

Final report MO-2016-205: Fatal fall from height on bulk carrier,
New Legend Pearl, 3 November 2016

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Final Report

Marine inquiry MO-2016-205
Fatal fall from height on bulk carrier

New Legend Pearl

3 November 2016

Approved for publication: September 2017

Transport Accident Investigation Commission

About the Transport Accident Investigation Commission

The Transport Accident Investigation Commission (the Commission) is a standing commission of inquiry and an independent Crown entity responsible for inquiring into maritime, aviation and rail accidents and incidents for New Zealand, and co-ordinating and co-operating with other accident investigation organisations overseas. The principal purpose of its inquiries is to determine the circumstances and causes of occurrences with a view to avoiding similar occurrences in the future. Its purpose is not to ascribe blame to any person or agency or to pursue (or to assist an agency to pursue) criminal, civil or regulatory action against a person or agency. The Commission carries out its purpose by informing members of the transport sector and the public, both domestically and internationally, of the lessons that can be learnt from transport accidents and incidents.

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Important notes

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Citations and referencing

Information derived from interviews during the Commission's inquiry into the occurrence is not cited in this final report. Documents that would normally be accessible to industry participants only and not discoverable under the Official Information Act 1982 have been referenced as footnotes only. Other documents referred to during the Commission's inquiry that are publicly available are cited.

Photographs, diagrams and pictures

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Verbal probability expressions

The expressions listed in the following table are used in this report to describe the degree of probability (or likelihood) that an event happened or a condition existed in support of a hypothesis.

Terminology (adopted from the Intergovernmental Panel on Climate Change)	Likelihood of the occurrence/outcome	Equivalent terms
Virtually certain	> 99% probability of occurrence	Almost certain
Very likely	> 90% probability	Highly likely, very probable
Likely	> 66% probability	Probable
About as likely as not	33% to 66% probability	More or less likely
Unlikely	< 33% probability	Improbable
Very unlikely	< 10% probability	Highly unlikely
Exceptionally unlikely	< 1% probability	



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The New Legend Pearl



Location of accident

Source: maps of net

Contents

- Abbreviations ii
- Glossary ii
- Data summary iii
- 1. Executive summary 1
- 2. Conduct of the inquiry 2
- 3. Factual information 3
 - 3.1. Events leading up to the accident 3
 - 3.2. Narrative 5
 - 3.3. The crew 7
 - 3.4. The cranes 7
 - 3.5. Risk identification and control 8
 - 3.6. Safety harnesses 8
- 4. Analysis 11
 - 4.1. General 11
 - 4.2. The accident 11
 - 4.3. Fall protection 12
 - 4.4. The decision to change the crane wire on passage 13
 - 4.5. Safety management and safety culture 13
- 5. Findings 15
- 6. Safety issues 16
- 7. Safety actions 17
 - General 17
 - Safety actions addressing safety issues identified during an inquiry 17
 - Safety actions addressing other safety issues 17
- 8. Recommendation 18
 - General 18
 - Recommendation 18
- 9. Key lessons 19
- 10. Citation 20
- Appendix 1: Risk assessment and risk control plan 21
- Appendix 2 Port State Control Inspection 22

Figures

- Figure 1 Crew working at height without full fall protection 3
- Figure 2 The *New Legend Pearl* at Marsden Point 4
- Figure 3 Cable sock joining the old wire and the replacement wire 5
- Figure 4 Number 1 and 2 cranes and the position of the snag (inset)..... 6
- Figure 5 Safety harness worn by the bosun 9
- Figure 6 Safety harness lanyard hooked back onto itself 10
- Figure 7 Guidance from the International Safety Equipment Association 10
- Figure 8 The damaged safety hook..... 12

Abbreviations

BV	Bureau Veritas
MNZ	Maritime New Zealand
STCW Convention	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers

Glossary

boatswain/bosun	the foreman of a deck crew
burst out	the forced, unintentional disengagement of a safety hook. It is also possible with a locking safety hook if the hook is improperly attached or poorly maintained
cable sock	a wire mesh grip used to connect and pull wires and cables
classification society	an organisation that publishes its own classification rules in relation to the design, construction and survey of ships. A classification society verifies compliance with these rules during construction and periodically while the ship is in service. Classification societies can also be licensed by flag states to survey ships and issue certificates on their behalf
jib	the arm of a crane that provides horizontal reach
lanyard	a short rope or line used for securing
locking collar	mechanism to lock and prevent the accidental opening of a safety hook
luffing wire	a crane wire used to raise and lower a crane's jib
roll out	the unintentional disengagement of a non-locking safety hook during operation
stevedores	persons employed in the loading and unloading of ships

Data summary

Vessel particulars

Name:	<i>New Legend Pearl</i>
Type:	bulk carrier
Class:	Bureau Veritas
Limits:	unlimited
Classification:	1 + HULL BULK CARRIER, CSR, BC-A (HOLD NO.2, 4 MAY BE EMPTY), ESP, VERI STAR-HULL, IN WATER SURVEY, GRAB {25} + MACH AUT UMS, MON-SHAFT
Length:	179.90 metres
Breadth:	28.40 metres
Gross tonnage:	20,809
Built:	Jiangmen Nanyang Shipyard Co. Limited, China, July 2010
Propulsion:	B&W 6S42MC-MK77/6480Kw/136r/MIN
Service speed:	13.7 knots
Owner/operator:	Tianjin Zhongyuda Logistic Co. Limited Operated by Hongkong Fortune Int'l Shipping Co. Limited
Port of registry:	Panama
Minimum crew:	14
Date and time:	3 November 2016, 1530 ¹

Location 36° 33.'8 South 176° 46.'3 East

Person involved boatswain

Injuries fatally injured

Damage NA

¹ Times in this report are in New Zealand Daylight Time (UTC + 13 hours) and are expressed in the 24-hour format.

