Report of Investigation into the fatal accident on board Hong Kong Registered Ship *Ocean Amber* at Richards Bay, South Africa on 20 February 2013

Marine Accident Investigation Section
Marine Department
The Hong Kong Special Administrative Region

1 September 2015

Purpose of Investigation

This incident is investigated in accordance with the Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (the Casualty Investigation Code) adopted by IMO Resolution MSC 255(84).

The purpose of this investigation conducted by the Marine Accident Investigation and Shipping Security Policy Branch (MAISSPB) of Marine Department, in pursuant to the Merchant Shipping Ordinance Cap. 281, the Merchant Shipping (Safety) Ordinance (Cap. 369), the Shipping and Port Control Ordinance (Cap. 313), or the Merchant Shipping (Local Vessels) Ordinance (Cap. 548), as appropriate, 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 incidents in the future.

The conclusions drawn in this report aim to identify the different factors contributing to the incident. They are 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.

Purpose of the investigation

Table of Contents Page

1 Summary

1.1 At about 2107 hours on 20 February 2013, a fatal accident happened on board the Hong Kong registered bulk carrier *Ocean Amber* (the *Vessel*) when the *Vessel* was anchored at the Richards Bay, South Africa at an approximate position of 28^0 53.78 S, 032^0 10.68 E.

1.2 Prior to the accident, the *Vessel* was dragging her port anchor drifting towards another nearby ship at the stern. Emergency operation to avoid collision by heaving up the port anchor was performed. At 2107 hours when operating the port anchor windlass, the windlass hydraulic motor exploded. An Able-Bodied seaman standing beside and operating the port anchor windlass was hit by debris against his neck and jaw. Despite rescue measures, he was declared dead at 2312 hours by paramedics from rescue helicopter.

1.3 The investigation into the accident revealed that the main contributory factor to the accident was that the loading capacity of the port anchor windlass had been exceeded due to the following reasons:

a) dragging of anchor and anchor chain on the seabed;
b) shock loading due to heavy rolling and pitching of the *Vessel* in severe weather and rough sea condition;
c) frictional force due to anchor chain touching of ship's hull;
d) fouling of anchor by an abandoned anchor chain on the seabed; and
e) severe rise of hydraulic pressure inside the port windlass hydraulic motor by runaway of the port anchor chain that probably started in a flash before the explosion.

1.4 The investigation also revealed the following safety factors:

a) the Master had not fully assessed the weather condition in the anchorage so as to prepare well for heaving up port anchor before the weather condition worsened. The anchor party was summoned only when the weather condition turned bad. The operation of heaving up the port anchor in severe weather condition contributed to the overloading of the port anchor windlass; and
b) the exploded windlass hydraulic motor was not fitted with safety guard. Understood that the maker of the anchor windlass only provides safety guards to new deliveries.

2 Description of the vessel

2.1 Particulars of "Ocean Amber"

Port of Registry	:	Hong Kong
IMO Number	:	9075670
Official Number	:	HK-1873
Call Sign	:	VRCR4
Classification Society	:	Nippon Kaiji Kyokai
Type of Ship	:	Bulk Carrier
Keel Laid	:	24 March 1994
Built At	:	Hyundai Heavy Industries, Ulsan, Korea.
Ship Owner	:	Noble Mount Investments Ltd, Hong Kong.
DOC Company	:	Fleet Management Ltd – HKG
Length Overall	:	224.97 metres
Breadth	:	32.25 metres
Depth	:	19 metres
Gross Tonnage	:	38,779
Net Tonnage	:	24,372
Deadweight	:	73,592
Main Engine	:	One set of Hyundai B&W 5S60MC
Engine Power	:	10,216 kW
No. of Crew	:	25

Fig. 1: M.V. "Ocean Amber"

2.2. "Ocean Amber" is a seven-hold bulk carrier built by Hyundai Heavy Industries, Ulsan, Korea in 1994. She is powered by a five-cylinder marine diesel engine, B&W 5S60MC, and is capable of developing an engine power of 10,216 kW. The *Vessel* is owned by Noble Mount Investments Limited, Hong Kong and managed by Fleet Management Limited, Hong Kong (the *Company*).

