickness of the 15 mm stay.

The corrosion found on the starboard lifeboat's keel stays was extensive and would have occurred over a relatively long period of time. Initially, the galvanising on the keel stays would have protected any adjacent areas of the underlying mild steel where the coating had been damaged or broken down (for example where the securing bolt passed through the stays). Eventually the zinc coating on the stays in the area of the keel block connection would have been completely consumed and from that point of time the corrosion would have progressed unchecked in the area. The corrosion would also have gradually worked its way up the keel stays as the galvanised coating was progressively consumed and this phenomenon was particularly evident on one keel stay of each of the starboard boat's hooks.

The paint applied to the keel stays at some time in the past was an unsuccessful attempt to slow the rate of corrosion. The port lifeboat's forward hook stays had not been painted, despite the fact that one was significantly wasted, which suggests the possibility that the after hook stays had not been painted either.

There was evidence that the keel stay compartments at the forward and after ends of both lifeboats were regularly damp and they all had a high level of particulate contamination in the area of the keel blocks. In addition, the markings on all of the hook stays indicated that rain, condensation and possibly sea spray had regularly run down the stays from the lifeboat decks above. The wet, salty, dirty and warm conditions inside the enclosed lifeboats were almost ideal for the on-going corrosion and wastage of the stays, which had apparently gone unnoticed during the boat's periodic maintenance.

4.3.1 On-load release system maintenance

For a reasonably long period of time before the accident on 7 October, the keel stays on *Lowlands Grace*'s port lifeboat's after hook (and indeed the keel stays on both hooks in the starboard lifeboat) would have been in a poor condition. The on-load release systems fitted to the lifeboats were part of the ship's planned maintenance program as required by SOLAS. The fact that the crews present or previous had not taken corrective action to address corrosion of the keel stays indicates that the ship's lifeboat maintenance regime was deficient. The accident involving the port lifeboat can be directly attributed to the lack of a simple, less-than-a-minute inspection of the after hook's keel attachment which is readily visible via the door in the after bulkhead inside the lifeboat.

In submission the ship's managers stated:

The fixing plates were not receiving any attention whatsoever be it from the lifeboat manufacturers, the classification society inspections, or the crew's inspections. This pattern of non-inspection can undoubtedly be traced to manufacturers and their failure to include any mention of the keel stay.

Please keep in mind:

- 1) These fixing plates are by design under the constant stress of the weight of the lifeboat and its equipment as it hangs from hook while secured to it davits.
- 2) The hook assembly is mainly comprised of moving parts which are located above deck while the keel stay is not a moving part located below deck.
- 3) The nature of the position of the fixing plates makes inspection easy to overlook.

Shipboard maintenance regime

Under the provisions of the International Maritime Organization's SOLAS convention and MSC Circular 1093, 'companies' (in *Lowlands Grace's* case, the ship manager) are responsible for the servicing and maintenance of lifeboats aboard their ships. The convention requires that each ship must carry adequate instructions for on-board maintenance which includes a checklist and a log for recording past maintenance. MSC Circular 1093, 'Guidelines for periodic servicing and maintenance of lifeboats, launching appliances and on-load release gear', was issued in June 2003 and stipulates that:

Weekly and monthly inspections, and routine maintenance as defined by the manufacturer, should be conducted under the direct supervision of a senior ship's officer in accordance with the instructions provided by the manufacturer.

It also lists a number of specific checks for on-load release systems. One of these checks is the condition of the 'hook fastening' ie. the keel connection.

Lowlands Grace's safety management system (SMS) included a record of lifeboat maintenance in the form of the ship's 'Lifeboat and Davit Weekly Inspection Record'. This document, (dated October 2003, revision 3), referred to the relevant provisions of SOLAS (Regulations III/20 and III/36) and also carried the advice:

Maintenance manual and associated documents issued by Manufacturer should be available on board for inspection.

The associated check-list for the inspection of the lifeboats, davits and on-load release system, however, included only two items that related to the on-load release system:

Quick release system & lifting hook assembly greased. Cable and control handle check for excessive play.

Lifeboat lowered and auto released and manoeuvred in the water for 15 minutes. Every three months.

The weekly inspection records indicated that the lifeboat had last been inspected on 29 September 2004 and had been lowered to the water and taken away on 29 July, about two and a half months prior to the accident. The comments in these records stated that the on-load release equipment was in 'good' condition.

