



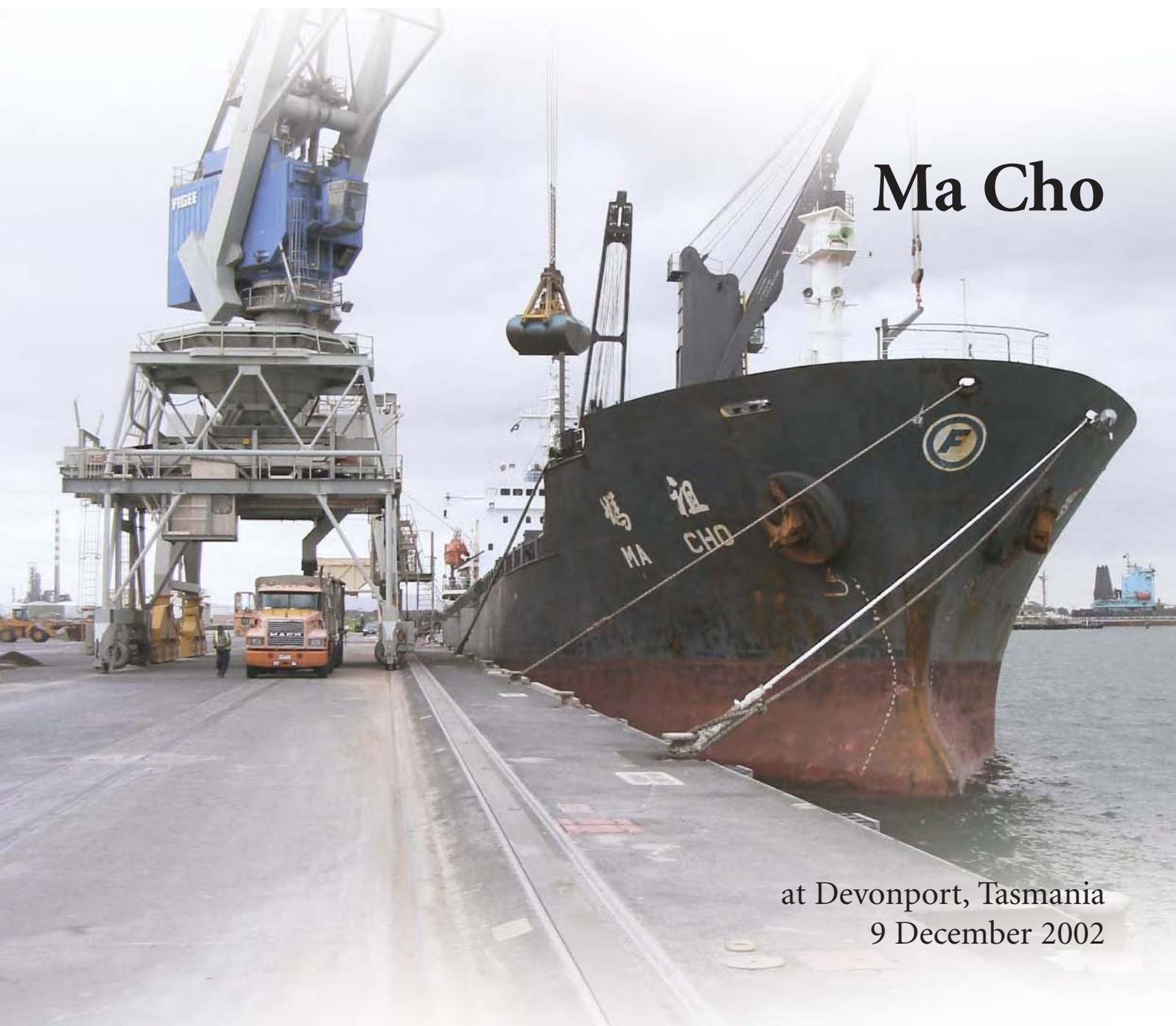
Australian Government
Australian Transport Safety Bureau

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MARINE SAFETY INVESTIGATION
No. 188

Independent investigation into the lifeboat incident
on board the Hong Kong flag bulk carrier

Ma Cho



at Devonport, Tasmania
9 December 2002



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ISBN 1 877071 60 9

June 2004

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1 SUMMARY

On 8 December 2002, *Ma Cho* arrived in Devonport, Tasmania, to discharge a part cargo of fertiliser at number four berth on the western side of the river.

On 9 December, the master made the decision to conduct an abandon ship drill before the vessel was due to depart for Geelong. The drill commenced at about 1540 and the starboard lifeboat was prepared for lowering to the water.

At approximately 1548 the mate reported that the crew inside the lifeboat were seated and had fastened their safety belts. Lowering of the boat then commenced with one of the crew operating the davit winch brake from the deck. When the boat had been lowered approximately two metres from the davit head the after on-load release hook suddenly opened, releasing the after fall. The lifeboat's stern fell to leave the boat suspended vertically by the remaining forward fall with its stern swinging approximately five metres above the water. The boat crew were shaken by the incident but remained secured in their seats inside the now vertical lifeboat. The second mate had sustained a small cut over his left eye.

After the crew had disembarked, the lifeboat was lowered to the water to allow the on-load release system to be inspected. It was found that the cable operating the after hook was not properly secured by the saddle clamp under the operating unit. Each time the actuating handle was operated, lost motion was induced by the cable sliding through the clamp and this meant that the after hook was not resetting fully. The cable clamp was temporary repaired and then the lifeboat was housed in its davit. *Ma Cho* was subsequently cleared to complete the voyage to Geelong.

The report conclusions include:

- The cable clamp securing the aft hook's operating cable adjacent to the operating mechanism had been modified which resulted in lost motion within the cable.
- As a result of the lost motion in its operating cable, the after hook had not been fully reset when the previous lifeboat drill was conducted on 2 November 2002.
- The design of the on-load release system was flawed with respect to the hook locking mechanism.
- The ship's safety management system was deficient with respect to both the operating and maintenance instructions and to crew training on the on-load release system.