2.3 Accommodation and machinery space is located at the aft of the *Vessel*.

3 Sources of evidence

a) The statements of the Master, Officers and crew of the *Vessel*

b) Information provided by the Ship Management of the *Vessel*

c) The Classification Society of the *Vessel*

4 Outline of events

(All times were local time GMT + 2 hours unless otherwise stated)

4.1 On 16 February 2013, the *Vessel* arrived at Richards Bay, South Africa under ballast condition (drafts forward 4.50m and aft 7.00m). At 1610 hours, the *Vessel* anchored at position about 28^0 51.97 S and 032^0 11.86 E in accordance with the Port Authority's instruction, she used her port anchor with seven shackles of chain on deck.

4.2 While waiting for berthing to load coal cargo in bulk, as per Port Control Authority's instructions received on 17 February 2013 at 0837 hours, the *Vessel* was required to shift her anchoring position. At 0847 hours, she was re-anchored at position 28^0 53.78 S, 032^0 10.68 E using her port anchor with seven shackles on deck. At that anchoring position, the nature of the seabed at a water depth of about 53 meters was a mixture of fine sand and shells. The nearest distances of the *Vessel* from the coast and from the nearest ship in the anchorage were 6.47 nm[1] and 0.72 nm respectively.

4.3 On 20 February 2013 at 1757 hours, as the wind force increased, the Chief Officer was sent forward by the Master to check the port anchor as dust was seen coming out of the port anchor windlass momentarily. The Chief Officer found that there was too much weight on the port anchor chain and as a result, the bow stopper securing pin was bent. At that time, the wind direction was south to southwesterly of force 6 on the Beaufort wind scale (about 25 knots) and the swell was 2 to 3 meters. The *Vessel* was rolling frequently and pitching heavily.

4.4 The Third Officer at the bridge was called and the Master also went forward to inspect the port anchor and bow stopper securing pin. The Master and the Chief Officer decided to renew the pin, otherwise, it would be difficult to remove the bow stopper in case of emergency.

4.5 The crew was called to crop the port bow stopper securing pin and replace it with the pin from the starboard bow stopper. However, the replaced pin was bent shortly afterwards due to the heavy weight applied on the port anchor chain. A stainless steel rod was used to fabricate another pin which was used to secure the port bow stopper along with wire lashing.

4.6 At 2012 hours, the Third Officer, who had gone forward to recheck the port

[1] nm means nautical mile, 1 nautical mile equal 1.852 kilometer

anchor chain, reported to the Master that the distance from the nearby ship at the stern was decreasing. At 2014 hours, the Third Officer confirmed with the Master that the *Vessel* was dragging anchor and was closing in on the nearby ship at the stern. The Master called for anchor stations and a main engine movement was given on dead slow ahead to control the *Vessel*'s drift. At 2018 hours, the Third Officer announced through the *Vessel*'s public address system for the anchor party to go to the forecastle.

4.7 At 2032 hours, the Master was on the bridge and the Chief Officer was at the forecastle with the anchor party, standing-by to heave up port anchor. The hydraulic power pack of the windlass hydraulic motor was switched on and gear was engaged. At 2035 hours, the Chief Officer reported that the port anchor chain was moving up and down. The Master instructed the Chief Officer to heave the port anchor and keep standby there after removing the lashings of the port bow stopper as he was using the main engine to move the *Vessel* away from the nearby ship at the stern.

4.8 Shortly afterwards, the main engine was ordered half ahead and at 2042 hours, the Chief Officer reported that the port anchor chain was leading astern and there was weight on the port anchor chain. At that time, the *Vessel*'s speed was about 5 knots and she was dredging her port anchor to move away from the nearby ship at the stern. At 2045 hours, the Master informed crew members at the forecastle that the *Vessel* was unable to move forward and the *Vessel* was facing trouble in heaving up the port anchor. (The *Vessel* had increased her distance from the nearby ship at the stern from 0.35 nm to 0.7 nm.)

4.9 At 2047 hours, the main engine and rudder were being used to adjust the *Vessel*'s position and *Vessel*'s heading was being swung. The Chief Officer reported that the port anchor chain was moving up and down with moderate weight. The Master instructed crew members to start heaving up the port anchor.

4.10 At 2051 hours, the Master informed the Port Control Authority at Richards Bay that the *Vessel* was dragging anchor and was shifting her position.