While the evidence indicates that the current and previous crews had been performing regular inspections of the on-load release equipment as per the relevant checklist, the instructions in the checklist were inadequate. The two items on the

checklist did not adequately reflect the content of the manufacturer's maintenance instructions (42 separate weekly and monthly items) and the checklist did not stipulate that the manufacturer's instructions must be followed during routine maintenance. In addition, the checklist did not include the content of the MSC Circular 1093, the current IMO guidelines, with respect to inspecting the keel connection.

Manufacturer's maintenance instructions

Lowlands Grace carried a manual titled 'Instructions for On-board Maintenance of Life-saving Devices' which set out the manufacturer's requirements for the operation and maintenance of the lifeboats and their on-load release systems. The manual was dated December 1990 and as such pre-dated MSC Circular 1093 (2003) and its predecessor MSC Circular 614 (1993). The manual divided the maintenance into three sections; weekly, monthly and annual. Weekly maintenance instructions comprised 13 separate points including a visual inspection of the operating mechanism, operating cables and hook assemblies, ensuring that the system was correctly reset, sufficiently lubricated, clean and free from corrosion. Point 7.2.3 of the manufacturer's weekly instruction stated:

Check for any sign of corrosion that may need corrective action.

Monthly maintenance consisted of 29 points including the cleaning, lubrication and adjustment of the operating cables as required, in addition to an operational test. Point 7.3.14 of the manufacturer's monthly instructions stated inter alia:

Clean off and lubricate all parts which require it. ie. Any signs of corrosion, dirt, foreign bodies and/or heavy salt deposits.

While the manufacturer's maintenance instructions which were on board the ship at the time¹, did not specifically state that the keel connection should be inspected, a reasonably thorough inspection of the system with points 7.2.3 and 7.3.14 in mind would have detected the poor condition of the keel stays where they were connected to the keel block on the port lifeboat's after hook.

The manufacturer's weekly instructions also included a check of the operating cables and their clamps which are located on the keel stays below the forward and after decks. To complete this check the inspection doors in the bulkheads at each end of the lifeboat must be opened.

The ship's management company contended that the location of the keel connection in the enclosed space at the aft end of the lifeboat was a factor in the crew's failure to detect its poor condition. While this may have been the case, if the crew had been inspecting the operating cables and clamps as stipulated in the manufacturer's maintenance instructions, it is likely that the condition of the keel connection would have been detected and rectified.

4.3.2 Periodic survey and testing of the on-load release system

In addition to periodic maintenance performed by the crew, *Lowlands Grace's* lifeboats were subject to periodic survey and testing by the ship's classification society in accordance with the provisions of SOLAS and the International Maritime

¹ The manufacturer's instructions for Titan hooks now contain a specific requirement to inspect the 'hook foundations' annually.

Organization's Life Saving Appliances Code. The ship must pass these surveys in order to maintain the validity of its Cargo Ship Safety Equipment Certificate. The survey regime applied to the lifeboat on-load release systems, includes the annual survey of the lifeboat and an operational load test and full service every five years. The test load used is 110 per cent of the loaded capacity of the lifeboat.

With respect to the five year survey requirement, *Lowlands Grace's* lifeboat on-load release systems had last been overhauled and tested in May 2003. This was prior to the release of MSC Circular 1093 which now stipulates that maintenance other than weekly and monthly 'should be conducted by the manufacturer's representative or a person appropriately trained or certified by the manufacturer for the work to be done.' The overhaul took place about 17 months before the accident and was probably the time when the keel stays in the starboard boat had been painted to inhibit the corrosion. Painting of the keel stays is not recommended by the on-load release system manufacturer. Had the work been done by personnel appropriately trained by the manufacturer the significance of the corrosion problem would probably have been recognised and rectified. In any event, the lifeboat's maintenance regime should have been modified to include careful monitoring of the condition of the keel stays, a reasonable maintenance precaution for a known problem.

Lowlands Grace underwent an annual equipment survey on 7 April 2004. During this survey a surveyor from the classification society inspected the ship's lifeboats and found them to be satisfactory. An extract from the Bureau Veritas survey report states the following:

Examination of the lifting hooks, keel attachment, etc. and, where fitted, the on-load release and hydrostatic lock.