1. Executive summary

- 1.1. On the morning of 3 November 2016, the bulk carrier *New Legend Pearl* was east of Coromandel Peninsula on passage between the New Zealand ports of Bluff and Marsden Point. The crew were attempting to change a hoisting wire on one of its cargo cranes. Part-way through the task the hoisting wire snagged on the crane jib that was resting in its cradle, about eight metres above the hatch cover.
- 1.2. One of the crew donned a safety harness and climbed up onto the crane jib, secured the lanyard of his harness around a luffing wire and walked along the jib to unsnag the wire. However, the lanyard prevented him reaching the snag, and he was in the process of transferring the lanyard to a different securing point when he lost his balance or slipped and fell eight metres to the deck below. He died from his injuries.
- 1.3. The Transport Accident Investigation Commission (the Commission) **found** that it was about as likely as not that the locking mechanism for the safety harness hook was not engaged, which allowed the lanyard to roll or burst out of the hook when the crew member fell, and that the safety harness was not suitable for the intended task.
- 1.4. The Commission also **found** that:
 - the risk assessment conducted prior to the crew starting the wire replacement on crane number 2 did not fulfil the requirements of the operator's safety management system, because it did not adequately identify and manage the risks associated with the task
 - the repeat failures of the crew to comply with safe working practices when working at height and the acceptance of using a substandard wire on a working crane are indications of a poor safety culture on board the *New Legend Pearl*.
- 1.5. The Commission identified two **safety issues**: the operator's risk assessment process did not prevent the crew member working at height with an inadequate fall-protection system; and both the safety management system and the underlying safety culture on board did not meet industry good practice.
- 1.6. The Commission made one **recommendation** to the flag state for the *New Legend Pearl* to address these safety issues.
- 1.7. The **key lessons** arising from the inquiry are:
 - working at height is a risky activity and all crew should use suitable safety harnesses that are fit for the intended tasks
 - working at height is a risky activity that must be properly managed using a formal risk assessment methodology
 - attaching a safety harness by passing it through or around the securing point and back onto the lanyard is a dangerous practice that can result in inadvertent release unless the lanyard and hook are designed for that purpose.

2. Conduct of the inquiry

- 2.1. At about 1700 on 3 November 2016, the Transport Accident Investigation Commission (the Commission) was notified by the Rescue Coordination Centre New Zealand that a crew member had fallen from a crane and sustained head injuries on board the bulk carrier *New Legend Pearl*. The vessel was proceeding towards a rendezvous with a rescue helicopter carrying a paramedic.
- 2.2. At about 1815, the Commission was updated by the Rescue Coordination Centre that when the helicopter paramedic arrived the crew member was already deceased. The Commission opened an inquiry the same day under section 13(1)b of the Transport Accident Investigation Commission Act 1990 and appointed an investigator in charge.
- 2.3. On the same day, the Commission notified the Panama flag administration of the accident and invited Panama to participate in the investigation in accordance with the International Maritime Organization's Casualty Investigation Code.
- 2.4. On 4 November 2016, two investigators travelled to Marsden Point and conducted interviews with the vessel's crew and collected evidence. One interview was conducted with the assistance of a Chinese interpreter. Physical evidence removed from the vessel included: the safety harness that the deceased had been wearing; a specimen safety harness; and documentary evidence.
- 2.5. On 8 November 2016, agreement was reached with the Panama flag administration that New Zealand would lead the inquiry and conduct the investigation on behalf of Panama.
- 2.6. Additional information was sourced from Maritime New Zealand (MNZ), Bureau Veritas (BV) and the ship's operator.
- 2.7. On 23 December 2016, the Commission received the post-mortem toxicology report from the Coroner's Office.
- 2.8. On 9 March 2017, the Commission received the post-mortem report from the Coroner's Office.
- 2.9. All documentation received from the operator that was considered significant to the investigation was translated through the interpretation services of the Department of Internal Affairs.
- 2.10. On 27 July 2017, the Commission approved the draft report to be circulated to interested persons for comment.
- 2.11. The draft report was circulated to six interested persons. Five responses, including two submissions, were received.
- 2.12. The Commission considered these submissions in detail and any changes as a result have been included in the final report.
- 2.13. The Commission approved the report for publication on 27 September 2017.

3. Factual information

3.1. Events leading up to the accident

- 3.1.1. Prior to the accident the *New Legend Pearl* had called at the port of Bluff. The vessel had been delayed for several days; it was alongside the berth from 0100 on 26 October until 1454 on 31 October.
- 3.1.2. At 0800 on 26 October, cargo operations commenced using the ship's cranes, but after about two hours they were stopped because the stevedores² observed what they thought was a crack in the structure of a crane.
- 3.1.3. The crew went to check the crane and demonstrated that what appeared to be a crack was only grease. However, the port company had already reported their concerns about the condition of the cranes to MNZ. A maritime officer from MNZ issued a Notice of Imposition,³ dated 26 October 2016, which stated, 'the four cargo cranes are not to be used for the lifting of any equipment or cargo'. Cargo operations were halted until the cranes could be inspected and declared structurally sound by a classification society⁴ surveyor.
- 3.1.4. The vessel's operator arranged with its classification society, BV, for a surveyor to attend the vessel and carry out an occasional cargo gear survey. There was a two-day delay waiting for the surveyor to arrive, during which time the crew took the opportunity to carry out rust removal and painting on the cranes.
- 3.1.5. At about 1015 on 27 October, the port facility's health and safety team were advised by stevedores that the crew on board the *New Legend Pearl* were not working safely. The health and safety officers boarded the vessel and witnessed the crew working at height, on the cranes, without full fall-protection equipment (see Figure 1). The ship's duty officer was informed of their concerns and work on the cranes ceased.



Figure 1
Crew working at height without full fall protection

² Stevedores are persons employed in loading and unloading ships.

³ Notice of Imposition of Conditions on the Use and Operation of a ship pursuant to sections 55 or 397 of the Maritime Transport Act 1994.

⁴ A classification society is an organisation that publishes its own classification rules in relation to the design, construction and survey of ships. A classification society verifies compliance with these rules during construction and periodically while the ship is in service. A classification society can also be licensed by flag states to survey ships and issue certificates on their behalf.