4.11 At 2052 hours, the Chief Officer reported that the port anchor chain was moving up and down but not coming up, and that there was weight on the port anchor chain. At 2054 hours, the port anchor chain had gone across the bow and did not come up. At 2055 hours, the port anchor chain was pointing at the 12 O'clock direction. At 2056 hours, the Master informed crew members that the *Vessel* was moving ahead using main engine. The Chief Officer reported that the port anchor chain was coming up now. At 2057 hours, the port anchor

chain was pointing at the 10 O'clock direction at medium stay. At 2059 hours, the port anchor chain was pointing at the 9 O'clock direction at short stay, leading astern and coming up. At 2104 hours, the port anchor chain was at short stay leading astern and the sixth shackle was coming up. At 2106 hours, the port anchor chain was leading astern and not coming up. At 2107 hours, the port anchor chain was at short stay, touching ship side. When the Master asked to heave the port anchor, the positions of the Chief Officer and the two Able-Bodied Seamen "A" and "B" were as shown in the photograph re-constructed after the accident (Fig.2), and as shown on the forward mooring station layout plan (Fig.3). The Chief Officer was near the bulwark on the port side, whereas "A" and "B" were beside the port anchor windlass.

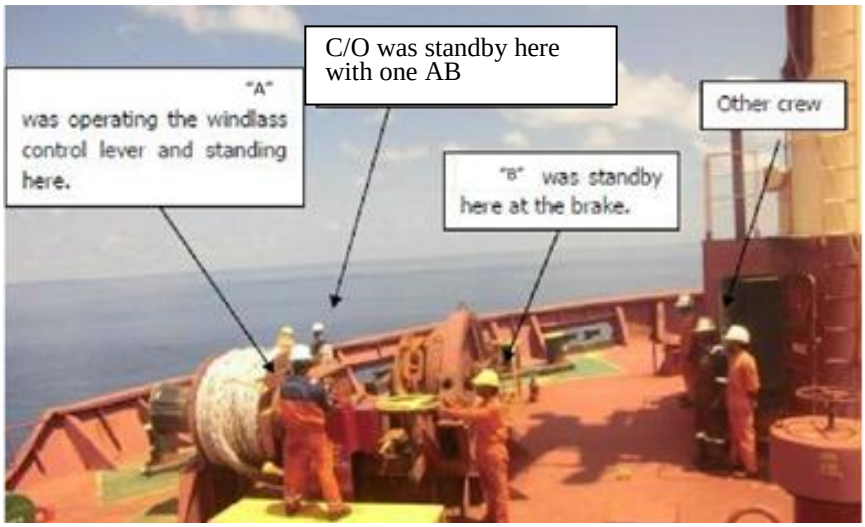

Fig. 2: Photograph re-constructing the positions of the Chief Officer, "A" and "B" at the time of the accident

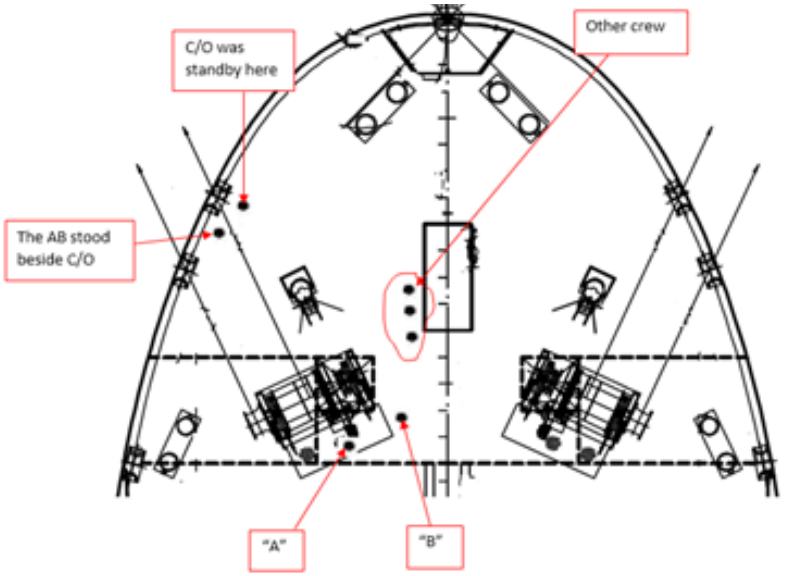

Fig. 3: Layout plan of the forward mooring station marked with the positions of the Chief Officer, "A" and "B" at the time of the accident