This indicates that the area of the on-load release system's keel attachments should have been specifically targeted during the survey. For the after hook of the port lifeboat to have failed at the keel connection a mere six months later, this survey must have been deficient.

In submission, Bureau Veritas, stated:

It is confirmed that Bureau Veritas, on behalf of the Hong Kong Register carried out the annual survey of the life saving equipment on 7 April 2004, in Singapore and that an overload test of the portside life boat launching equipment was performed under Bureau Veritas attendance, in Manila, and a certificate of test issued on 8 May 2003.

It is understood that the portside lifeboat had been launched in July 2004 as part of the regular drills.

The reports contain no remarks regarding the signs of corrosion at the lower part of the hook assemblies, neither declaration of the personnel of the ship regarding same.

Classification is a private contract based on declaration of the client regarding problems which may affect class.

When classification societies act by delegation of the flag state, in the scope of international conventions as the SOLAS convention, the requirements of the conventions apply.

Lifesaving equipment requirements pertain to the SOLAS convention and are outside the class scope.

Under the SOLAS convention it is incumbent on the ship owner to maintain the condition of the ship between surveys, and of course to declare any change, damage and repair which may have occurred between surveys.

The Bureau Veritas reports contains pre printed format such as mentioned... (above) ...of the draft ATSB report.

“Examination of the lifting hooks, keel attachment, etc. and, where fitted, the on load release and hydrostatic lock.”

This wording is an overview of the items which are surveyable, or on which declarations are expected to be received during the survey.

All surveys are carried out on the basis of random checks within the prescribed scope.

Neither classification, nor the flag state, nor port state control can substitute the ship owner in ensuring that any equipment is in a safe operating condition at all times.

The extent of wastage and corrosion to the hook stays indicates that they were deteriorating over a relatively long period. None of the surveys carried out on the vessel in the two years preceding the accident on 7 October 2004 identified the extent of the problem.

The ongoing class survey regime on board ships is in place to ensure, among other things, compliance with statutory safety requirements. In the case of lifeboats and other lifesaving equipment, the statutory requirement is that it must be in working order and ready for immediate use before the ship leaves port and at all times throughout a voyage. While the first responsibility for the maintenance of such equipment lies with the ship owner (or their management company), surveys conducted by classification societies on behalf of Flag authorities should identify and ensure rectification of faults that may have been overlooked by the ship's maintenance system. In the case of *Lowlands Grace*, the failure of the past surveys to identify the long term corrosion problem with the on-load release system keel stays was directly causal in the accident.

4.4 Subsequent failure of the forward hook

When the after hook failed on the port lifeboat, all of the weight of the swinging lifeboat was transferred to the forward fall and hook. The forward hook subsequently opened, releasing the lifeboat from height, which resulted in the deaths of two of the crew, injury to the other three and severe damage to the boat. Had the lifeboat remained suspended from the forward fall, it is less likely that there would have been significant injuries to the crew or as much damage to the lifeboat.

There have been many incidents involving single hook failures which have not resulted in significant crew injury or severe damage to the lifeboat. Two recent examples of such incidents investigated by the ATSB are *Alianthos* (report 164) and *Ma Cho* (report 188). While the failure of one hook is uncommon, it is reasonably

foreseeable given past incidents. As a consequence, the design safety margin should be sufficient to ensure that one hook can take the whole weight of the lifeboat in such an emergency.

The SOLAS Convention in force at the time that *Lowlands Grace*'s lifeboat on-load release systems were manufactured (SOLAS 1986, Chapter III Regulation 41 7.6.4) required that:

The mechanism shall be designed with a factor of safety factor of 6 based on the ultimate strength of the materials used, assuming the mass of the lifeboat is equally distributed between the falls.

To meet this requirement, classification societies test prototypes of on-load release hooks with a static load six times the safe working load of the hook for a minimum period of five minutes (in addition to other types of load testing). Thus, each hook fitted to *Lowlands Grace*'s lifeboats had been designed to carry a static load of at least 30 tonnes. On the day of the accident the total weight of the lifeboat and crew was approximately 3.64 tonnes, only about 12 per cent of the theoretical static design strength of the forward hook.

After the failure of the after hook, the dynamic load on the forward hook would have reached a maximum when the lifeboat's swinging velocity was at a maximum. This would probably have occurred when the boat had rotated and swung forward to bring its fore and aft line in line with the forward fall (a rotation of around 120–130 degrees). The dynamic load at this point would have been more than three times the static load. This dynamic force which was acting to open the forward hook, would have been multiplied by the lever action of the suspension ring, so the instantaneous load at the time may have been more than 50 tonnes.