- 3.1.6. At about 1730 on the same day, one of the port health and safety officers witnessed the crew once again working at height on the cranes without fall protection. The health and safety officer informed the master that under no circumstances should the crew be working without the proper personal protective equipment. The health and safety officer sent an online report on the unsafe work to MNZ.
- 3.1.7. On 28 October, an MNZ maritime officer conducted a Port State Control inspection,⁵ and found several deficiencies that had to be rectified before the vessel could depart from Bluff.
- 3.1.8. On 28 and 29 October, a surveyor from BV carried out an occasional cargo gear survey. Four recommendations were issued which had to be carried out by 15 December 2016.
- 3.1.9. MNZ then issued a Notice of Withdrawal⁶ to remove the imposition. The deficiencies identified during the Port State Control inspection (see Appendix 2) had also been rectified, so MNZ released the vessel from detention.
- 3.1.10. At about 1900 on 29 October, cargo operations resumed. However, the stevedores were unhappy with the condition of the hoisting wires on numbers 2 and 4 cranes (see Figure 2).
- 3.1.11. The following day the crew fitted a new hoisting wire onto number 4 crane, which was the only spare wire on board. This crane was prioritised because it was the only crane that could work cargo at number 5 hatch.
- 3.1.12. Later that afternoon the master emailed the agent at Marsden Point, the vessel's next port, to request a quotation for a new crane hoisting wire. The agent replied the following day, but no order was placed for a new wire. Cargo was still able to be loaded at Marsden Point with only three gangs,⁷ and number 2 crane was not required.
- 3.1.13. The master consulted the operator and a decision was made to replace the hoisting wire on number 2 crane with the old wire that had been removed from number 4 crane. The intention was to change the wire during the passage from Bluff to Marsden Point so that the cranes were fitted with the best available wires.
- 3.1.14. At 1454 on 31 October, the *New Legend Pearl* departed Bluff for Marsden Point.



Figure 2
The *New Legend Pearl* at Marsden Point

⁵ A Port State Control inspection is a safety inspection carried out on a foreign ship by an officer of the local regulator.

⁶ Notice of Withdrawal of Impositions of Conditions on the Use and Operation of a Ship Pursuant to sections 55 or 397 of the Maritime Transport Act 1994.

⁷ A gang is a group of stevedores working as a unit in handling cargo.

3.2. Narrative

- 3.2.1. By the morning of 3 November 2016, the ship had endured three days of strong winds on its voyage to Marsden Point. The master and the chief officer discussed the weather forecast. Because the wind was still at Force 5,⁸ the master decided to not allow the crew to change the wire on number 2 crane that morning, but agreed that sea conditions might improve sufficiently by the afternoon. At the morning meeting the chief officer talked to the crew about the procedure for changing the wire.
- 3.2.2. By the afternoon, the wind had decreased to Force 4⁹ and conditions had improved sufficiently to allow the wire change to go ahead. The chief officer completed a risk assessment and the working-at-height checklist before the work commenced.
- 3.2.3. At about 1330, the bosun,¹⁰ the ship's carpenter and the deck crew assembled on deck to change the wire on number 2 crane. About half an hour later the chief officer joined the deck crew to supervise the work.
- 3.2.4. The carpenter and two able seamen climbed onto the crane-house to release the old wire at its termination point. The wire was lowered to the deck, where the end was cut off neatly so that it could be connected to the new wire with a cable sock¹¹ (see Figure 3).



Figure 3
Cable sock joining the old wire and the replacement wire

- 3.2.5. The crew commenced heaving the connected wires through the hoisting-wire sheaves, but stopped when the cable sock snagged on the crane-jib¹² cross-beam (see Figure 4).

⁸ Force 5 on the Beaufort wind scale is 17-21 knots.

⁹ Force 4 on the Beaufort wind scale is 11-16 knots.

¹⁰ The bosun (or boatswain) is the foreman of a deck crew.

¹¹ A cable sock is a wire mesh grip used to connect and pull wires and cables.

¹² The jib is the arm of a crane that provides horizontal reach.

- 3.2.6. The bosun put on his safety harness and climbed up the ladder of number 1 crane and across to the end of number 2 crane's jib (see Figure 4). He secured his safety harness lanyard¹³ around a luffing wire¹⁴ and walked along the jib to reach the point where the cable sock had snagged (see Figure 4).
- 3.2.7. When the bosun reached the cross-beam, he could not reach the snag with his lanyard still secured around the luffing wire. He unhooked the lanyard to relocate it to a lower wire so that he could reach it.
- 3.2.8. At some point in the process of moving the lanyard between the luffing wires, he lost his balance and fell eight metres onto number 2 hatch cover. None of the crew could say for sure whether the bosun was clipped onto a luffing wire when he fell. The safety harness was intact but the gate (see Figure 8) of the securing hook was damaged.
- 3.2.9. The bosun was unconscious and bleeding, so the chief officer immediately sent the crew to get first aid equipment. The ship's carpenter remained with the bosun. The chief officer went to the ship's office and called the master to report the accident and request a helicopter evacuation.
- 3.2.10. At about 1730, the helicopter paramedic was winched on board and confirmed that the bosun was deceased. The *New Legend Pearl* continued on passage to Marsden Point.

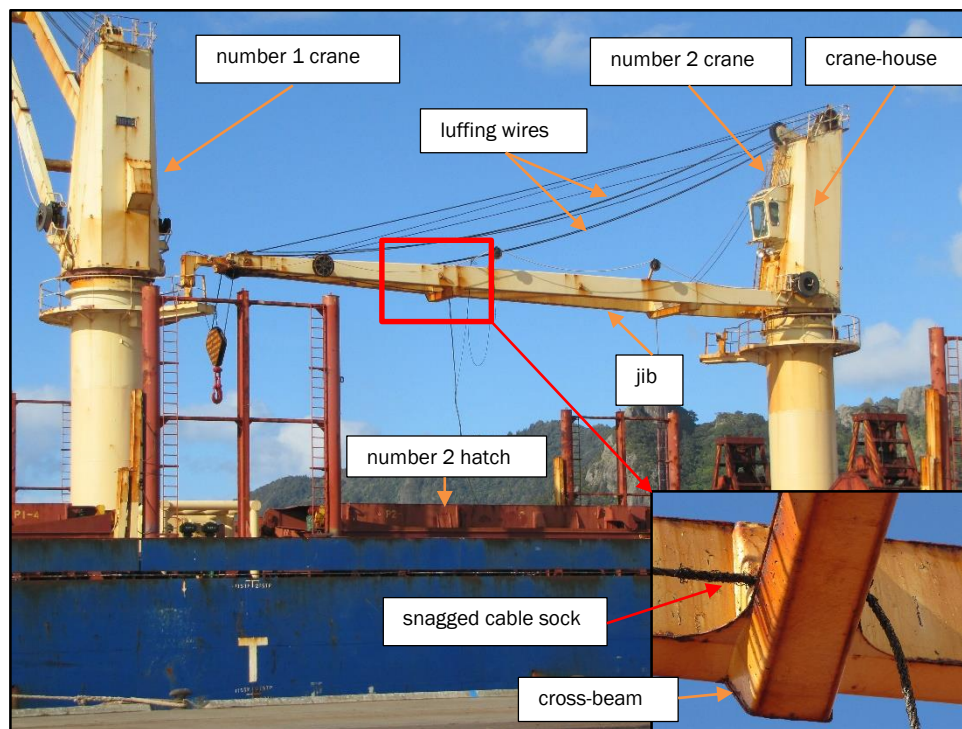


Figure 4
Number 1 and 2 cranes and the position of the snag (inset)

¹³ A lanyard is a short rope or line used for securing.