4.12 When "B" saw fire sparks (probably from metal grinding), which lasted for a few seconds, emerging from a position close to the windlass hydraulic motor, "A" attempted to apply the brake on the port anchor windlass (Fig.4). Suddenly, the windlass hydraulic motor exploded. "B" ducked down immediately once he heard the abnormal sound. "A" was unfortunately hit by debris against his neck and jaw. He limped towards starboard side and lied on the deck near No.1 cargo hold booby hatch.

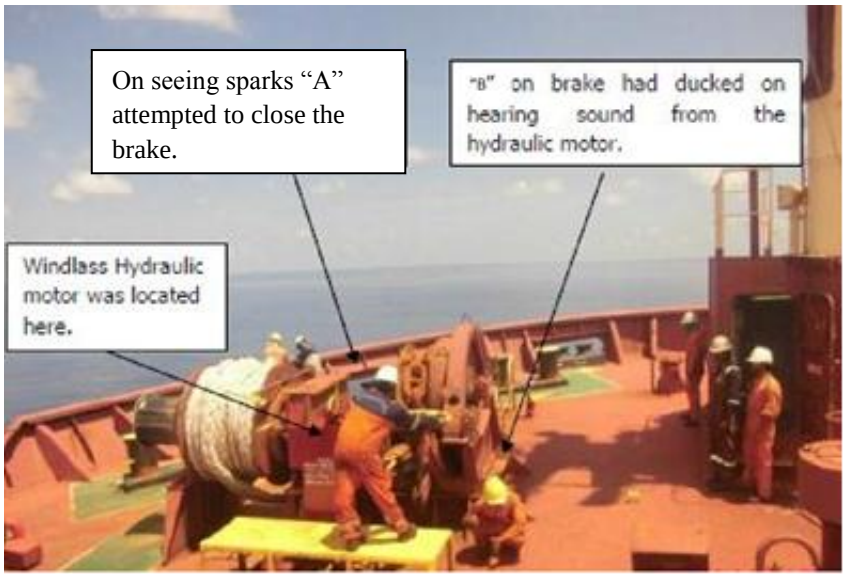

Fig. 4: Photograph re-constructing the actions of "A" and "B" at the time of the accident

4.13 The port anchor chain ran out few links. The Chief Officer and other crew members applied brake to control the port anchor chain. "B" immediately switched off the electrical power supply to the hydraulic power pack of the windlass hydraulic motor.

4.14 "A" was bleeding profusely. The crew tried to stop the bleeding by applying pressure using hand and clean cloth, but it was in vain. At 2117 hours, the Master reported the accident to the Port Control Authority at Richards Bay and requested for immediate helicopter evacuation. At 2215 hours, "A" stopped responding. He had no breathing or pulse and his bleeding stopped. At 2310 hours, an emergency rescue helicopter landed on the *Vessel* and at 2312 hours, "A" was declared dead by paramedics.

4.15 The port windlass hydraulic motor was completely damaged. Ship staff dismantled the starboard windlass hydraulic motor and switched over to replace the damaged one on port side in order to lift up the port anchor. At 0922 hours on 23 February 2013, when the port anchor was heaved up from the water, it was

found that the port anchor was fouled by an abandoned anchor chain on seabed. The finding was reported to the Port Control Authority.

4.16 On 26 February 2013, the *Vessel* was berthed at Richards Bay coal terminal. The deceased was landed and handed over to local authorities for autopsy.

4.17 The damaged port windlass hydraulic motor and the broken parts of the motor are shown in Fig.5 and Fig.6.

Fig. 5: The damaged port windlass hydraulic motor

Fig. 6: The broken parts of the port windlass hydraulic motor

5 Analysis

Working experience & training

5.1 The Master of the *Vessel* had about ten years of seagoing experience, about four years of which were in the capacity of a master. He took over the *Vessel* as a master about four months before the accident. He held a Certificate of Competency as a master issued by the Government of India on 23 August 2007 of validity until 31 December 2016, and a Class 1 License (Deck Officer) issued by the Hong Kong Marine Department on 10 October 2012.