The report makes a general recommendation to ISM Code accreditation authorities regarding ship safety management systems as they relate to on-load release systems. The report also recommends that the lifeboat manufacturer and classification societies review the design of the on-load release system.

2 SOURCES OF INFORMATION

The master and crew of *Ma Cho*

Qingdao Beihai Shipyard

Australian Maritime Safety Authority

References

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

The International Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management (ISM) Code) as adopted by IMO resolution A.741(18).

Guidelines on implementation of the International Safety Management (ISM Code) by Administrations as adopted by IMO resolution A.788(19).

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

Ma Cho

Ma Cho is a Hong Kong flag bulk carrier of 16 873 deadweight tonnes at its summer draught of 8.814 m (figure 1). The vessel is owned by Ebbtide Navigation of Gibraltar and managed by Fenwick Shipping Services in Hong Kong. It is classed +100 A1, Bulk Carrier, Strengthened for Heavy Cargos, +LMC, with Lloyds Register of shipping.

Ma Cho was built in 1996 at the Xingang Shipyard, Tianjin, in China. The ship has an overall length of 143.45 m, a moulded breadth of 22.00 m and a moulded depth of 12.20 m. Propulsive power is provided by a 6-cylinder MAN B&W 6L35MC, single acting, direct reversing 2-stroke diesel engine of 3 882 kW. The main engine drives a single fixed-pitch propeller, which gives the ship a service speed of 13.5 knots.

The ship is of standard geared bulk carrier design with four cargo holds located forward of the accommodation superstructure. Two pedestal cranes, located on the main deck, each serve two holds.

At the time of the incident, *Ma Cho* had a crew of 27, comprising a master and three mates, chief and five engineers including two electricians, boatswain and six deck ratings, four engine room ratings, two cadets, two catering staff and two supernumeraries. The majority of the crew were Chinese nationals with the exception of the master, mate and supernumeraries who were Bangladeshi. Thirteen of the crew, including the second and third mates, had served on the vessel for the previous eleven months with the remainder having joined between two and seven months earlier.

At the time of the incident, the master of *Ma Cho* held a foreign-going master's certificate of competency and had 20 years experience at sea, the last five in command. He had been master on *Ma Cho* for the previous five months. The mate held a chief officer's certificate, had been at sea for 10 years and, like the master, had joined the vessel five months previously.

FIGURE 1:
Ma Cho



Lifeboats

Ma Cho is equipped with two 30-man totally enclosed lifeboats. The lifeboats are both type BH-6A constructed by Qingdao Beihai Shipyard in China. Each lifeboat is stowed in a gravity davit on the port and starboard sides of the first deck of accommodation above the main deck. The starboard lifeboat is the designated rescue boat.

The lifeboats are constructed of fibre reinforced plastic and each boat is 6.5 m in length, has a breadth of 2.3 m and a depth of 1.2 m. The unladen weight of each boat is 2 850 kg with a fully laden design weight of 5 200 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 boat's controls are accessible from this position, including the davit winch brake remote release cable and the on-load release operating lever which is located on the console in front of the coxswain. Seating for the rest of the crew is provided around the periphery of the boat. There is a hatch located above the coxswain's seat and additional hatches at the forward and after ends of the cabin to allow the crew access to the on-load release hooks. Normal embarkation is via the stern hatch.

Propulsive power is provided by a SABB L3.139B, 4-stroke diesel engine, which gives each boat a fully laden speed in excess of 6 knots.

The on-load release system

Both of *Ma Cho*'s lifeboats are fitted with a BG-3 on-load fall release system manufactured by the lifeboat builder. The BG-3 system 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.

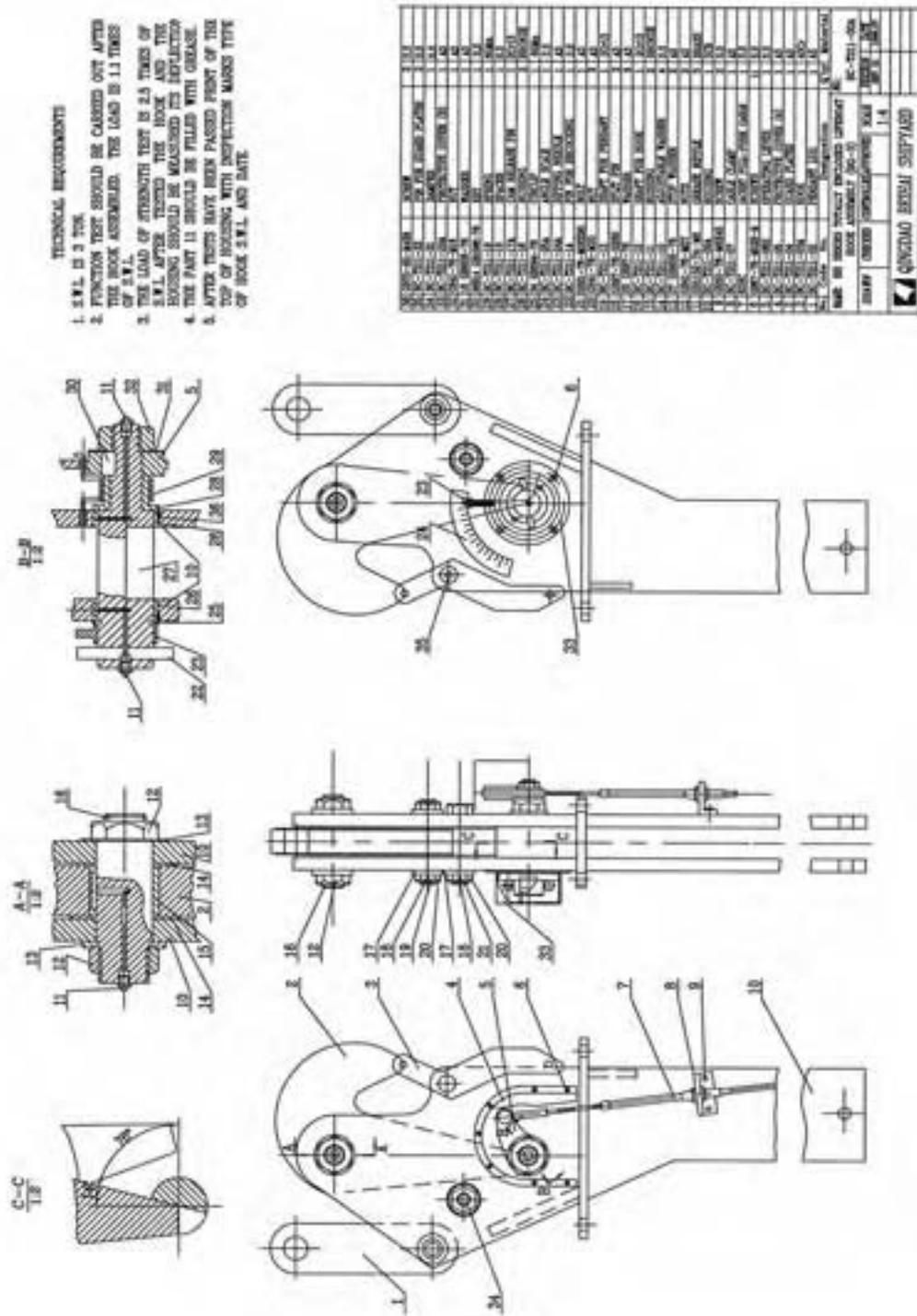
The main components of the BG-3 on-load release system are

