Report of investigation into the fatal accident on board Hong Kong registered bulk carrier "*Tiger Pioneer*" at the North Pacific Ocean (49°15.7'N, 159°40.1'W) on 24 June 2016

The Hong Kong Special Administrative Region

Marine Department

Marine Accident Investigation Section

28 June 2018

Purpose of Investigation

The purpose of this investigation conducted by the Marine Accident Investigation and Shipping Security Policy Branch (MAISSPB) of Marine Department is to determine the circumstances and the causes of the incident with the aim of improving the safety of life at sea and avoiding similar incident in future.

It is not intended to apportion blame or liability towards any particular organization or individual except so far as necessary to achieve the said purpose.

The MAISSPB has no involvement in any prosecution or disciplinary action that may be taken by the Marine Department resulting from this incident.

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1. Summary

All times are local (UTC-9) unless otherwise specified.

1.1 On 24 June 2016, the Hong Kong registered bulk carrier *Tiger Pioneer* (*the vessel*), under ballast condition, was en route from Busan, Republic of Korea to Kalama, USA. During the voyage in the North Pacific Ocean, the cargo hold cleaning operations were in progress preparing for loading grain at the arrival port.

1.2 At about 0800 hours, one able-bodied seaman (the AB) and two ordinary seamen (OS) were assigned to rinse the No. 3 cargo hold (the Hold) and its hatch coaming with high pressure fresh water gun.

1.3 At about 0840 hours, they were proceeding to enter the Hold to rinse the forward upper part. By climbing down the vertical ladder through a manhole, the AB entered into the cargo hold and reached the elevated gratings fitted passageway of the permanent means of access (PMA) platform which was about 14.4 metres above the tank top. When the AB stepped on the fourth grating counting from the port side, the grating detached from its support frame. Losing his balance, the AB fell onto the tank top together with the detached grating.

1.4 The AB was injured seriously. He was pronounced dead at about 1052 hours when *the vessel* was heading to the nearest emergency medivac rescue point.

1.5 The investigation into the incident revealed the main contributory factors as follows:

a) the AB failed to take extra precaution to avoid falling and did not follow the requirements of risk assessment to wear safety belt while he was walking on the elevated passageway in the Hold; and

b) the dislocation of the grating of the PMA platform in the Hold with its securing bolts and nuts missing might be caused by the vibration of the ship or the sloshing effect of the ballast water during her ballast voyage to loading ports.

1.6 The following safety issues were also found in the investigation:

a) the risk of the dislocation of the grating was not identified during the risk assessment for cargo hold cleaning operation; and

b) there was no procedure in the company safety management system to ensure all means of access arrangements remained in serviceable condition before being used.

2. Description of the vessel

Name of vessel	:	***Tiger Pioneer*** **(**Figure 1)
Flag	:	Hong Kong, China
Port of registry	:	Hong Kong
IMO No.	:	9712199
Ship type	:	Bulk carrier
Year built, shipyard	:	2015, Yangzijiang Shipyard Co., Ltd.
Gross tonnage	:	36,322
Net tonnage	:	21,603
Summer deadweight	:	63,461.9 metric tonnes
Length (Overall)	:	199.89 metres
Breadth (moulded)	:	32.31 metres
Main engine & power	:	1 x MAN B&W 5S60ME-C82, diesel engine, 8,050 kW
Classification society	:	Lloyd's Register (LR)
Registered owner	:	Marin Shipping Pte. Ltd.
Management company	:	Greathorse International Ship Management Co., Ltd.

Figure 1 – *Tiger Pioneer*

3. Sources of Evidence

3.1 The management company of *the vessel*.

4. Outline of Events

4.1 On 8 June 2016, *the vessel* departed from the port of Hongdagua, the Philippines under ballast condition to her next destination for loading grain in Kalama, USA. Her estimated time of arrival (ETA) at the next port of Kalama was 29 June 2016. *The vessel* called Busan, the Republic of Korea for bunkering and resumed her voyage on 13 June 2016.

4.2 During the voyage, all cargo holds were required to be cleaned preparing for loading grain in USA. Since the departure from Hongdagua, the crew had completed cleaning all cargo holds except No.3 cargo hold (the Hold) in which ballast water was filled for ocean passage.

4.3 On 22 June 2016, the crew washed the Hold with high pressure sea water and planned to rinse and clean with fresh water on the following day.

4.4 On 24 June 2016, *the vessel* was sailing in the North Pacific Ocean on course 086(T) with a speed of 12.0 knots to Kalama. The weather condition was fair with westerly wind up to Beaufort scale of force 5-6, rather rough sea with swell 2.5-3.0 metres and cloudy sky with visibility of 5.0 nautical miles. *The vessel* was rolling one to two degrees occasionally.

4.5 At about 0710 hours, the bosun reported to the chief officer on the bridge for daily job order as usual. In consideration the weather condition was acceptable, the chief officer confirmed with the bosun to rinse the Hold including its hatch coaming and the tank top with fresh water as the final step of cleaning.