5.2 The Chief Officer had about 10 years of seagoing experience. It was his first vessel assigned in the capacity of a chief officer. He joined the *Vessel* about two months before the accident. He held a Certificate of Competency as a chief mate issued by the Government of India on 31 March 2005 of validity until 30 May 2016, and a Class 2 License (Deck Officer) issued by the Hong Kong Marine Department on 24 November 2011.

5.3 The deceased Able-bodied (AB) seaman had about nine years of seagoing experience, about eight years of which were in the capacity of an AB. He joined the *Vessel* in the rank of AB about one month before the accident. He held a Certificate of Competency issued by the Government of India on 2 September 2002 and was qualified to assist in carrying out navigational watch.

Fatigue at work, alcohol abuse

5.4 There was no evidence to show that any crew member, including the deceased, suffered from fatigue at work. An unannounced random alcohol test was conducted for some crew members after the accident and there was no indication or evidence of alcohol abuse.

Severe weather in the anchorage

5.5 The *Vessel* was in the outer fringe of a tropical revolving storm existing in the Mozambique Channel, Indian Ocean. The adverse weather in the area was primary caused by the storm.

5.6 Richards Bay was open to the direct effect of the weather from the India Ocean. In this accident, seven out of eleven lengths of anchor chain at port side were lowered and it required a considerable anchor windlass capacity to heave them up even under good weather condition.

5.7 The anchor party was summoned only when the weather condition turned bad

and under such condition, the loading capacity of the port anchor windlass could have been exceeded. The Master had not fully assessed the weather condition in the anchorage so as to prepare well for heaving up the port anchor before the weather condition worsened.

The anchor windlass

5.8 The *Vessel* was provided with two sets of stockless High Holding Power Anchors each weighing 7,425 kg. Each anchor was connected to a 78 mm diameter anchor chain (Grade K3) of length 11 shackles. The type of anchor windlass was 1906-8816So (Central Hydraulic System) manufactured by Friedrich Kocks GMBH, BREMEN under TTS Kocks (TTS) and certified by Lloyds Register (Fig. 7). The type of driving winch was 8816So. The maximum pull was 434 kN and the maximum depth was 194 m. The average speed from a depth of 82.5 m was 9 m/min. The brake holding power at chain lifter was 2,068 kN.

Fig. 7: Port anchor windlass

5.9 The windlass hydraulic motor was manufactured by Friedrich Kock GmbH, Bremen under TTS Kocks (TTS) (Fig. 8). The type of the windlass hydraulic motor, according to the maker's manual, was A6VM80 with a cast iron casing and a total of seven pistons. However, it was reported that the windlass hydraulic motor for both port and starboard anchor windlasses on board had been replaced after 4 years of service of the *Vessel* by a higher capacity model of A6VM107. The record of this replacement was not available on board.

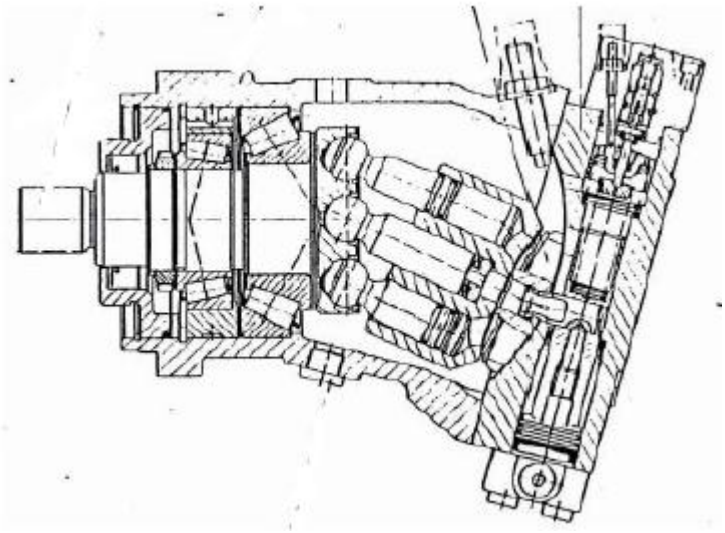

Fig. 8: The sectional drawing of the windlass hydraulic motor

5.10 There was a pressure relief valve (Fig. 9), set at a relief pressure of 280 bars, to protect the hydraulic power pack, which was installed inside the fore peak store, from over-pressure. There was no pressure relief valve fitted on the windlass hydraulic motor.