- the operating mechanism located on the coxswain's console
- the forward and after hooks and their associated locking mechanisms
- the hydrostatic interlock unit
- the flexible operating cables which connect the operating mechanism to the two hooks.

The operating mechanism is shown in figure 2. The normal hook release procedure when the boat is waterborne (and the hydrostatic interlock is disengaged) involves removing a locking pin from the actuating lever and moving the lever to the release position. The movement of the actuating lever turns a gear wheel, which in turn drives a larger geared quadrant. Flexible operating cables attached to the geared quadrant transmit simultaneous tripping motion to the forward and aft hook locking mechanisms (figure 3).

Each hook is held closed by a cam release pin, which bears on the tail of the hook. 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.

FIGURE 3:
Hook mechanism



The teleflex 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. Lubrication for the sliding inner cable and rods is applied when the cables are manufactured and no further lubrication should be required.

The teleflex cables are fixed at each end adjacent to the operating and hook mechanisms. The securing arrangement adjacent to the operating mechanism consists of a saddle clamp fitted over the metal ferrule at the end of the outer sheath of the cable and secured by two bolts (figure 4a). Adjacent to the hook, the steel ferrule on the outer sheath of each cable is threaded and this section is secured by locking nuts in a metal bracket fixed to the keel stay (figure 4b).

Figure 4.
Operating cable clamps



a. Operating mechanism end



b. Hook mechanism end

The incident

On 8 December 2002, *Ma Cho* arrived in Devonport, Tasmania, to discharge a part cargo of fertiliser at number four berth on the western side of the river.

On 9 December, the master made the decision to conduct an abandon ship drill before the vessel was due to depart for Geelong. The company technical manager had requested the lifeboat release equipment be tested on-load. The drill commenced at about 1540 and the starboard lifeboat was prepared for lowering to the water.

Prior to the crew boarding, the master ordered the starboard lifeboat to be lowered about three metres from the davit head and then to be hoisted back to the stowed position as a safety precaution. This operation was performed without any apparent problem and the master noted, at that time, that indicators on each on-load release hook appeared to be in the fully reset position. Six members of the crew boarded the lifeboat under the command of the mate.

At approximately 1548 the mate reported that the crew inside the lifeboat were seated and had fastened their safety belts. Lowering of the boat then commenced with one

of the crew operating the davit winch brake from the deck. When the boat had been lowered approximately two metres from the davit head, the after on-load release hook suddenly opened, releasing the after fall. The lifeboat's stern fell to leave the boat suspended vertically by the remaining, forward, fall its stern swinging approximately five metres above the water. The forward fall and hook continued to hold the weight of the lifeboat although the heavy steel fall suspension ring had been bent during the boat's fall. The crew inside the boat were shaken by the incident but remained secured in their seats inside the now vertical lifeboat. The second mate had sustained a small cut over his left eye.

After checking on the condition of the crew inside the boat, the master contacted Devonport harbour authority to inform them of the situation. He was told that the pilot boat was busy and would take 20 minutes, or so, to reach the ship. The master decided not to wait for the pilot boat and instructed the crew to rig a ladder from the handrails adjacent to the lifeboat's upper hatch. When the ladder had been satisfactorily rigged, the crew exited the vertically suspended lifeboat, one at a time, until they were all safely back on the deck of the ship (figure 5).

During this time a marine surveyor from the Australian Maritime Safety Authority happened to be passing the ship on his way home from work. He saw the vertical lifeboat and decided to investigate, arriving on board while the crew were still climbing out of the lifeboat.

After the crew had disembarked, a chain block was rigged to raise the stern of the lifeboat so that it could be lowered to the water. By about 1800, the lifeboat was in the water and the crew boarded the boat again to inspect it and determine the cause of the incident. After several attempts to reset it, the crew found that the after on-load release hook was not resetting fully. Close inspection of the on-load release system revealed that the cable operating the after hook was not properly secured by the saddle clamp under the operating unit. Each time the actuating handle was operated, lost motion was induced by the cable sliding through the clamp. The second engineer then repaired the clamp by placing some brass shim material, as packing, between the saddle of the clamp and the metal ferrule on the operating cable to increase the clamping pressure (figure 4a). The system was then successfully reset and operated again several more times. The davit falls were then reattached and the security of the hooks was tested by raising and lowering the lifeboat several times.