4.6 The bosun assembled deck crew for tool box meeting and work assignment in the changing room. He gave a briefing of the cargo hold cleaning operations and emphasized the relevant risk and safety issues, such as to use personal protective equipment (PPE) including safety belt. The bosun assigned the work to two teams, Teams I and II. Team I consisted of the deceased AB and two OS. They were assigned to rinse the Hold and its hatch coaming with pressurized fresh water gun. Team II consisted of another AB and a cadet. They were assigned to go down onto the tank top of the Hold to clear the residual sea water. At about 0810 hours, both teams started the work.

4.7 About 30 minutes later, Team I completed rinsing of the forward port hatch coaming and prepared to enter the Hold through the manhole on the forward cross deck of the

Hold for interior washing. (Figure 2 and Figure 3)

4.8 At about 0840 hours, by climbing down the vertical ladder through the aforementioned manhole, the deceased AB entered into the Hold and stepped on the elevated PMA platform receiving the water gun with hose and safety belt lowered by the two OS on the deck. The AB then brought the water gun with hose with him and walked on the gratings of PMA platform (Figure 4 and Figure 5) to port side but without wearing the safety belt.

4.9 When the deceased AB stepped on the fourth grating counted from port side, the grating detached from its support frame. As such, the AB lost his balance and, together with the detached grating, fell onto the tank top which was about 14.4m below the PMA platform. The two OS on deck heard a clear clash sound from the Hold. They went to the hatch coaming immediately and found that the AB lay on the tank top (Figure 6).

4.10 Team II working on the Hold tank top witnessed the incident. The cadet immediately rushed to the AB and found the AB's head was bleeding severely with a pool of blood beneath his head. The AB of Team II immediately used his portable radio to report the incident to the bridge.

4.11 After receiving the message, the third officer and master on the bridge raised the ship's alarm, made internal public address announcement and activated the emergency shipboard rescue procedure.

4.12 At about 0845 hours, the rescue team arrived at the scene with first-aid kits and stretcher. They found that the AB's breathing and pulse were very weak. First-aid and cardiopulmonary resuscitation (CPR) were applied to the AB immediately followed by shifting the AB onto the stretcher and covered the AB with blanket.

4.13 Meanwhile, the master reported the incident to the ship management company via satellite phone. The company instructed the master to call the United States Coast Guard (USCG) Rescue Coordination Centre (RCC) for emergency medivac helicopter rescue in order to evacuate the AB.

4.14 At about 0903 hours, communication was established with the USCG RCC in Juneau (USCG Juneau) which was requested to arrange for emergency helicopter rescue operation. The local agent at destination port of Kalama was also informed to render urgent assistance.

4.15 At about 0932 hours, *the vessel* was at position 49°18'.5N, 159°26'.6W. As the closest air rescue source could only be available from Kodiak Island, Alaska, *the vessel* immediately altered her course to proceed to the designated rendezvous point as instructed by USCG Juneau.

4.16 At about 0957 hours, the AB was injected with Morphine (1ml/20mg) as advised by the duty flight surgeon of USCG Juneau.

4.17 The ship's crew continued to monitor vital signs and provided medical aid as advised by the medical guidance from USCG Juneau and air rescue station of Kodiak Island, Alaska (ARSKI). The medical guidance was given following the feedback of the AB's condition provided by the master.

4.18 At about 1046 hours, however, the AB's breathing and pulse stopped and his skin became pale. The master reported the same to USCG Juneau and ARSKI.

4.19 At about 1241 hours, the local agent relayed the message from the USCG Juneau duty flight surgeon that the AB was pronounced dead at 1052 hours on 24 June 2016 as any attempts would be futile given the nature and extent of his injuries. At about 1300 hours, the USCG Juneau duty flight surgeon confirmed with the master the same message via satellite phone and the emergency medivac helicopter rescue was stood down accordingly.

4.20 At about 1314 hours, *the vessel* resumed her voyage to the original destination of Kalama as per the company's instruction.

4.21 On 1 July 2016, *the vessel* arrived at Temco Terminal of Kalama and the remains of the AB were removed by the Cowlitz county Coroner's office on the same day.

5. Analysis

Ship certificates and crewmembers on board

5.1 All statutory certificates of *the vessel* were valid at the time of the incident.

5.2 As per the safe manning requirements, *the vessel* was adequately manned by 21 qualified crew members of Chinese nationality. Details of the experience of the master, relevant deck officers, bosun and the deceased AB are shown in the table below.

Rank	Service year with Company (months)	Service year on rank (years)	Current tour (months)
Master	7	3.0	3.5
Chief officer	9	6.0	1
3rd officer	22	2.0	3.5
Bosun	9	4.3	1
The AB	3.5	2.5	3.5

5.3 The deceased AB was 38 years old and was on his first tenure with the company. He had more than two years' experience in the same rank on vessels of similar type and had served about three and half months on board *the vessel* prior to the incident.