¹⁴ The luffing wires raise and lower the crane's jib.

3.3. The crew

- 3.3.1. At the time of the accident there were 24 crew on board the *New Legend Pearl*. The minimum crew required by the safe manning certificate was 14. All of the crew originated from the People's Republic of China.
- 3.3.2. The master had commenced his seagoing career in 1993 and gained his master's certificate of competency in 2008. This qualification was issued under the provisions of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, (STCW Convention), as amended. He had been sailing in the rank of master since 2009 and the *New Legend Pearl* was the first bulk carrier he had sailed on. Prior to joining the vessel he had spent one day at the company's office being introduced to the company's safety management system. A copy of the safety management system had been sent to him for reading before he joined the *New Legend Pearl* on 18 August 2016.
- 3.3.3. The chief officer had been at sea since 2006 and had a chief mate's certificate of competency issued under the provisions of the STCW Convention in September 2015. The contract on board the *New Legend Pearl* was his first appointment as chief officer. He had completed his previous contract as a chief officer under training and joined the *New Legend Pearl* on 2 March 2016.
- 3.3.4. The bosun was 51 years old and had worked at sea for more than 30 years. He was the eldest crew member and he was well respected by the crew as an experienced seafarer. He had been found fully fit for sea service on 23 February 2016 and joined the *New Legend Pearl* on 26 February 2016.

3.4. The cranes

3.4.1. The cranes were subject to an inspection regime carried out in accordance with the International Labour Organization's Occupational Safety and Health (Dock Work) Convention, 1979 (No. 152), which requires specific tests and examinations of a ship's lifting appliances. These requirements are written into New Zealand law through Maritime Rule Part 49, Ships' Lifting Appliances. A foreign ship that is working cargo in New Zealand territorial waters must be able to produce evidence that the following tests and examinations have been carried out on every lifting appliance:

- tested by a competent person¹⁵ prior to first use and after any substantial repair or alteration, using proof loads at a specified factor of the safe working load of the lifting appliance
- re-testing of every lifting appliance at least once in every five-year period
- thorough examination by a competent person at least once in every 12-month period.

These examination and test requirements are also reflected in the BV Rules for the Certification of Lifting Appliances Onboard Ships and Offshore Units (October 2011).

3.4.2. The cranes on board the *New Legend Pearl* had been most recently tested in June 2015 and an annual thorough examination had been carried out in August 2016. The tests and examinations had been carried out or witnessed by the ship's classification society, BV.

¹⁵ 'Competent person' means a person who is authorised to carry out testing and examination of ships' lifting appliances and loose gear by the equipment manufacturers, a classification society, a testing establishment recognised by MNZ or another nation's shipping administration.

3.5. Risk identification and control

3.5.1. The Maritime Labour Convention 2006¹⁶ was adopted by Panama and regulated by Executive Decree No. 86, 2013. The *New Legend Pearl* was subject to the requirements of this decree, which placed an obligation upon the owners:

... to adopt effective safety and health policies and programs of work, including an evaluation of risk, as well as training and education of seafarers, with the purpose of preventing work accidents, professional injuries or illnesses.

3.5.2. The operator's Risk Identification, Assessment and Control Programme established the methods of and requirements for risk identification, assessment and control.

3.5.3. On board, the master was responsible for implementing the risk control plan, training relevant personnel on risk perception and control, and providing feedback to the operator about on-board risks.

3.5.4. The operator's risk control programme grouped risks into five categories ranging from unacceptable to ignorable.

3.5.5. Working at height without safety controls presented an unacceptable risk and required the application of controls to reduce the risk to a tolerable level. A risk assessment plan was required, with special attention paid to specific work locations.

3.5.6. The operator expected the following factors to be taken into account when selecting risk control measures:

- a) Where possible, elimination or complete elimination of the source risk;
- b) If elimination is not possible, the risk should be actively reduced;
- c) After all optional control measures have been considered, consideration may be given to personal protective equipment;
- d) Consideration should be given to the establishment of contingency plans and crisis management, as well as the provision of appropriate emergency equipment.

3.5.7. The operator also had specific instructions for working at height, which were applicable to any work performed at a point that could lead to a fall from two metres or more. The following steps were required to be completed prior to working at height:

- a detailed investigation of the work site
- developing a safe operation plan based on the weather conditions and operating environment
- explaining the safety procedures and precautions to the operating personnel
- designating a person or persons responsible for organisation and supervision.

3.6. Safety harnesses

3.6.1. The safety harnesses provided to the crew were half-body harnesses that conformed with the Chinese mandatory national standard for full-body harnesses. This standard specified the requirements and inspection rules of personal fall-protection systems used in working at height for a total weight of no more than 100 kilograms. The harnesses were supplied to the vessel with lanyards and hooks already attached (see Figure 5).

¹⁶ The Maritime Labour Convention 2006 is an international treaty adopted by the International Labour Organization. It sets internationally agreed minimum standards for the health, safety and welfare of seafarers and came into force in August 2013.