5.11 It was a class requirement that over pressure protection be provided on the discharge side of the hydraulic pump. In this case, a pressure relief valve was fitted in a closed circuit through which the hydraulic oil would be discharged back to the system oil tank once the pressure relief valve was activated. The arrangement complied with the class requirement.

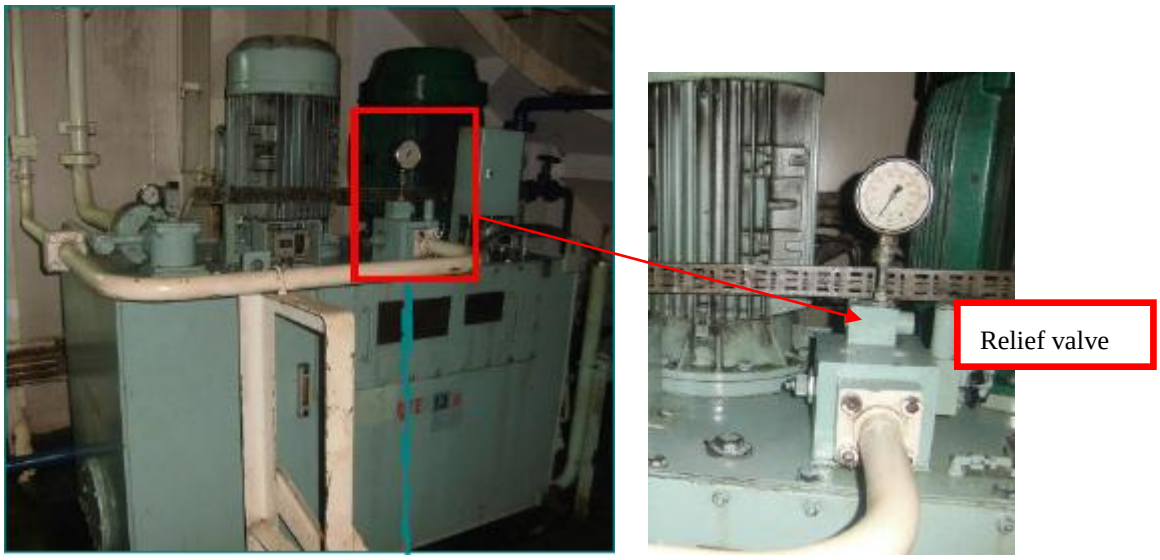

Fig. 9: Hydraulic Power Pack in Fore Peak Space

Similar accidents

5.12 Similar catastrophic failures of windlass hydraulic motors had previously happened and investigation reports from the Australian Transport Safety Bureau (MV" *APL Sydney*" on 13 December 2008), and the Marine Accident Investigation Branch of UK (MV" *Stellar Voyager*" on 23 March 2009) had established causes linked to the design by the equipment maker TTS Kocks (TTS).

5.13 Subsequently, the concerned Classification Society recommended installing a guard for this type of anchor windlass from TTS to protect the operator. TTS agreed with the recommendation and safety guards were installed on new anchor windlasses.

5.14 However, it was reported by the *Company* that no information of the safety guard was provided to existing vessels.

The most probable causes of the accident

5.15 At the time of the accident at 2107 hours on 20 February 2013, the port anchor chain was at short stay, leading astern and touching ship side as reported by the Chief Officer. The Master asked to heave up the port anchor. Shortly afterward, the windlass hydraulic motor of the port anchor windlass exploded.

5.16 The port anchor windlass was driven by a high speed windlass hydraulic motor which was coupled with a planetary reduction gear box with gear ratio of 1168:1. Such a high gear ratio would result in severe over speeding of the windlass hydraulic motor if the port anchor chain probably started to run out a few link in a flash not noticeably just before the explosion by external forces with the windlass hydraulic motor engaged with the chainwheel. Over speeding of the port windlass hydraulic motor in the reverse direction would result in severe rise of hydraulic pressure inside the motor due to the positive displacement pumping action.