Weather conditions

5.4 The weather condition was fair with westerly wind up to Beaufort scale 5-6, rather rough sea with swell 2.5-3.0 metres and cloudy sky with visibility 5.0 nautical miles. *The vessel* was rolling one to two degrees occasionally. The slight rolling and pitching of *the vessel* was considered to be safe for carrying out cargo hold cleaning operations.

Fatigue, alcohol and drugs abuse

5.5 When the vessel was at sea, the AB usually kept watch on bridge as lookout for the shifts of 08-12 hours and 20-24 hours. During the cargo hold cleaning operations, he would provide assistance on deck whenever necessary. According to the duty records, he had sufficient rest time of 15 hours on 22 June 2016 and 16 hours on 23 June 2016 i.e. the two days before the incident. There was no sign of fatigue issue related to the incident.

5.6 Moreover, there was no drug or alcohol abuse related to the incident based on the available evidences.

Death of the AB

5.7 The AB fell down from the passageway of the elevated PMA platform which was about 14.4 metres above the tank top. The "Certificate of Death" issued by the Department of Health of State of Washington, USA clearly indicated that the cause of death of the AB was "blunt force traumatic injuries", which matched with the occurrence of fall from aloft.

Risk assessment and company procedures on cargo hold cleaning

5.8 The company had established procedures to identify the risk for the cargo hold cleaning operation on board *the vessel*. The procedure requires a form of "RA-C029 Cargo Hold Cleaning (Sweep and Washing)" to be completed for such operation.

5.9 The form RA-C029 was duly completed by the chief officer before the commencement of the cargo hold cleaning operation. It included a series of risk assessments for various aspects, e.g. falling objects, ventilation, adequate illumination, weather condition, pressure of the high pressure water jet and fall from height. Risks for all aspects were identified and considered as low risk including the fall from height under the existing safety control measures such as to wear safety belt when height was over two metres and to wear personal protective equipment (PPE) properly, etc.

5.10 However, there was no specific identification for the risk of passageway including the safe fixture of gratings. Neither the chief officer nor the AB realized that risk.

Working condition of the Hold

5.11 To facilitate cargo hold cleaning operation, ballast water in the Hold had been pumped out leaving small amount of seawater or salt stains presented on the surfaces of inner structures of the Hold, e.g. the ladders, passageway and tank top. The general condition of the Hold was satisfactory.

5.12 The hatch cover of the Hold was fully opened to provide sufficient natural light illumination. Before the deceased AB entered into the Hold, Team II had already entered into the Hold. It was not considered that the working condition of the Hold was a contributory factor to the incident.

Personal protective equipment

5.13 The AB wore proper PPE, i.e. a coverall boiler suit, a safety helmet with chin strap, gloves, rain coat and rain boots which were appropriate for working on deck.

5.14 When the AB prepared to work inside the Hold for the cleaning operation, a safety belt had been provided for him. Without any reason known, however, the AB did not wear the safety belt as per the requirement of safety control measures stipulated in the risk assessment. The safety belt was just put on the PMA passageway when the AB walked to the port side to commence the washing (Figure 4).

Permanent Means of Access (PMA)

5.15 In compliance with the requirements of International Maritime Organization resolution MSC.133(76) as amended by MSC.158(78), *the vessel* was fitted with PMA in all cargo holds for inspection and maintenance purpose. A typical configuration of PMA would include ladders, elevated platforms, passageways and gratings.

5.16 The PMA platform at about 14.4 metres above the tank top was assembled with guardrails, stanchions and rectangular gratings. The guardrails consisted of an upper rail at a height of 1 metre and an intermediate rail at a height of 0.5 metre. (Figure 5)

5.17 The rectangular gratings were supported by the platform support frames and secured by bolts and nuts at their four corners. The support frames were formed with "L' type angle bars and about 20mm higher than the upper surface of the gratings.

5.18 The dimensions of the grating involved in the incident and its support frame and the opening (Figure 7) were as follows:

	Length (cm)	Width (cm)	Length of Diagonal (cm)
Grating	***80.0***	70.5	106.6
The opening	71.0	60.0	***93.0***
Support frame	83.0	72.0	109.8

5.19 The design and the securing method of the gratings were in order. However, once the grating is dislocated due to missing of all its bolts and nuts, it might fall down through the opening of the supporting frame or the side edge of the frame.

5.20 After the incident, a detailed inspection was conducted to examine all PMA platforms

in cargo holds. Structural construction of all PMA were found in good condition, but securing bolts and nuts of some gratings were loosened or missing. Figure 8 shows their conditions in the fore end of the Hold and the following table shows the overall inspection results.