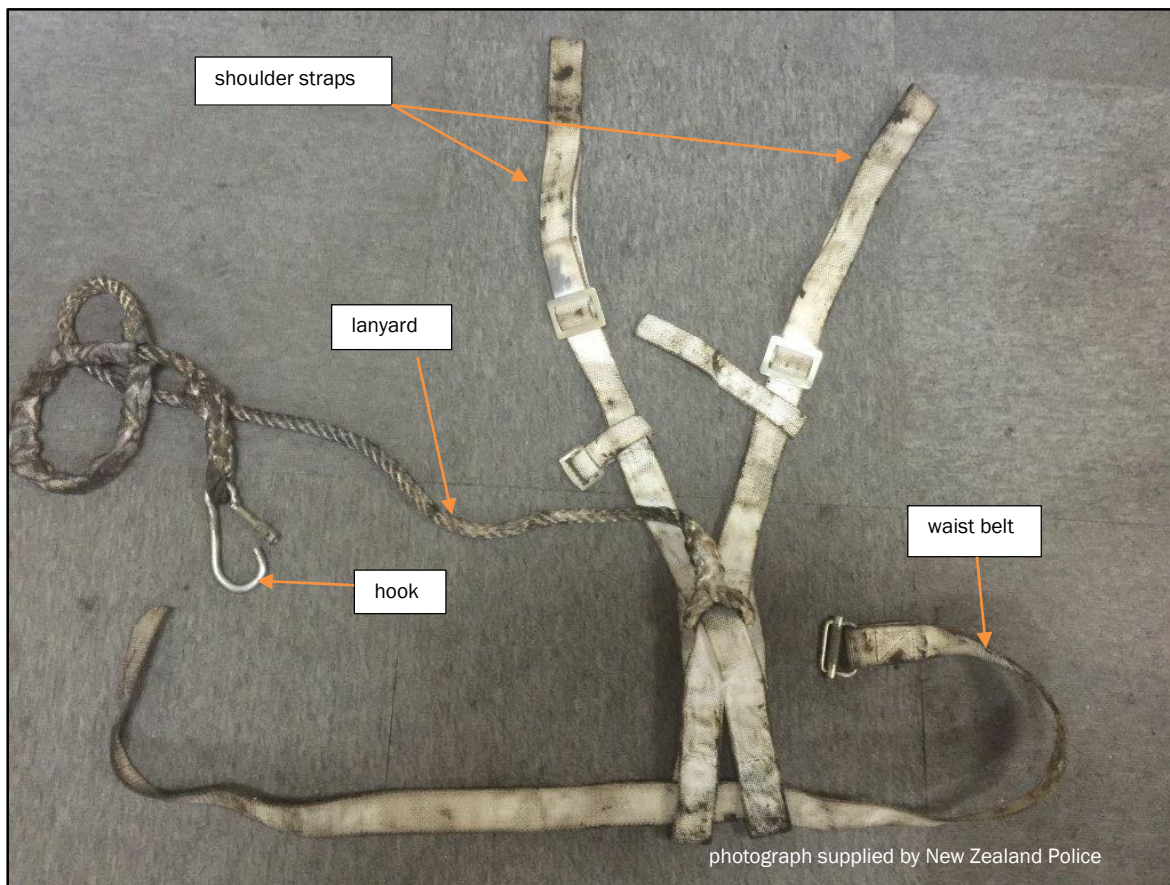


Figure 5
Safety harness worn by the bosun

- 3.6.2. The lanyards were made of 14-millimetre, soft polyester, three-strand, right-hand-lay rope, eye-spliced with three tucks. There was no marking to indicate that the lanyard met the mandatory Chinese standard for lanyards used in personal fall-protection systems.
- 3.6.3. The hooks attached to the lanyards were mild-steel carbine hooks with manually lockable gates. The hooks were not stamped with any identification, safe working load or indication of meeting the recommended Chinese standard for connectors used in personal fall-protection systems.
- 3.6.4. The crew working on top of the crane-house were wearing safety harnesses as well as their normal personal protective equipment consisting of boiler suits, safety helmets and safety boots. They secured their safety harness lanyards to strong points by clipping each lanyard back onto itself (see Figure 6). There were no designated anchor points or safety wires specifically for the purpose of fall-protection.



Figure 6
Safety harness lanyard hooked back onto itself

EXAMPLES OF IMPROPER CONNECTIONS

Just as a chain is only as strong as its weakest link, the integrity of a fall protection system depends on proper connection of all its components. The following are some examples of improper connections:

- A. Do not attach two or more snap hooks or carabiners to a single D-ring.
- B. Do not load a carabiner or snap hook at the gate.
- C. Ensure that connections are compatible and secure.
- D. Do not attach two snap hooks or carabiners together.
- E. Do not tie back on a lanyard unless specifically designed to do so by the manufacturer.
- F. Ensure that the snap hook is closed and locked.

Source: International Safety Equipment Association Use and Selection Guide Personal Fall Protection Equipment, Edition 1, February 2015

Figure 7
Guidance from the International Safety Equipment Association

4 Analysis

4.1 General

- 4.1.1 Working at height on a ship at sea can be dangerous, particularly on an open deck, due to unpredictable motion and slippery surfaces caused by salt deposits and sea spray.
- 4.1.2 The following analysis discusses what happened and why, and the significance of two safety issues:
- the operator's risk assessment process did not prevent the bosun working at height with an inadequate fall-protection system
 - the safety management system and the underlying safety culture on board did not meet industry good practice.

4.2 The accident

- 4.2.1 The bosun was working on top of number 2 crane's jib when he fell eight metres onto number 2 hatch cover (see Figure 4) and suffered fatal injuries.
- 4.2.2 He had climbed onto the jib to clear a snagged cable sock, but with the lanyard of his safety harness secured to a luffing wire he was unable to reach the snag below him.
- 4.2.3 The bosun was seen to be in the process of moving the position of his safety harness lanyard hook when he lost his balance and fell. There were no designated fall-prevention anchor points on the cranes, so the crew regularly secured their lanyards to convenient fixings or wires (see Figure 6). The bosun had passed his lanyard around one of the crane's luffing wires, then hooked it back onto itself.
- 4.2.4 The practice of hooking a lanyard back onto itself is not recommended unless the lanyard and hook have been specifically designed for that purpose. This practice prevents the hook aligning with the force applied in the event of a fall, which means that it can also expose the gate of the hook to side-loading forces. The force required to roll out¹⁷ or burst out¹⁸ the gate of a hook is significantly less than the force the hook can withstand when pulled in direct alignment with the long axis of the hook.
- 4.2.5 After the accident the gate on the bosun's safety harness hook was found bent sideways and it no longer married up with the end of the hook (see Figure 8). The crew said that the safety equipment had been checked before they started changing the wire and had been found to be in a satisfactory condition. If this damage occurred during the fall, then the locking collar¹⁹ on the end of the gate should have been damaged as the gate was pulled sideways. However, the locking collar was not damaged. Therefore it is about as likely as not that when the bosun fell he had either removed the locking collar in preparation for removing the hook from the upper luffing wire, or had clipped onto the lower luffing wire but had yet to engage the locking collar. Any sideways force on the gate as the shock-load came onto the lanyard could have caused the gate to burst out and disconnect the harness from the anchor point.

¹⁷ Roll out is the unintentional disengagement of a non-locking safety hook during operation.

¹⁸ Burst out is the forced, unintentional disengagement of a safety hook. It is also possible with a locking safety hook if the hook is improperly attached or poorly maintained.

¹⁹ A locking collar is a mechanism to lock and prevent the accidental opening of a safety hook.