5.17 At the time of the accident, it was probably that the loading capacity of the port anchor windlass had been exceeded due to the following factors that had contributed to the total force applied on the port anchor chain:

a) dragging of anchor and anchor chain on the seabed;
b) shock loading due to heavy rolling and pitching of the *Vessel* in severe weather and rough sea condition;

c) frictional force due to anchor chain touching of ship's hull; and
d) fouling of anchor by an abandoned anchor chain on the seabed.

5.18 The other safety factors revealed:

a) the Master had not fully assessed the weather condition at the anchorage so as to prepare well for heaving up port anchor before the weather condition worsened. The anchor party was summoned only when the weather condition turned bad. The operation of heaving up port anchor in severe weather condition contributed to the overloading of the port anchor windlass; and

b) the maker of the anchor windlass only provided safety guards to new deliveries while no guard or protective device being provided to existing vessels, i.e. no safety guard was fitted onto the windlass hydraulic motor of the *Vessel* to protect operators.

Safety measures for prevention of injury of personnel

5.19 According to recommendation made by the maker, safety guards may be helpful to protect operators in case of explosion occurred. The recommendation was accepted and both port and starboard hydraulic motors were fitted with safety guard.

6 Conclusion

6.1. At 2107 hours on 20 February 2013, a fatal accident happened on board the *Vessel* when she was anchored at the Richards Bay, South Africa at an approximate position of 28^0 53.78 S, 032^0 10.68 E.

6.2. Prior to the accident, the *Vessel* was dragging her port anchor drifting towards another nearby ship at the stern. Emergency operation to avoid collision by heaving up the port anchor was performed. At 2107 hours when operating the port anchor windlass, the windlass hydraulic motor exploded. An Able-Bodied seaman standing beside and operating the port anchor windlass was hit by debris against his neck and jaw. Despite rescue measures, he was declared dead at 2312 hours by paramedics from rescue helicopter.

6.3. The investigation into the accident revealed that the main contributory factor to the accident was that the loading capacity of the port anchor windlass had been exceeded due to the following reasons:

a) dragging of anchor and anchor chain on the seabed;
b) shock loading due to heavy rolling and pitching of the *Vessel* in severe weather and rough sea condition;
c) frictional force due to anchor chain touching of ship's hull;
d) fouling of anchor by an abandoned anchor chain on the seabed; and
e) severe rise of hydraulic pressure inside the port windlass hydraulic motor by runaway of the port anchor chain that probably started in a flash before the explosion.

6.4 The investigation also revealed the following safety factors:

a) the Master had not fully assessed the weather condition in the anchorage so as to prepare well for heaving up port anchor before the weather condition worsened. The anchor party was summoned only when the weather condition turned bad. The operation of heaving up the port anchor in severe weather condition contributed to the overloading of the port anchor windlass; and
b) the exploded windlass hydraulic motor was not fitted with safety guard. Understood that the maker of the anchor windlass only provides safety guards to new deliveries.

7 Recommendation

7.1 A copy of this report is to be forwarded to the *Company* informing them the findings in the investigation and reminding them :

a) safety alert should sent to all vessels in the managed fleet to warn crew members on board regarding the accident and precautions should be observed for anchoring operation;

b) on board training should be carried out to educate crew members for correct handling procedure of anchor windlass and vessel, with special emphasis on circumstances such as anchor dragging, adverse weather conditions, anchor fouling, etc. which may place excessive load on the windlass equipment and handling of anchoring equipment in such scenarios;

c) physical guards and barriers should be made around the windlass hydraulic motors to protect personnel involved in anchoring operation from the potential explosion of the windlass hydraulic motor; and

d) internal audit of the vessel*'s* safety management system should be carried out to locate any shortfall in the system and to enhance the efficiency of safety management on board.

7.2 A Merchant Shipping Information Note (MSIN) should be issued to promulgate the lessons learnt from this accident.

8 Submission

8.1 In the event that the conduct of any person or organization is commented in an accident investigation report, it is the policy of the Marine Department to send a copy of draft report to that person or organization for comments.

8.2 The draft report was sent to the follows for comments

a) the ship management company of the *Vessel ;*
b) the maker of the windlass hydraulic motor Friedrich Kocks; and
c) the Port Control Authority at Richards Bay, South Africa.

8.3 Comments were received from the ship management company of the *Vessel* only. Their comments had been considered and the content of the report was revised where appropriate.