Passageway in cargo hold	Number of gratings	Number of nut missing (pcs)	Number of nut loosened (pcs)	Number of both nut and bolt missing (pcs)
No.1 fore	14	3	4	1
No.1 aft	21	1	0	0
No.2 fore	21	13	3	0
No.2 aft	22	1	7	0
No.3 fore (Figure 9)	**22**	**8**	**5**	**9 (two gratings with all 4 pieces missing)**
No.3 aft	22	10	1	1
No.4 fore	22	1	2	0
No.4 aft	22	0	4	0
No.5 fore	22	0	5	0
No.5 aft	15	0	2	1

5.21 From the table shown above, the missing or loosening of grating's securing bolts and nuts of the PMAs in the cargo holds were common, especially in No. 2 and No. 3 cargo holds which were in the midship section of *the vessel*. It could be deduced that the bolts and nuts might be missing or loosening due to ship's vibration. Furthermore, the sea water loaded in the Hold might also slosh over the PMA platform and the gratings during the ballast voyage. These sloshing forces could cause the loosening and missing of the secured bolts and nuts, resulting in the dislocation of the grating from its original position and/or the falling down of the grating from the support frames.

The AB falling from the PMA platform

5.22 According to the above analysis, the cause of the AB falling down from the PMA platform was that he did not strictly follow the requirements of control measures of the risk assessment results to wear safety belt while he was walking on the passageway of the elevated PMA platform. When the AB stepping on the grating

without noticed it was dislocated, the grating moved away from its supporting frame. The AB and the grating then fell through the PMA platform onto the tank top.

Emergency response to rescue casualty

5.23 After the incident happened, the crew members at the scene immediately reported it to the master. The master promptly activated the shipboard contingency response procedure, contacted the company and requested USCG Juneau for assistance. The AB was then provided with medical treatment on board according to the USCG Juneau's advice

5.24 The emergency response on board *the vessel* was considered proper and appropriate.

Review of the inspection procedures for means of access (MA) arrangements of cargo holds

5.25 Paragraph 2.3 of SOLAS regulations II-1/3-6 stipulates that "*the construction and materials of all means of access and their attachment to the ship's structure shall be to the satisfaction of the Administration. The means of access shall be subject to survey prior to, or in conjunction with, its use in carrying out surveys in accordance with regulation I/10*". The MA included the platform, passageways, gratings and ladders as aforementioned.

5.26 MA may be subject to deterioration in the longer term due to corrosive environment and external forces from ship motions and sloshing of liquid contained in the tank/cargo hold/space. As such, they should be inspected at regular intervals. The inspection procedures are to be contained in a section of the MA Manual (the Ship Structure Access Manual).

5.27 After the incident, the company had reviewed the company HSQE procedure "*MAINT-11 Instructions for Inspection and Maintenance of Cargo Holds/Tanks Structure and Coating*". There is no specific/detailed guidance of maintenance and inspection to the PMA platforms, passageways and its gratings.

5.28 The company had also reviewed *the vessel*'s planned maintenance system (PMS) (the AMOS[1] system), the guidance of maintenance and inspection to cargo holds are very limited as "Inspect cargo hold structures and conditions" without specific/detailed

[1] AMOS (Asset Management Operating System) - The acronym AMOS originally stood for 'Administration, Maintenance, Operations and Spares', a moniker that highlighted the solution's primary functions. However, reflecting the growing sophistication of the system, the meaning has since been revised– it now stands for 'Asset Management Operating System'. AMOS Maintenance is the world's leading maintenance management system for the maritime industry, used daily on thousands of vessels. The software is specifically designed to meet the demands of ship owners and managers aiming to improve operational performance and profitability.

instructions of Maintenance and Inspection to the PMA platforms, passageways and its gratings.

6. Conclusion

6.1 In the morning on 24 June 2016 while *the vessel* was in the North Pacific Ocean en route to Kalama, USA, the AB fell and landed onto the tank top to his death from the elevated PMA platform inside the No.3 cargo hold (the Hold).

6.2 The investigation into the incident revealed the main contributory factors as follows:

a) the AB failed to take extra precaution to avoid falling and did not follow the requirements of risk assessment to wear safety belt while he was walking on the elevated passageway in the Hold; and

b) the dislocation of the grating of the PMA platform in the Hold with its securing bolts and nuts missing might be caused by the vibration of the ship or the sloshing effect of the ballast water during her heavy ballast voyage to the loading port.

6.3 The following safety issues were also found in the investigation:

a) the risk of the dislocation of the grating was not identified during the risk assessment for cargo hold cleaning operation; and

b) there was no procedure in the ship's safety management system to ensure all means of access arrangement remained in serviceable condition before being used.

7. Recommendations

7.1 The ship management company shall consider to:

a) establish a procedure in the ship's safety management system manual to ensure that all means of access arrangements including securing devices are regularly inspected and maintained in serviceable condition, especially after loading with ballast water in cargo hold; and

b) issue safety instructions to remind all officers and crew to:

- take extra precaution when engaging in aloft works on the cargo hold means of access arrangements, and use safety belt or fall arrestor devices as far as practicable;
- inspect means of access to ensure they are in proper condition before using it; and
- assess the hazard of loosening or missing of the securing bolts and nuts of the gratings of PMA platforms which may result in the dislocation of the gratings and the risk of fall and brief all crew members of such hazard.
- Sign a form or checklist to confirm they have complied with all safety control measures before work.