As the lifeboat continued to swing upward, it would have been slowing and the dynamic load would have been decreasing. The suspension ring lever effect would have reached a maximum when the lifeboat had rotated to approximately 155–165 degrees (with the suspension ring at 90 degrees to the applied load from the fall). From this point, as the lifeboat rotated further, the dynamic load acting to open the forward hook would have decreased.

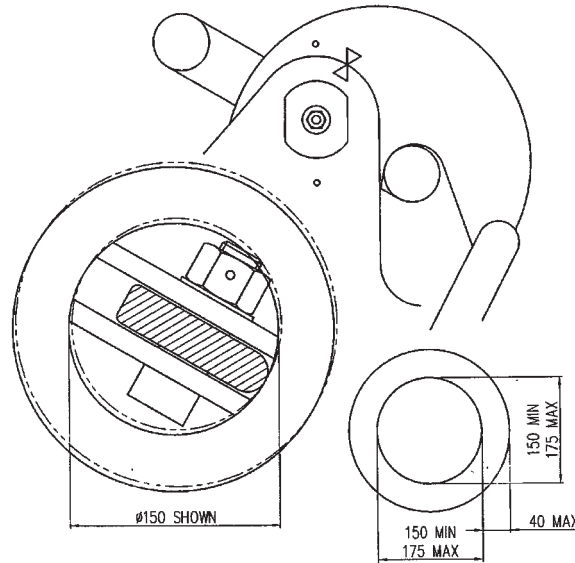
Witnesses stated that the lifeboat had rotated to an angle of between 200 and 220 degrees before the forward hook opened and released the forward fall. This does not correspond with the time when the dynamic load on the hook would have reached a maximum, ie. between 120 and 165 degrees. This would indicate that neither the maximum dynamic load due to the lifeboat's swing nor the multiplying effect of the suspension ring lever alone caused the hook to open. The failure of the foredeck, when the lifeboat was vertical or near vertical, led to the end of the operating cable for the forward hook being bent. It was only this event, in combination with the hook load, which led to the forward hook opening.

4.4.1 The suspension ring

Lowlands Grace's lifeboat falls were fitted with suspension rings which were of an elongated oval shape. The ring had internal length of 480 mm, and an internal width of 65 mm. The shape of the ring meant that it formed a lever, with the hook's pivot pin acting as the fulcrum, which effectively multiplied opening force applied to the forward hook at the time of the incident. This increase in load was at least partially responsible for the failure of the forward hook.

The suspension ring specified by the on-load release manufacturer for 5 tonne Titan on-load release systems is a circular ring with a minimum internal diameter of 150 mm and a maximum internal diameter of 175 mm. This ring is sized to ensure that in circumstances similar to those which occurred on *Lowlands Grace* the suspension ring will clear the main pivot pin and thus not form a lever to increase opening forces on the hook (Figure 22). Had *Lowlands Grace*'s lifeboat davits been fitted with the suspension rings stipulated by the on-load release manufacturer, there would have been significantly less opening force applied to the forward hook and it may not have failed and opened under load.