By 1930 the starboard lifeboat had been raised to the davit head and stowed. There was some difficulty fitting the after harbour pin as the forward fall suspension ring had been distorted when the lifeboat's stern fell and the weight of the boat was suddenly transferred to the forward fall. The damage to the suspension ring meant that the forward end of the boat was slightly higher than the after end when the boat was at the top of the davit.

Ma Cho finally departed Devonport and sailed for Geelong on the morning of 10 December. The AMSA surveyor had inspected both of the ship's lifeboats prior to departure and issued a deficiency notice stipulating that the classification society was to inspect the starboard lifeboat while the ship was in Geelong.

FIGURE 5:
***Ma Cho's* starboard lifeboat after the incident**



4 COMMENT AND ANALYSIS

A marine investigator from the Australian Transport Safety Bureau boarded *Ma Cho* at Geelong on the morning of 11 December to conduct an investigation of the incident. The master, mate, chief engineer and second engineer were interviewed and provided accounts of the incident. Copies of relevant ship's documents were obtained, including records of past drills, lifeboat instruction manuals, lifeboat maintenance instructions and maintenance records. In addition the lifeboat manufacturer provided design drawings, type approval and test certificates for the on-load release system.

An on-load test of the port lifeboat was conducted in the presence of surveyors from the Australian Maritime Safety Authority and Lloyd's Register.

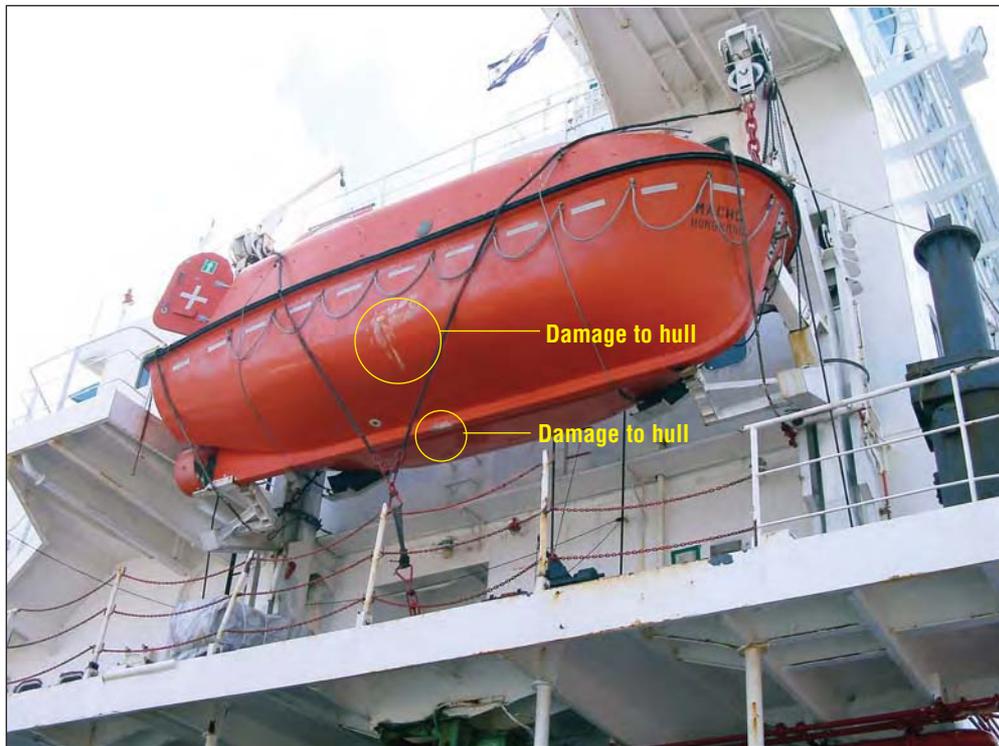
The primary aim of the investigation was to establish the sequence of events with a view to determining how the after fall became detached from the lifeboat and the factors that may have contributed to the incident. Although there was no loss of life or serious injury, the incident was significant as there have been a number of failures involving lifeboat on-load release systems in recent years. Such incidents investigated by the ATSB; *Alianthos* (report number 164), *Washington Trader* (report number 160), *Waddens* (report number 145). Other marine investigation agencies including the Transportation Safety Board (TSB) of Canada, the Transport Accident Investigation Commission (TAIC) of New Zealand and the Marine Accident Investigation Branch (MAIB) of the United Kingdom have also investigated accidents involving on-load release systems in recent years.

Damage

The damage to *Ma Cho*'s starboard lifeboat was minor and consisted of:

- some scratches on the starboard side of the hull (figure 7)
- a small area of damage on the keel (figure 7)
- some damage to the port side of the stern boarding platform
- some cracking in the fibreglass at the join between the hull and canopy around the forward hook keel stay bar
- distortion of the forward fall suspension ring.

FIGURE 6:
Damage to starboard lifeboat



Examination of the on-load release system

An examination of the starboard lifeboat and its on-load release system was conducted to establish how the after fall became detached from its hook when the boat was being lowered. The lifeboat was inspected while it was suspended by the falls in the davit cradles.

The hook units were inspected initially to ascertain the state of the system. Both hooks were found to be indicating fully reset. Inspection of the locking cams (visible between the side plates of the hook unit) confirmed that the indicators were correct. The metal covers on both sides of both hook units were removed to allow the cam release pin drives and indicator drives to be inspected. All of the main components of both hook units were found to be fully operable. There was no evidence to suggest that the incident was the result of a failure of any component in the aft hook unit mechanism.