7.2 A Hong Kong Merchant Shipping Information Notice is to be issued to promulgate the lessons learnt from the accident.

8. Submissions

8.1 Copies of the draft report shall be sent to the following parties for comments:

a) the shipowner/management company, the master and the chief officer of *the vessel*; and

b) the Ship Safety Branch of Marine Department.

8.2 Comments from the ship management company were received during the consultation period and the comments have been considered before finalization of the report.

Appendix I - Figures

Figure 2 - Overview of fore inspection access in the Hold (view from aft tank top)

Figure 3 - Entrance manhole on the cross-deck of the Hold hatch forward (view from Starboard side) and birdeye view from the manhole opening

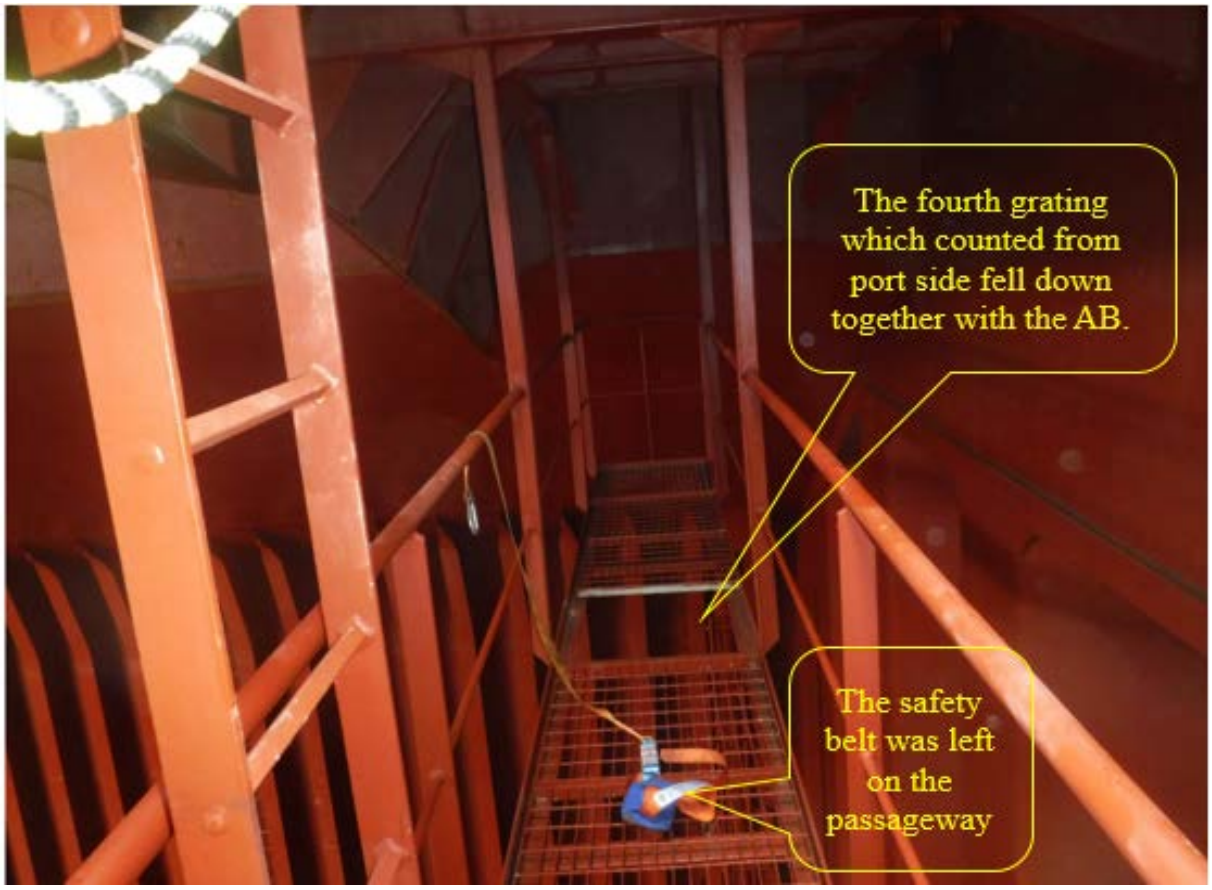

Figure 4 – The passageway on the fore PMA platform in the Hold (view from starboard side)