Figure 22: Lifeboat manufacturer's recommended suspension ring



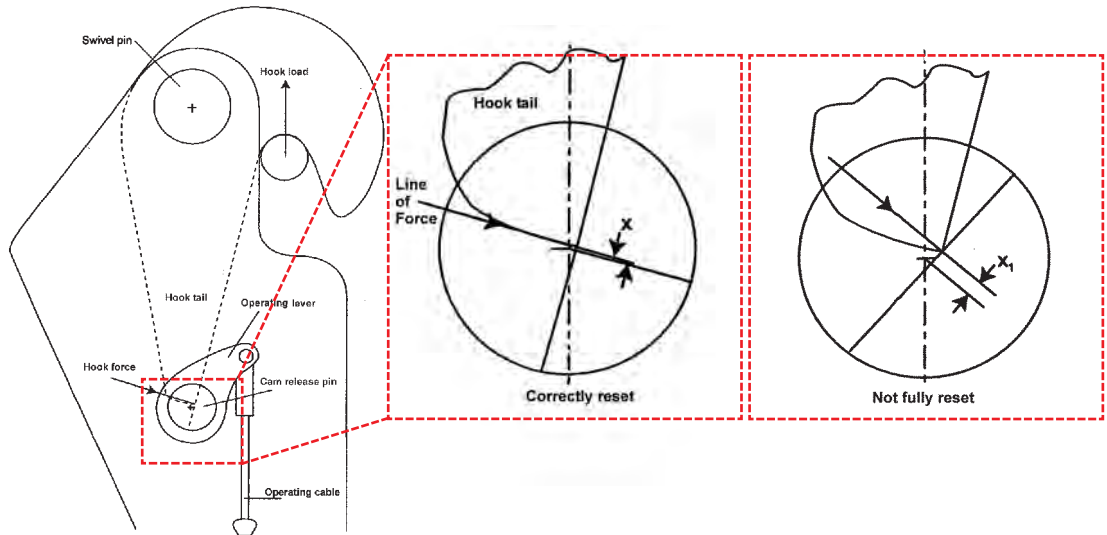
5 – Tonne 'Titan' gear recommended ring size shown in detail.
Minimum ring size, showing clearance over hook pivot pivot pin

4.4.2 On-load release design

Lowlands Grace's hook locking system uses the cam release pin to lock the tail of the hook. In this type of system any hook load results in a turning moment on the cam release pin which transmits a force via the operating lever and cables to the operating mechanism. This means that the operating system is always 'loaded' when the hooks are taking weight. While the magnitude of the turning moment is very small when the cam release pin is properly reset (bearing fully on the tail of the hook), a slight rotation of the pin results in a much larger turning moment and corresponding force which is transmitted to the operating system. Figure 23 shows the effect when the cam release pin is slightly rotated, ie. when X increases to X_1 . In this case, for any given hook load, the magnitude of the turning moment on the cam release pin increases dramatically.

When the operating cable for the forward hook on *Lowlands Grace*'s port lifeboat was bent at the time the foredeck failed, the cam release pin holding the hook closed was slightly rotated to the effect that X increased to X_1 . This dramatically increased the turning moment on the cam release pin. The remaining stiffness in the operating cable (as the operating system at the other end of the cable remained locked) was insufficient to carry the additional force being transmitted from the heavily loaded hook. The cam release pin rotated further and allowed the hook to open.

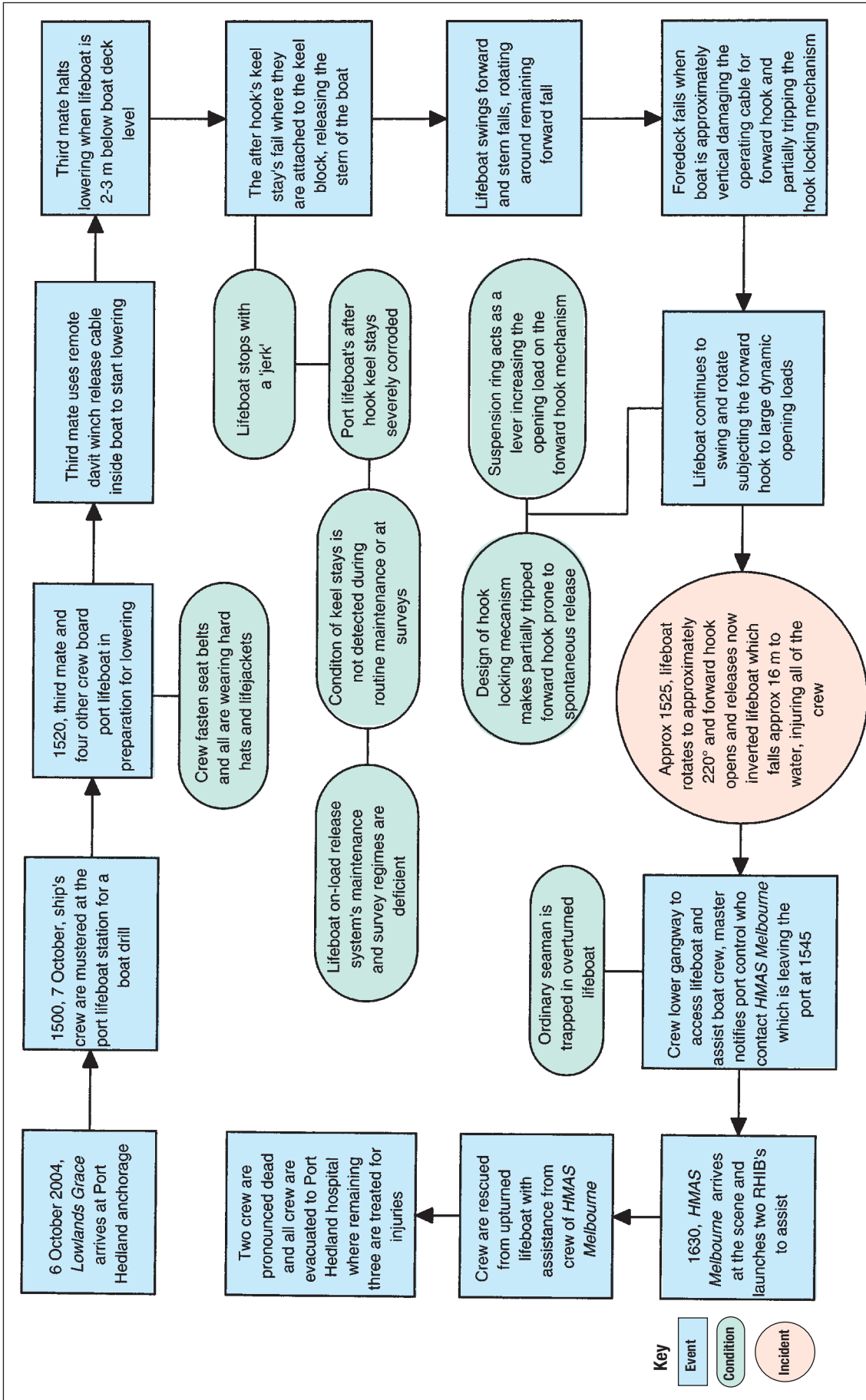
Figure 23: Hook locking mechanism with detail of cam release pin and hook tail contact