The operating mechanism was found to be in the secured position with the safety pin fitted to the actuating lever. The repair made by the second engineer to the aft hook operating cable clamp was noted. Apart from the cable clamp there were no other problems evident with the operating mechanism.

In general the on-load release system showed surface corrosion and flaking paint on all external components. The cover for the hydrostatic interlock emergency bypass button, on top of the operating unit, was also missing. Given the age of the vessel (approximately six years) the condition of the lifeboat's on-load release equipment was poor which indicated a lack of regular maintenance, apart from greasing (figure 7).

FIGURE 7:
Forward and aft hooks



Examination conclusions

When the lifeboat was lowered to the water in Devonport after the incident, the second engineer examined the on-load release system and correctly identified why the after hook had opened inadvertently under load. After opening the enclosure under the coxswain's console, he found that the operating cable for the after hook was sliding inside the clamp beneath the operating mechanism (figure 4a) causing lost motion each time the mechanism was actuated. Rather than moving the inner cable inside the outer sheath, the outer sheath was sliding through the clamp for a part of the resetting movement. When he removed the outer saddle on the cable clamp he found that it had been modified sometime in the past. The semi circular ridge on the clamp, which is designed to mate with a groove on the operating cable's metal ferrule, had been removed, apparently with a file. He found that even when the bolts securing the outer saddle were tight, the operating cable was still sliding inside the clamp. This led to the temporary fitting of the brass shim material under the outer saddle to increase the clamping pressure on the cable.

The relative movement between the aft hook operating cable and the clamp adjacent to the operating mechanism compromised the on-load release system in two ways. The loose clamp resulted in lost motion in the operating cable, which meant that the hook could not be fully reset. In addition, any opening force resulting from the load on hook could not be effectively opposed by the operating mechanism. In a partially reset condition, the loaded after hook mechanism would have been subject to greatly increased opening forces which could not be transmitted to, and reacted by, the locked operating mechanism. A force high enough to overcome the friction in the hook mechanism and operating cable would cause the hook to open.

The ship's maintenance records did not indicate that there had been a problem with the starboard on-load release system in the past and there was no record of any work on the system or modification to the cable clamp. It is probable that there may have been lost motion in the operating cable for a considerable period of time, with the

likelihood that the aft hook had not been fully reset after a number of previous lifeboat operations. The ship's records indicate that the starboard lifeboat was last lowered, and the on-load hooks operated, during the lifeboat drill on 2 November 2002. It is probable that the after hook was not fully reset after this drill.

The indicator on the after hook should both have provided the crew with a clear warning that it was not fully reset and prompted further investigation of the system. Similarly inspection of the cam release pin, visible between the side plates of the hook, would have revealed that it was not fully reset. The fact that the after hook mechanism wasn't investigated, either at the time of the previous drill or during subsequent routine maintenance, suggests a lack of competence in the operation and maintenance of the system.

The full-scale deflection of each hook indicator is 76 degrees, which coincides with the angular rotation of the cam release pin. For the hook to be fully reset, the cam release pin (and thus the indicator) must be rotated through this angle to leave the flat face of the cam release pin in linear contact with the tail of the hook. It is possible that a small change in the final 'reset' position of the aft hook indicator may not have prompted remedial action by the crew because it had been occurring over a period of time and had been accepted as the 'normal' position. In addition, the indicator scale on the aft hook had been painted over (figure 7) and thus there was no readily visible marking to indicate the fully reset position. These factors may account for the master's perception that the after hook appeared to be fully reset immediately prior to the incident.

On the day of the incident, the master took the precaution of ordering the empty boat to be partially lowered and then raised before boarding the crew. The fact that this operation was completed successfully indicates that it was only the subsequent increase load, due to the weight of the six crew in the boat, which caused the after hook to open.

Shipboard safety management system

The International Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management (ISM) Code) requires all ships to 'develop, implement and maintain a safety management system...'. The Code states under '1.2 Objectives':

- 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 alia:
 - .1 provide for safe practices in ship operation and a safe working environment;
 - .2 establish safeguards against all identified risks...

In practice implementation of the ISM Code requires that every ship's safety management system must make adequate provisions to provide a safe working environment for the crew and establish safeguards against all identified risks. To obtain and maintain its ISM Code certification, every ship manager and every vessel must demonstrate the adequacy of the safety management system in respect of these things when audited by the accreditation authority.

Lifeboat accidents involving the failure of on-load release systems have been occurring with increasing frequency for the last decade or more. In January 2001, the MAIB published a Review of Lifeboat and Launching Systems Accidents, which states from 1991 to 2001 there were 11 such incidents, in their jurisdiction alone, involving seven deaths and nine serious injuries. Similar statistics are available from many other maritime administrations around the world. Significant numbers of seafarers are dying and being seriously injured as a result of these lifeboat accidents. Operations involving lifeboat on-load release systems must be considered to be inherently risky and thus adequate safeguards to protect the crew must be included in every vessel's safety management system.

At the time of the incident, *Ma Cho's* manager, Fenwick Shipping Services, held a valid Document of Compliance for bulk carriers and the ship had been issued with a Safety Management Certificate. These documents are evidence that the vessel's safety management system had been audited by a competent authority and found to meet the requirements of the ISM Code.

Despite meeting the requirements of the ISM Code accreditation authority, *Ma Cho's* safety management system at the time of the incident was inadequate in respect of procedures for operating and maintaining the lifeboat on-load release system. The training of the crew in the operation of the on-load release system was also deficient which also suggests that the ship's safety management system did not meet the requirements of the ISM Code.

Operation and maintenance of the on-load release system

Ma Cho had a number of documents on board relating to the operation and maintenance of the lifeboat and its on-load release system. These documents included the lifeboat manufacturer's combined operation and maintenance manual, ship-specific launching and maintenance procedures and completed maintenance records. In addition to these, the instructions for operating the on-load release system were fitted inside the lifeboat. All of these documents were in English text with the exception of the lifeboat launching procedure which did not include instructions for operating the on-load release system.