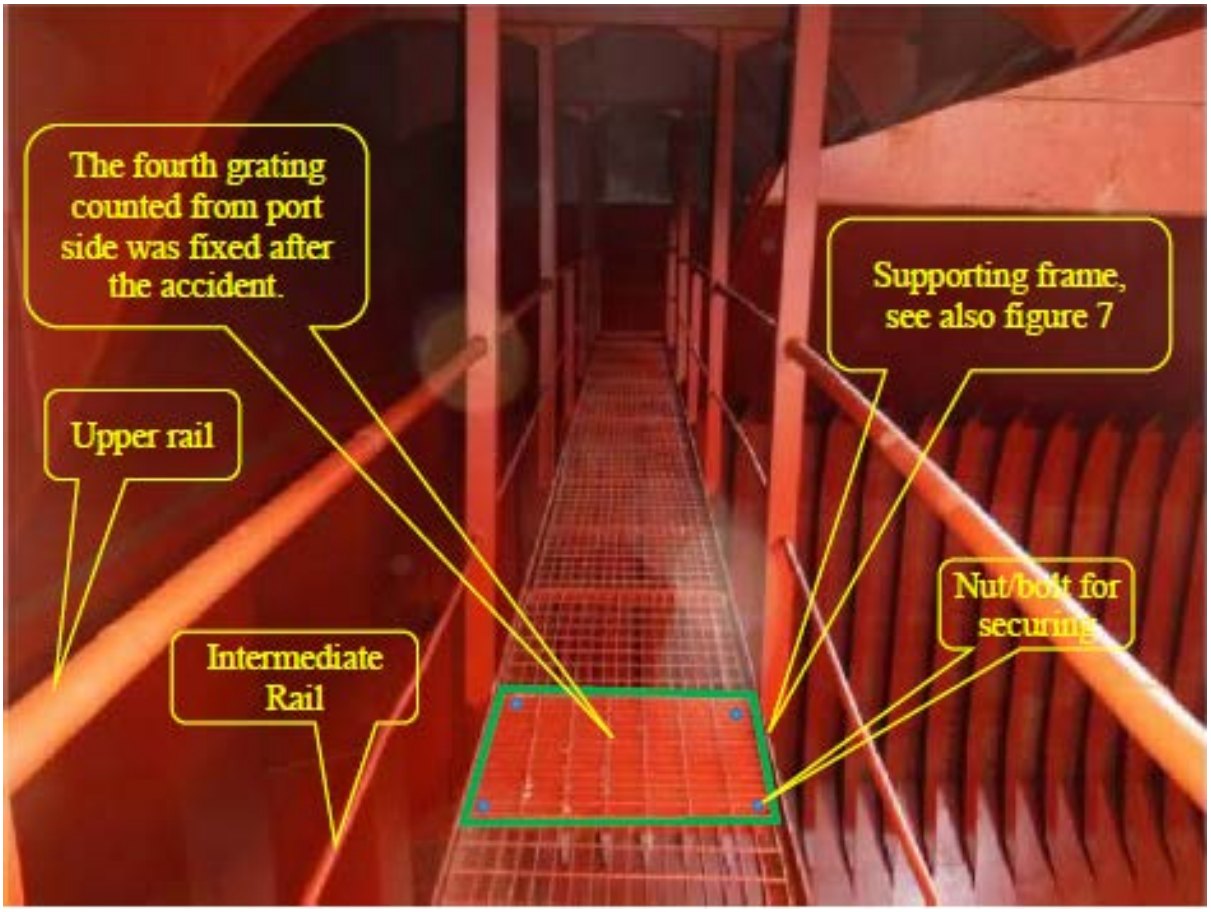

Figure 5 – the passageway on the fore PMA platform in the hold (view from port side)