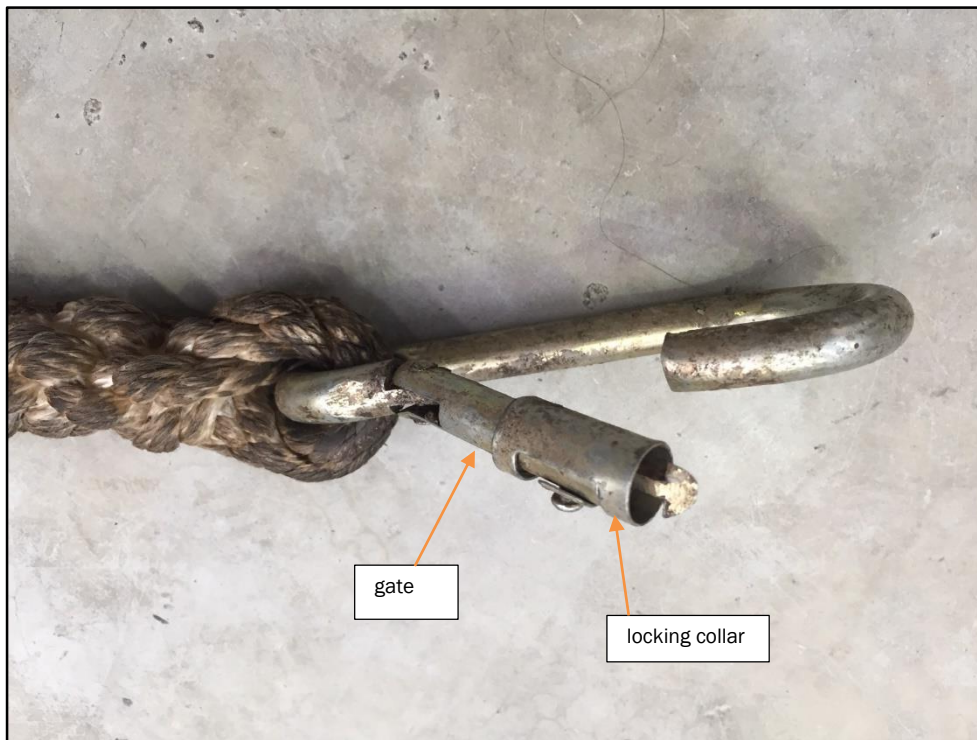


Figure 8
The damaged safety hook

4.3 Fall protection

Safety issue – The operator’s risk assessment process did not prevent the bosun working at height with an inadequate fall-protection system.

- 4.3.1 The operator’s Risk Identification, Assessment and Control Programme required risks to be identified, categorised and controlled. On the day of the accident, a working-at-height risk assessment was carried out for working on number 2 crane (see Appendix 1) and a checklist was completed before the wire change commenced.
- 4.3.2 The assessment sheet showed that the hazard of falling had been identified, the consequence of which was severe injury or death. The actions or control measures to reduce the risk were discussion, training, supervision and inspection of personal protective equipment before carrying out the wire change. A personal fall-protection system includes the harness, an anchor point and a lanyard and hook. All components must be fit for purpose and used correctly for it to be effective.
- 4.3.3 The bosun’s actions to free the snagged wire were impromptu and not properly planned. The initial risk assessment had not distinguished between working at height on the crane-house and working out on the crane-jib. Both were high-risk activities. However, the chances of the bosun losing his balance and the need to transfer his securing point were greater out on the jib. A task-specific risk assessment should have identified that additional control measures were required.
- 4.3.4 The location of the snag required an exposed traverse along the jib where there were fewer handholds, footholds and securing points. The jib was also more susceptible to the vibration and movement of the vessel. When the bosun lost his balance, the safety harness was the only thing preventing him falling to the deck, but it was not properly secured to a reliable strong point.
- 4.3.5 The harness that the bosun was wearing had only one lanyard. The sample harness that the Commission removed from the vessel was fitted with two lanyards. The two-lanyard type was

designed to provide security when the wearer is performing a task that requires them to move between anchor points.

- 4.3.6 The operator's instructions for working at height stated that, 'the harness must be attached to a reliably secured device right above the worker'. However, there were no designated fall-arrest anchoring points on the crane-jibs. This meant that the bosun or any other crew member could only achieve an attachment by passing the lanyard around a luffing wire and back onto itself. The hooks on the harnesses provided on board were mild steel carbine hooks with manually lockable gates. The hooks were not stamped with any identification, safe working load or indication of meeting the recommended Chinese standard for connectors used in personal fall-protection systems. They were not of a type suitable for looping around an attachment point and back onto the lanyard. They were not therefore suitable for use when changing a wire or any other task requiring the crew to work out on the crane-jibs.
- 4.3.7 A bulk carrier with its own cranes will, from time to time, require new crane wires to be fitted. This was not the first time that a wire and sock arrangement had become snagged on a cross-beam during this type of operation. A good risk assessment should have identified the need either to provide single securing points designed for the safety harnesses on board, or for the provision of harnesses with clips suitable for securing back onto themselves in the way the bosun rigged his harness. Equally, a good risk assessment should have identified the possible need to change securing points, and mitigated that risk by requiring a harness with dual securing lanyards. Either measure could have prevented the accident.

4.4 The decision to change the crane wire on passage

- 4.4.1 The vessel's schedule for testing and inspecting lifting appliances was up to date and the cranes had been surveyed by BV in order to confirm compliance with the International Labour Organization's convention No. 152. When the stevedores at Bluff found numerous broken strands in the hoisting wires on numbers 2 and 4 cranes, they were right to question their condition and to not use the cranes.
- 4.4.2 The crew agreed that the wires needed replacing, and the decision was made to change the hoisting wire on number 2 crane while the vessel was on passage from Bluff to Marsden Point. The intention was to have all of the vessel's cranes rigged with the best wires available on board.
- 4.4.3 However, there were no more new wires on board, so the crew used the damaged wire that had been removed from number 4 crane. The rules of BV required the crane to undergo a load test if a used wire was installed on the crane. Therefore, number 2 crane would have to have remained out of service at Marsden Point until an approved surveyor attended and witnessed a load test.
- 4.4.4 It is of concern that the crew were considering placing a used wire that had previously been considered not fit for purpose onto a crane. There was no logical reason for doing so, except if they intended to use the crane with the old wire at subsequent ports outside New Zealand.
- 4.4.5 Had a new wire been sourced and fitted, number 2 crane could have been operational before the *New Legend Pearl* left Marsden Point without the need for a load test. The wire change could have been carried out alongside using a personnel cage for working at height, and the risk substantially reduced.