The instructions for tripping and resetting the on-load release system in the lifeboat manufacturer's manual contained various warnings relating to its operation. The resetting instructions included a stipulation that the position of the cam release pin must be checked, by looking between the hook side plates, before the boat is hoisted. The instructions also stipulate that the position of the cam release pin must be checked again after the boat has been hoisted to a position just above the water. Given that the after hook was probably not left fully reset after the drill on 2 November 2002, it must be concluded that the crew had not made these critical checks and were thus not sufficiently conversant with the hook resetting procedure.

The maintenance stipulated by the manufacturer of the system consisted solely of periodic testing and monthly greasing of the various points on the hook mechanisms. Similarly the ship's maintenance instructions for the on-load release system, contained in the safety equipment weekly maintenance checklist, consisted only of periodic testing and greasing. There were no maintenance instructions on board relating to more major servicing necessary to maintain the on-going safety of the on-

load release system and no mention of the maintenance requirements of critical items such as the cam release pin, hook tail, swivel pin and bush, operating cables etc.

In addition, the manufacturer's instruction manual was not type specific and did not contain detailed drawings of the BG-3 system fitted to *Ma Cho*'s lifeboat. There was a reference in the instructions to a more detailed manual, specifically for the BG-3 release system, which was not evident on the ship. The maintenance instructions on board the vessel for the on-load release system were inadequate and, like the operating instructions, would have been of limited use in English text for most of the Chinese and Bangladeshi crew.

The ill conceived modification made, at some time in the past, to the outer saddle of the after operating cable clamp was directly causal in the incident. Had the cable clamp been corrected fitted, the operating cable's outer sheath would have been securely fixed with respect to the operating mechanism and the system would have performed as designed.

The submission from the ship's technical manager stated:

...after opening up the clamp it was noted that the half round circular ridge on the outer half of the clamp was disappeared rendering the locking ferrule ineffective. It was further noted that the ridge on the outer clamp was intentionally removed by filing, and the half bore was somewhat enlarged. I has asked the engineers about that, but nobody seemed to have any idea when and why this happened.

There is no justifiable reason why any competent engineer, who understood the operation of the on-load release system, would modify the cable clamp in this fashion and it is evidence of inadequate past maintenance of the system. In addition, the general condition of the system, particularly the external components, indicated that the maintenance regime was deficient.

The ship's maintenance records show that the lifeboat and on-load release system had been checked/greased approximately weekly between the time of the lifeboat drill on 2 November and the day of the incident. This meant that the system had been checked on at least four occasions (and probably far more if the problem existed prior to the drill on 2 November) without the problem with the after hook being detected. This is further evidence that the maintenance of the system had been inadequate.

The submission from the ship's technical manager stated with respect to the crew's training and maintenance of the on-load release system:

While I fully agree with your conclusion that the crew was not adequately trained in the operation of the on-load release system at the time, however, with the mystery surrounding the damage of the outer half of the cable clamp I have reservations as to the part of the conclusion – “the maintenance of the on-load release system was poor”. From the practical point of view maintenance of the on-load release system is normally limited to periodic visual inspection and greasing of linkage and moving parts.

Crew training

Exercise and training form a vital defence against the sort of accident which occurred on board *Ma Cho* on 9 December. It is possible, had the crew been more conversant with the operation of the on-load release system, that they may have identified and rectified the problem with the after hook before the incident occurred. The safety management system aboard *Ma Cho* included a safety equipment training manual

and evaluation forms for safety training. However the training manual was for use throughout the fleet and did not have any instructions specific to *Ma Cho*'s lifeboats or on-load release equipment. In addition, the training manual did not contain any particular advice or warnings relating to on-load release equipment generally. To be of any real benefit, training in on-load release equipment must be type-specific, hence the training manual was of no benefit to the crew in this regard.

Ma Cho's master indicated that it was usual practice for one of the mates to instruct the crew in the operation of the on-load release system during lifeboat drills. Such training is very useful if the instruction includes a thorough explanation of operation of the system and the training includes practice. The ship's records showed that there had been five occasions in the previous seven months when a lifeboat (either port or starboard) had been lowered to the water and manoeuvred. A significant proportion of the crew had been on the vessel for the previous eleven months. However, given the size of the crew and the frequency of the drills, it is doubtful if any crew member had been instructed in the operation of the on-load release system and had had an opportunity to practice the training more than once in the previous six months.

Like most on-load release systems, that aboard *Ma Cho* was relatively simple to understand and operate. However, resetting the system requires the simultaneous actions of three crew members. All of these individuals must be thoroughly conversant with the operation of the system and the fact that the after hook was probably not correctly reset on 2 November 2002 suggests that training on the system had not been adequate.

Design issues

The Beihai BG-3 on-load release system was designed to meet the requirements of the 1974 International Convention for the Safety of Life at Sea (SOLAS) and its 1983 amendments. The design is approved by various classification societies including Lloyd's Register.

The design of the on-load release system has some aspects that contributed to the incident on board *Ma Cho*. In particular, the cam release pin locking arrangement is prone to inadvertent release when not fully reset and/or when parts of the mechanism are worn as a result of a period of time in service.

The cam release pin arrangement

Ma Cho's hook locking system uses the cam release pin to lock the tail of the hook. This arrangement is similar to systems which have been used by various other manufacturers and which have been implicated in a number of other lifeboat accidents. The design is particularly prone to premature release when not fully reset, or if there is wear on the tail of the hook or the hook's swivel pin and bush.

In relation to 'the locking principle of the hook release system' the lifeboat manufacturer submitted:

As we know, many lifeboat manufacturers adopt the cam release pin to lock the hook tail in the hook release system. This locking principle has been widely accepted by the manufacturer, classification societies and the customers. BG-3 hook release system had been type approved by many classification societies and the 6 times safety working load hook strength test had been carried out to prove that the working principle is safe and reliable.