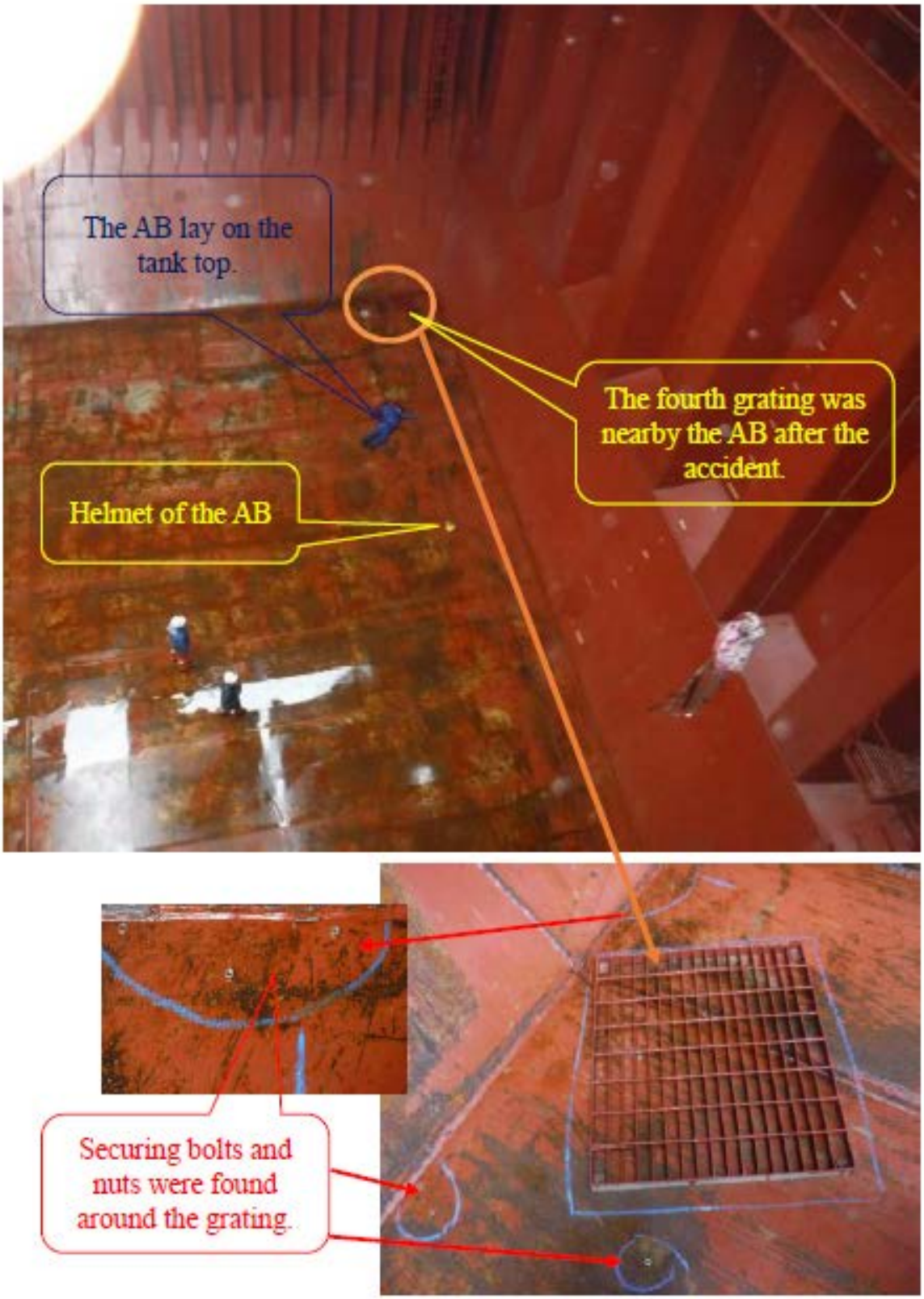

Figure 6 - The on-scene photos after the accident

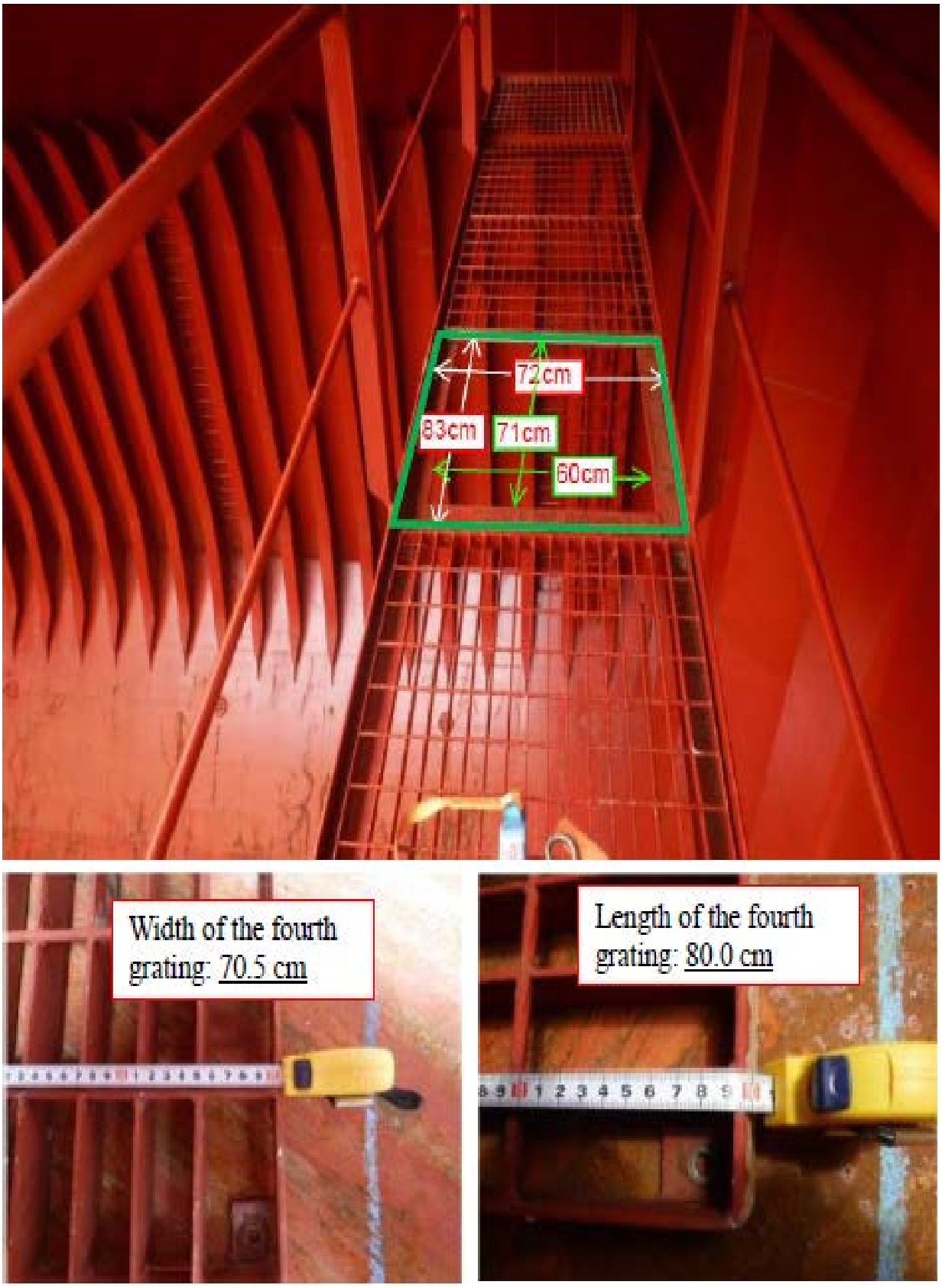

Figure 7 – The measurements of the support frame and the fourth grating