The way in which the hook is locked by the cam release pin makes this type of system particularly prone to spontaneous release when not fully reset and/or when parts of the mechanism are worn. For these reasons this type of system has been implicated in a number of other lifeboat accidents and thus there is a compelling need to make the system as fail safe as possible throughout its service life. While good maintenance practices and correct operation by competent crew mitigate these risks, it is almost certain that during their service life many of these systems will not be operated or maintained in the fashion that the manufacturer stipulates.

While the *Lowlands Grace* incident is somewhat different due to the failure of the foredeck, the design issue vis-a-vis the cam release pin is still implicated. While the possibility that other designs of on-load release systems would also have failed in the circumstances cannot be ruled out, had *Lowlands Grace*'s port lifeboat been fitted with a system utilising a more positive method of locking the hooks, it is possible that the severe consequences of the accident could have been avoided.

Figure 24: Lowlands Grace's Events and causal factor chart



5 CONCLUSIONS

These conclusions identify the different factors that contributed to the accident 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 lifeboat accident aboard *Lowlands Grace* at Port Hedland on 7 October 2004:

- The port lifeboat's after hook's keel stays were wasted (corroded), around the point of attachment to the keel block, to the point where they had little remaining strength.
- While the lifeboat was being lowered a momentary shock load, when the third mate halted the lowering, caused the after hook's wasted keel stays to fail and separate from the keel block. The stern of the lifeboat then dropped, with the boat swinging forward and rotating about the fixed point of the forward fall.
- When the lifeboat was vertical, or close to it, the foredeck failed, and in the process the end of the operating cable for the forward hook was damaged (bent) which led to the hook's cam release pin being rotated some way towards its tripping position.
- The lifeboat rotated to approximately 220 degrees with the forward hook being subjected to very high opening forces which rotated the cam release pin until the hook opened.
- The lifeboat, now detached from both falls, then fell approximately 16 m to the water, still inverted, to strike slightly bow down.
- The corrosion and wastage of the port lifeboat's after hook's keel stays occurred over a relatively long period of time due to its conditions of service.
- The ship's planned maintenance procedures with respect to the on-load release systems fitted to the lifeboats were deficient as the condition of the wasted keel stays had not been detected and rectified.
- The lifeboat's survey regime was deficient with respect to the on-load release systems fitted to the lifeboats as the condition of the wasted keel stays had not been detected and rectified.
- The suspension rings fitted to the lifeboat davit falls were incorrectly sized and subjected the forward hook to greatly increased opening forces while the lifeboat was swinging.
- The design of the on-load release system is also implicated in the failure of the forward hook as the system of locking the hook became particularly prone to spontaneous release when the operating cable was damaged.