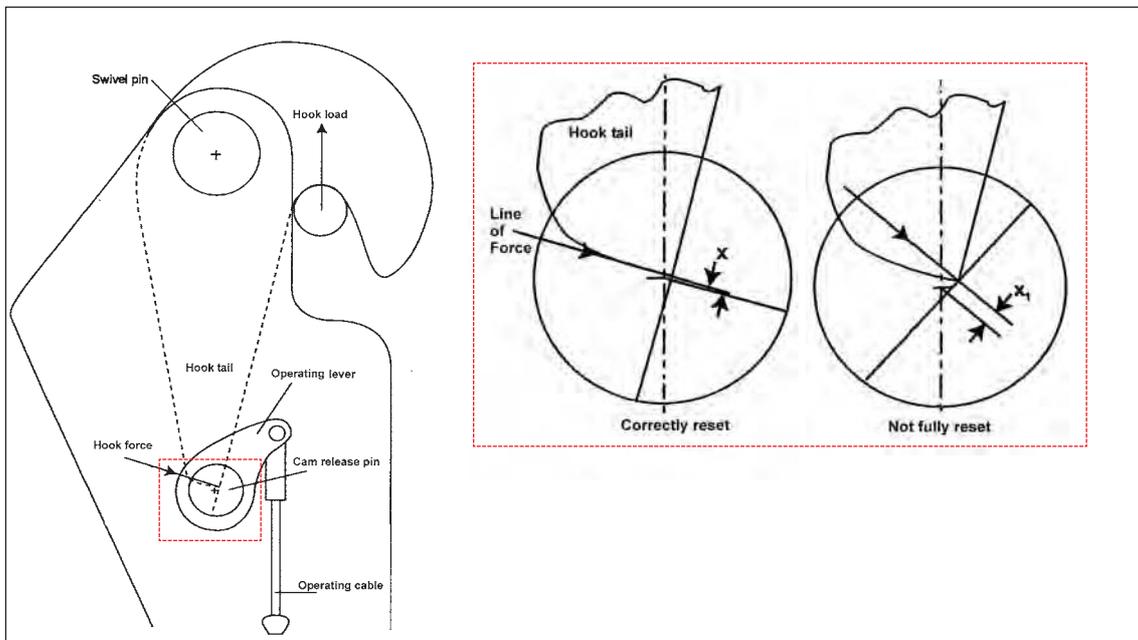
Moreover, before the installation, each hook should be tested by 2.5 SWL to ensure the quality. Due to often use, the hook tail will be worn. If this wear is not greater than 1mm, and the crew can operate and maintain this system according to the requirements, this system is still safe. This is concluded from the many times test. There are several thousands' sets of BG-3 release hooks installed on our lifeboat, and never happened any accident when the operator operate and maintain the system according to the requirements.

MAIB's 'Review of Lifeboat and Launching Systems Accidents' states:

Analysis of a number of accidents reveals that premature hook release has often been caused by the failure to re-set it correctly when the lifeboat is recovered from its previous launching. This shortcoming stems from a lack of understanding of the mechanism involved, inadequate training and poor maintenance. Once the hook has been incorrectly reset, spontaneous release is possible at any time before the lifeboat is next put in the water.

The Review cites the specific example of the system of hook locking used on *Ma Cho's* lifeboats. The follow diagrams are reproduced from the MAIB Review.

FIGURE 8:
Diagram of hook mechanism



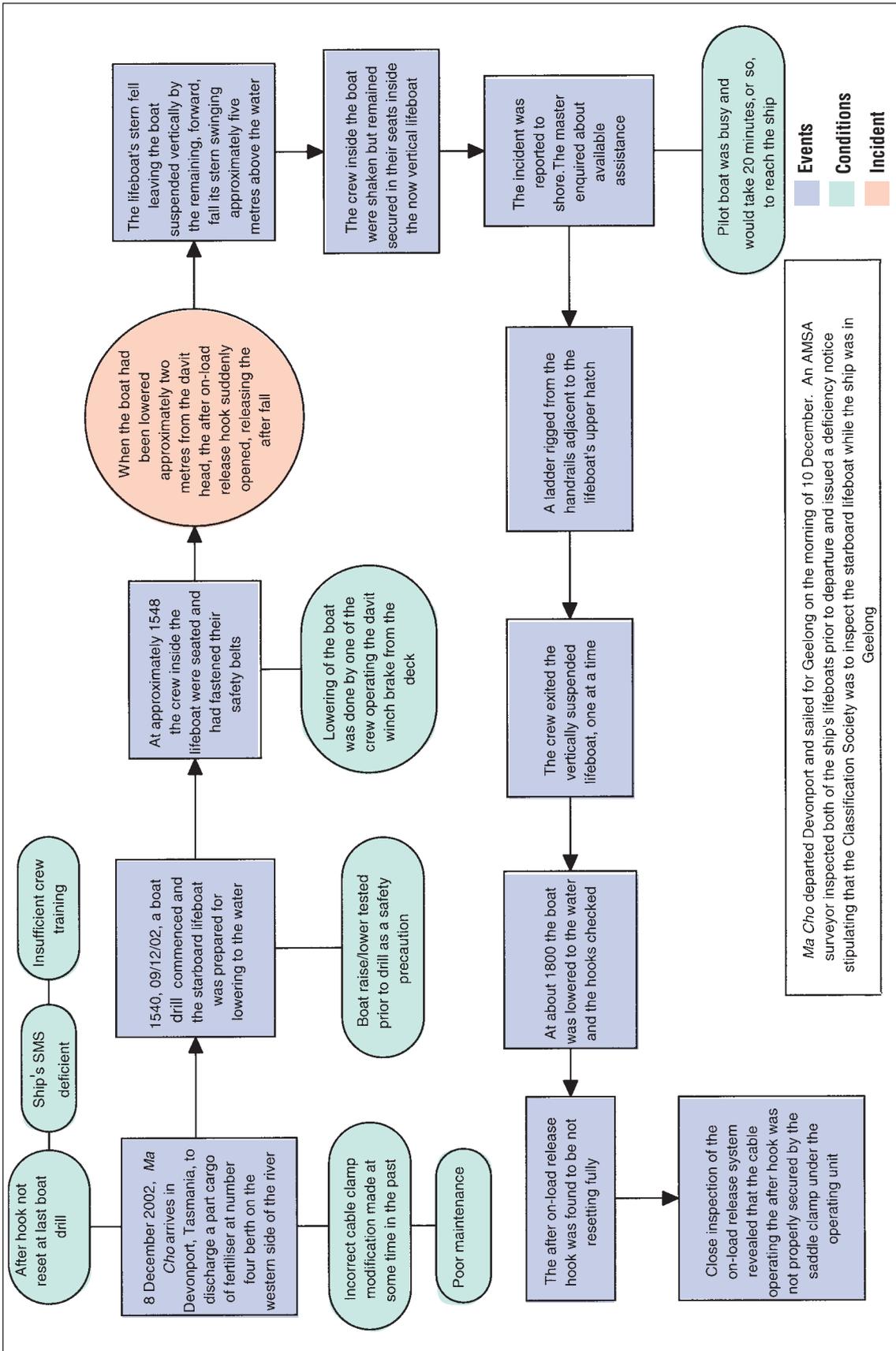
It can be seen from the diagrams that when the hook mechanism is in the fully reset position the force transmitted to the face of the cam release pin by the tail of the hook acts on a relatively small effective moment arm X. This produces a relatively small hook opening force which is transmitted to the operating mechanism via the operating lever and operating cable. The spring and friction forces in the hook