4.5 Safety management and safety culture

Safety issue – The safety management system and the underlying safety culture on board did not meet industry good practice.

- 4.5.1 The *New Legend Pearl* had a safety management system that fulfilled the occupational health and safety requirements of its flag state, Panama.
- 4.5.2 However, a safety management system is only effective if it is being followed by the crew at all levels.

- 4.5.3 An effective safety management system must have operational procedures and instructions for high-risk work. Working at height in different areas of a vessel will present different risks not covered by standard procedures.
- 4.5.4 The operator's working-at-height instructions required a designated person to provide supervision and guidance to workers in 'the correct use of harnesses, safety lanyards, helmets and other protective equipment'. The designated person was in this case the chief officer. However, there was also a duty of care imparted on every crew member, at every rank, to look out for their own safety and the safety of others.
- 4.5.5 Working at height without wearing fall-protection equipment had been observed on board on two occasions when the vessel was in Bluff. The second occasion was in spite of the crew having been previously warned against the poor practice.
- 4.5.6 The continued practice by the crew of working at height with so few safeguards suggests that they did not fully understand fall-prevention systems or the dangers associated with working at height. It is an indication that it was normal procedure to work at height in an unsafe manner. The unsafe practices for working at height, the failure to ensure that the safety equipment was fit for the proposed task of changing a crane wire at sea, and the acceptance of installing a used crane wire that had already been rejected as substandard by the stevedores in Bluff were all indications of a poor safety culture on board the *New Legend Pearl*.
- 4.5.7 The Code of Safe Working Practices for Merchant Seafarers, issued by the United Kingdom Maritime and Coastguard Agency, describes a good safety culture as:
- ... one where safety is an integral part of everything that is planned, discussed, done and documented. With good safety culture everyone in the company thinks about safety and new ways of improving it as a matter of course. They are constantly on the lookout for any unsafe acts or unsafe conditions, look out for each other, intervene to prevent accidents and incidents, actively share good ideas and always seek to improve.
- 4.5.8 A recommendation has been made to the flag state Panama to seek improvements in the operator's implementation of its safety management system on board its vessels, including the underlying safety culture.

5 Findings

- 5.1 The bosun either slipped or lost his balance and fell eight metres to the deck below when transferring the securing hook for his safety harness from one point to another.
- 5.2 The gate on the safety harness hook was fitted with a locking collar to prevent the inadvertent release of the hook. It was about as likely as not that the locking collar was not engaged when the bosun fell.
- 5.3 The bosun's safety harness was not fit for the task he was performing. The hook was not designed to be secured in the manner that it was. The harness should have had a more robust hook and lanyard arrangement, designed to be tied back on itself and with dual lanyards to enable safe transfers between securing points.
- 5.4 The risk assessment conducted prior to the crew starting the wire replacement on crane number 2 did not fulfil the requirements of the operator's safety management system, because it did not adequately identify and manage the risks associated with the task.
- 5.5 The repeated failures of the crew to comply with safe working practices when working at height and the acceptance of using a substandard wire on a working crane are indications of a poor safety culture on board the *New Legend Pearl*.

6 Safety issues

- 6.1 The operator's risk assessment process did not prevent the bosun working at height with an inadequate fall-protection system.
- 6.2 The safety management system and the underlying safety culture on board did not meet industry good practice.

7 Safety actions

General

7.1 The Commission classifies safety actions by two types:

- (a) safety actions taken by the regulator or an operator to address safety issues identified by the Commission during an inquiry that would otherwise result in the Commission issuing a recommendation
- (b) safety actions taken by the regulator or an operator to address other safety issues that would not normally result in the Commission issuing a recommendation.

Safety actions addressing safety issues identified during an inquiry

7.2 Safety actions taken by the operator included a review of the safety management system. This review identified that the safety management system was not understood or seriously implemented on board the *New Legend Pearl*. Safety consciousness and safety management training on board were found to be inadequate. The following preventive measures were pledged:

- the accident would be reported to the company and crew and all vessels would be required to emphasise the harm to family and other crew members caused by this accident
- the company would strengthen the monitoring and management of vessels by regular crew safety inspections and crew safety awareness training in respect of 'safety first'
- supervision of masters' efforts to train their crews on the safety management system
- strengthening training in key operations and improving the professional qualities of the crew. 'We shall ensure that crew members follow the requirements of the safety management system and carry out their work on vessels in a satisfactory manner, with crew safety always our top priority'.

7.3 A circular was sent out to inform the fleet of the accident and to remind all vessels to constantly attach great importance to the work safety of crews. During the vessel's first port call in China after the accident, the designated person ashore and the crew company manager addressed the crew and reiterated the importance of personal safety on board.

Safety actions addressing other safety issues

7.4 None identified.

8 Recommendation

General

- 8.1 The Commission may issue, or give notice of, recommendations to any person or organisation that it considers the most appropriate to address the identified safety issues, depending on whether these safety issues are applicable to a single operator only or to the wider transport sector. In this case, a recommendation has been issued to the general director of the Panama Maritime Authority.
- 8.2 In the interests of transport safety, it is important that this recommendation is implemented without delay to help prevent similar accidents or incidents occurring in the future.

Recommendation

- 8.3 The continued practice by the crew of working at height with so few safeguards suggests that they did not fully understand fall-prevention systems or the dangers associated with working at height. It is an indication that it was normal procedure to work at height in an unsafe manner. The unsafe practices for working at height, the failure to ensure that the safety equipment was fit for the proposed task of changing a crane wire at sea, and the acceptance of installing a used crane wire that had already been rejected as substandard by the stevedores in Bluff were all indications of a poor safety culture on board the *New Legend Pearl*.
- 8.3.1 **On 27 September 2017, the Commission recommended that the general director of the Panama Maritime Authority seek improvements in the operator's implementation of its safety management system on board its vessels, including the underlying safety culture. (027/17)**

No reply was available at the time of publication.

9 Key lessons

- 9.1 Working at height is a risky activity and all crew should use suitable safety harnesses that are fit for the intended task.
- 9.2 Working at height is a risky activity that must be properly managed using a formal risk assessment methodology.
- 9.3 Attaching a safety harness by passing it through or around the securing point and back onto the lanyard is a dangerous practice that can result in inadvertent release unless the lanyard and hook are designed for that purpose.