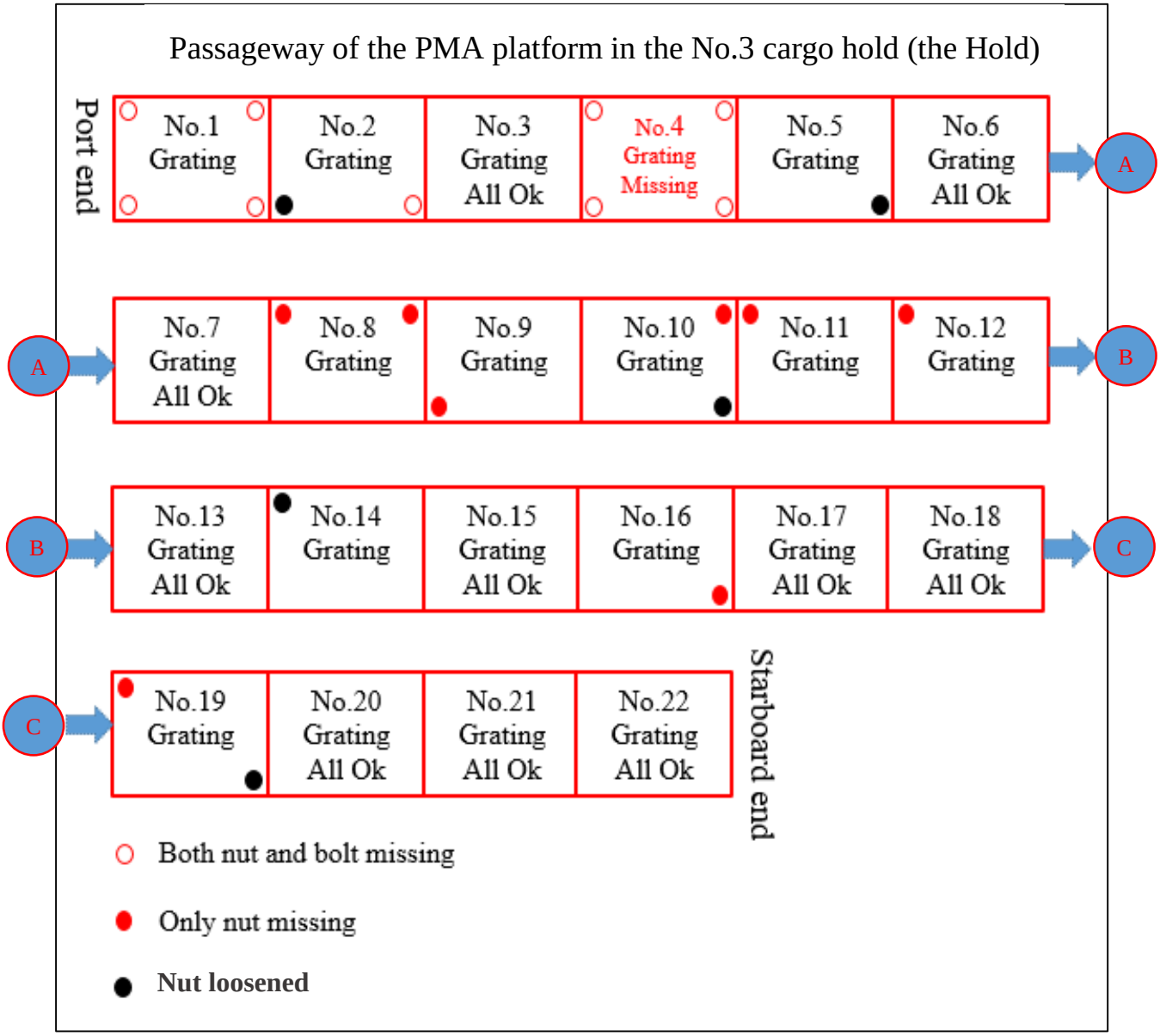

Figure 8 – Sketch to show the condition of the securing bolts and nuts of the gratings on the passageway in No. 3 cargo hold.