mechanism and operating cable and the operating mechanism (which is locked) oppose this opening force. A loss of motion in the operating cable will result in the release cam face at an angle to the hook tail ie. not fully reset. This substantially increases the turning moment on the cam and thus the opening force, by increasing the moment arm length from X to X1.

In service, the tail of the hook wears at the point of contact with the release cam face, particularly if the hook is released under load. Such wear has the effect of increasing the effective length of the moment arm as does wear on the swivel pin and bush. This normal wear, in combination with a relatively small loss of motion in the operating cable, will dramatically increase the opening force which must be opposed by the operating mechanism and by the operating cable and hook mechanism friction/spring forces. In the case of the *Ma Cho's* after hook, the loose cable clamp meant that the opening force could not be effectively transmitted to the operating mechanism. This resulted in the hook opening when the load became high enough to produce an opening force greater than the opposing forces in the operating cable and hook mechanisms.

Given its increased susceptibility to accidental release when subject to 'normal' in-service wear and the history of incidents on similar designs, it is doubtful if *Ma Cho's* hook locking mechanism can be considered to be safe.

FIGURE 9:
Ma Cho: Events and causal factor chart



5 CONCLUSIONS

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

Based on the evidence available, the following factors are considered to have contributed to the incident involving *Ma Cho*'s starboard lifeboat on 9 December 2002:

1. The cable clamp securing the aft hook's operating cable adjacent to the operating mechanism had been modified at some time in the past and was allowing the cable's outer sheath to move, resulting in lost motion within the cable.
2. The after hook had not been fully reset, as a result of the lost motion in its operating cable, when the previous lifeboat drill was conducted on 2 November 2002.
3. The relative movement between the cable clamp and the aft hook operating cable also meant that the operating mechanism could not oppose the additional tripping force caused by the aft hook's partially reset condition.
4. The ship's safety management system was deficient with respect to the operating and maintenance instructions and crew training on the on-load release system.
5. The maintenance of the on-load release system was poor.
6. The vessel's crew were insufficiently trained in the operation of the on-load release system.
7. The design of the hook locking mechanism is potentially unsafe given its susceptibility to tripping under load.

6 SUBMISSIONS

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

The draft investigation report was sent to the; master, chief engineer, chief officer, second engineer, ship's managers, lifeboat manufacturer, Australian Maritime Safety Authority, and Classification Societies which are member all of the International Association of Classification Societies.

Submissions were received from the lifeboat manufacturer and the ship's managers and the text of the draft report was amended to reflect to content of the submissions.

7 RECOMMENDATIONS

MR20040013

It is recommended that Qingdao Beihai Shipyard review the design of their BG-3 on-load release system in respect of the hook locking mechanism in light of the incident aboard *Ma Cho*.

MR20040014

It is recommended that classification societies issuing approvals for on-load release systems review the in-service safety of designs with hook locking mechanisms using the same principle as that used on *Ma Cho*'s lifeboats.

MR20040015

It is recommended that all ISM Code accreditation authorities ensure that the safety management systems on all vessels fitted with on-load release equipment provide adequate safeguards to mitigate the significant risks of operating and maintaining these systems.

8 *Ma Cho*

Name	<i>Ma Cho</i>
IMO No.	9118252
Flag	Hong Kong
Classification Society	Lloyds Register
Vessel type	Bulk carrier
Owner	Ebbtide Navigation
Year of build	1996
Builder	Xingang Shipyard, China
Gross tonnage	10 490
Summer deadweight	16 873 tonnes
Length overall	143.46 m
Breadth, moulded	22.03 m
Draught (summer)	8.814 m
Engine	MAN B&W 6L35MC
Engine power	3900 kW
Service speed	13.5 knots
Crew	27 (Bangladeshi and Chinese)

**Independent investigation into the lifeboat incident on board the Hong Kong flag bulk carrier *Ma Cho*
at Devonport, Tasmania 9 December 2002**

ISBN 1 877071 60 9

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