10 Citation

Code of Safe Working Practice for Merchant Seafarers, 2015 edition – incorporating Amendment 1, October 2016 – published by Maritime and Coastguard Agency (United Kingdom).

Appendix 1: Risk assessment and risk control plan

Risk Assessment Sheet

风险评估表

Risk Assessment Sheet

风险操作名称 Operation : WORKING ALOFT

日期: 2016.11.03

做风险评估人 Risk assessment undertaken by: (names of people) [REDACTED]

Date:

工作场所 Workplace: (name of the workplace): NO.2 CRANE

编号 No	危害 HAZARD	采取的预防/保护措施 PREVENTIVE/PROTECTIVE MEASURES USED	风险的评判 RISK ESTIMATION/EVALUATION	降低风险的行动计划 ACTIONS PLANNED TO REDUCE RISK
1	FALLING	ARRANGE A FULL TIME WATCHMAN; PROPER WEARING PPA	SEVERE INJURY OR DEATH	DISCUSSED WITH OPERATORS & TRAINED BEFORE OPERATION. CHECK SAFETY BELTS AND ALL THE OTHER TOOLS BEFORE OPERATION.

船舶安全风险评估日期 : Date of Ship Safety Risk Assessment Conducted:	From: 2016.11.03 to:2016.11.03	评估人 Conducted by: C/OFFICER	
评估地点 Location of conducted Assessment: NO.2 CRANE	签名 Signature: [REDACTED]		
公司意见: Company 's Comment			

HongKong fortune INT'L Shipping Co., Ltd
公司

香港新福运国际船务有限

Appendix 2: Port State Control Inspection

FORM B REPORT OF INSPECTION IN ACCORDANCE WITH THE MEMORANDUM OF UNDERSTANDING ON PORT STATE CONTROL

Maritime New Zealand
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Box 27-006 Wellington 6141 New Zealand
Phone: +64 4 473 0111
Fax: +64 4 494 1263
E-mail: PSC@maritimenz.govt.nz

copy to: master, head office, PSCO
if ship detained copy to: Flag State, IMO, recognized organization, if
applicable

2.name of ship NEW LEGEND PEARL 6.IMO number 9414773
10.date of inspection 28.10.2016 11.place of inspection NZBLU - Bluff

20.list of deficiencies

no.	code	nature of deficiency	conventions	action(s) taken	responsible RO
1	09227	LIVING AND WORKING CONDITIONS - WORKING CONDITIONS/Ropes and wires/2 HEAD LINES AND ONE FORWARD SPRING LINE IN POOR CONDITION	C147 and P147: Health protection, medical care, welfare and social security	17 - Rectify deficiency before departure	
2	10116	SAFETY OF NAVIGATION/Nautical publications/IAMSAR MANUAL NOT LATEST EDITION	SOLAS ch. V	16 - Rectify deficiency within 14 days	
3	10105	SAFETY OF NAVIGATION/Magnetic compass/COMPASS HAS A BUBBLE	SOLAS ch. V	15 - Rectify deficiency at next port	
4	07115	FIRE SAFETY/Fire-dampers/STARBOARD ENGINE ROOM FIRE DAMPER DOES NOT FULLY CLOSE	SOLAS ch. II-2	17 - Rectify deficiency before departure 10 - Deficiency rectified	
5	09229	LIVING AND WORKING CONDITIONS - WORKING CONDITIONS/Winches & capstans/MOORING LINES TURNED UP ON DRUM ENDS	C147 and P147: Health protection, medical care, welfare and social security	17 - Rectify deficiency before departure 10 - Deficiency rectified	
6	07105	FIRE SAFETY/Fire doors/openings in fire-resisting divisions/FIRE CONTROL STATION DOOR (A CLASS) SELF CLOSING MECHINISM NOT WORKING	SOLAS ch. II-2	17 - Rectify deficiency before departure	
7	09204	LIVING AND WORKING CONDITIONS - WORKING CONDITIONS/Safe means of access/FOCSLE IN UNTIDY CONDITION THAT RESTRICTS ACCESS TO LIFESAIVING AND FIRE FIGHTING EQUIPMENT	C147 and P147: Health protection, medical care, welfare and social security	15 - Rectify deficiency at next port	
8	09228	LIVING AND WORKING CONDITIONS - WORKING CONDITIONS/Anchoring devices/NO HAMMER FOR ANCHOR BITTER ENDS	C147 and P147: Health protection, medical care, welfare and social security	17 - Rectify deficiency before departure 10 - Deficiency rectified	
9	09127	LIVING AND WORKING CONDITIONS - LIVING CONDITIONS/Cleanliness/GALLEY VENTS ARE DIRTY	C147 and P147: Accommodation, recreational facilities, food and catering	17 - Rectify deficiency before departure	
10	07105	FIRE SAFETY/Fire doors/openings in fire-resisting divisions/PURIFIER DOOR (A CLASS) TIED IN OPEN POSITION	SOLAS ch. II-2	17 - Rectify deficiency before departure 10 - Deficiency rectified	
11	11124	LIFE SAVING APPLIANCES/Embarkation arrangement survival craft/LIFERAFT EMBARKATION LADDER ROPE AT DECK CONNECTION POINT IS IN POOR CONDITION.	LSA Code	15 - Rectify deficiency at next port	
12	03104	WATER/WEATHERTIGHT CONDITIONS/Cargo & other hatchways/MAN ACCESS HATCH TO CARGO SPACES 1,2 AND 3 NOT CLOSING CORRECTLY LOADLINE COMPROMISED	Load Lines, LL66/ANI/R14;	30 - Detainable deficiency	Bureau Veritas (115)
13	03104	WATER/WEATHERTIGHT CONDITIONS/Cargo & other hatchways/MAN ACCESS HATCH TO CARGO SPACES 1,2 AND 3 OPENING MECHANISM NOT WORKING	Load Lines	15 - Rectify deficiency at next port	



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12-202	Fishing vessel <i>Torea</i> , collision with uncharted rock, Foveaux Strait, 24 August 2012
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10-202	<i>M.V. Anatoki</i> , grounding, off Rangihaeata Head, Golden Bay, South Island, 6 May 2010
11-204	Interim Report Marine inquiry 11-204 Containership MV <i>Rena</i> grounding on Astrolabe Reef 5 October 2011
09-202	Marine Inquiry 09-202: Passenger vessel <i>Oceanic Discoverer</i> Fatal injury, Port of Napier 19 February 2009

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