6 RECOMMENDATIONS

MR20060004

It is recommended that ship owners, managers, statutory authorities and classification societies ensure that the keel attachments for hooks on lifeboats in service are inspected without delay to ensure that they are structurally sound.

MR20060005

It is recommended that ship managers, ship's crews, ISM accreditation authorities and classification societies ensure that lifeboat maintenance and survey regimes include thorough ongoing monitoring of the condition of keel connection arrangements for lifeboat hooks.

MR20060006

It is recommended that Umoe Schat-Harding (Mills Marine), UK, review the design of their Titan on-load release system in light of the *Lowlands Grace* accident and other incidents involving on-load release systems of similar design.

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 Hong Kong Marine Department, the Australian Maritime Safety Authority, Tai Chong Cheang Steamship Company, Bureau Veritas, Umoe Schat-Harding (Mills Marine), Laurent Giles Naval Architects and *Lowlands Grace's* master, mate, third mate, fitter and able seaman.

Submissions were received from the Hong Kong Marine Department, Tai Chong Cheang Steamship Company, Bureau Veritas and Umoe Schat-Harding. The text of the submissions was included and/or the text of the report was amended where appropriate.

8 *LOWLANDS GRACE*

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| IMO number | 8911499 |
| Call sign | VRWL8 |
| Flag | Hong Kong |
| Port of Registry | Hong Kong |
| Classification society | Bureau Veritas (BV) |
| Ship type | Bulk carrier |
| Builder | China Shipbuilding Corporation, Taiwan |
| Year built | 1990 |
| Owners | Atlas Marine Transport Company |
| Ship managers | Tai Chong Cheang Steamship Company (Singapore) |
| Gross tonnage | 77 273 |
| Net tonnage | 47 299 |
| Deadweight (summer) | 149 518 tonnes |
| Summer draught | 17.325 m |
| Length overall | 270.076 m |
| Length between perpendiculars | 260.033 m |
| Moulded breadth | 42.995 m |
| Moulded depth | 23.900 m |
| Engines | 1 x MAN-B & W 5L 80MCE |
| Total power | 12 430 kW |
| Crew | 25 Pilipino and Chinese |



Australian Government
Australian Transport Safety Bureau

Media Release

Unchecked corrosion responsible for lifeboat fatalities

The ATSB has found that severe corrosion over a long period led to two deaths when a lifeboat fell 16 metres during a safety drill. The two crew died and three were seriously injured in a lifeboat accident on board the Hong Kong registered *Lowlands Grace* while the ship was anchored off Port Hedland, Western Australia, on 7 October 2004.

The five casualties were members of the crew who had boarded one of the ship's lifeboats during a planned lifeboat drill. While it was being lowered, the lifeboat's after on-load release hook failed and released the stern of the 3.5 tonne boat from its davit fall. The boat's stern then dropped and the lifeboat became inverted before the forward hook also failed. The lifeboat then fell, upside down, into the sea approximately 16 metres below.

All of the crew inside the boat were injured by the fall with one of the deceased being trapped inside the upturned lifeboat. The injured crew were assisted by the crew of *HMAS Melbourne* which was departing Port Hedland when the accident occurred and was quickly on the scene.

The report concludes that the lifeboat's after hook's keel stays were severely corroded where they were attached to the keel and they failed during the lowering process when there was a momentary shock load. The forward on-load release hook opened after the boat's foredeck failed under the load of the swinging lifeboat which led to the hook's locking mechanism being partially tripped.

The report also concludes that the ship's maintenance and survey regime with respect to the on-load release systems fitted to the lifeboats was deficient as the condition of the wasted keel stays had not been detected and rectified. The design of the on-load release system was also implicated in the failure of the forward hook as the system of locking the hook became particularly prone to spontaneous release when the foredeck failed.

The report contains recommendations to ship owners, managers, crews, statutory and ISM accreditation authorities and classification societies with respect to lifeboat hook inspection and maintenance regimes. A recommendation is also made to the on-load release system manufacturer in regard to the design of the system fitted to *Lowlands Grace's* lifeboats.

Copies of the report can be downloaded from the ATSB's 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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