



REPUBLIC OF THE MARSHALL ISLANDS

Maritime Administrator

POLAR COD CASUALTY INVESTIGATION REPORT

Fall from Height in Engine Room

Arabian Gulf | 14 May 2019

Official Number: 4214

IMO Number: 9334557



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AUTHORITY

An investigation, under the authority of the Republic of the Marshall Islands laws and regulations, including all international instruments to which the Republic of the Marshall Islands is a Party, was conducted to determine the cause of the casualty.



Maritime Administrator

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PART 1: EXECUTIVE SUMMARY

On 14 May 2019, the Republic of the Marshall Islands-registered oil tanker POLAR COD, managed by Prime Tanker Management Inc. (the “Company”), was underway in the Arabian Gulf on a loaded voyage from the Kingdom of Saudi Arabia to Singapore.

At 1300,¹ the Third Engineer (3/E) reported to the Engine Control Room (ECR). While in the ECR with the Chief Engineer (C/E) and Second Engineer (2/E), a high-level alarm for a waste oil tank activated. After acknowledging the alarm, the 3/E left the ECR to check the cause. He was seen climbing an inclined ladder leading from the Engine Room’s second deck to the upper deck. Shortly thereafter, the Fourth Engineer (4/E) saw the 3/E falling to the main engine cylinder head intermediate platform. The 4/E was working in the Engine Workshop at the time and did not witness the start of the 3/E’s fall.

The Messman, who was reported by the Company to also be a medical doctor, checked the 3/E and determined he was not breathing and did not have a pulse. Cardiopulmonary resuscitation (CPR) was immediately started by the crew; however, the 3/E was determined to be deceased at 1415. As the time elapsed between the 3/E’s fall and when he was seen climbing the ladder was under 10 seconds, it is presumed that he fell from the inclined ladder between the second deck and upper deck from a height of 6 to 11.3 meters (m).

Although the cause of the 3/E’s fall could not be determined since there were no witnesses, the marine safety investigation conducted by the Republic of the Marshall Islands Maritime Administrator (the “Administrator”) concluded the following:

1. Causal factors which may have contributed to this very serious marine casualty include:
 - (a) the height of the handrails on the inclined ladder between the second deck and the upper deck of POLAR COD’s Engine Room were lower than the design specification;
 - (b) possible physiological or psychological stresses resulting from the 3/E’s weight loss efforts; and
 - (c) high ambient temperatures in the Engine Room while the ship was in the Arabian Gulf.
2. An additional factor identified, which did not contribute to this very serious marine casualty, was the 3/E’s failure to use the chin strap of his safety helmet at the time of his fall.

¹ Unless otherwise specified, all times are ship’s local time (UTC +3).

PART 2: FINDINGS OF FACT

The following Findings of Fact are based on the information obtained during the Administrator's marine safety investigation.

1. Ship particulars: *see* chart to right
2. On 14 May 2019, POLAR COD was berthed at Al Jubail, Kingdom of Saudi Arabia to load naphtha. The C/E, 3/E, and Electrician were in the Engine Room preparing for departure.
3. At about 0400, the 2/E relieved the 3/E as the Duty Engineer. The 3/E then went to his cabin for rest. The C/E and Electrician remained in the Engine Room with the 2/E and the 4/E.
4. At 0430, POLAR COD departed Al Jubail bound for Singapore. The ship was operating in Unmanned Machinery Space (UMS) mode following departure.
5. At about 1300, the 3/E returned to the ECR after having taken nine hours of rest. At the time, the C/E and 2/E were also in the ECR which is located on the Engine Room's second deck.
6. At 1327, a "Waste Oil Tank Level – High" alarm activated. The 3/E acknowledged the alarm on the control console and then left the ECR at about 1330 to investigate the cause.
7. Immediately after exiting, the 3/E was seen drinking from a water cooler located just outside the ECR. He was then seen by the C/E climbing the inclined ladder that went from the Engine Room's second deck to its upper deck.
8. The 4/E was working in the Engine Workshop on the second deck. As he was exiting the workshop, he saw the 3/E falling from above and landing on the main engine cylinder head intermediate platform. The 4/E did not see the start of the 3/E's fall nor where he fell from. He looked down and saw the 3/E lying motionless on the intermediate platform.
9. The C/E reported that he had heard something fall but did not know what it was. He estimated that about eight seconds elapsed from when he saw the 3/E climbing the ladder to when he heard the sound.

SHIP PARTICULARS

Ship Name
POLAR COD

Registered Owner
Polar Cod Shipping LLC

ISM Ship Management
Prime Tanker Management Inc.

Flag State
Republic of the Marshall Islands

IMO No.	Official No.	Call Sign
9334557	4214	V7VU4

Year of Build	Gross Tonnage
2007	40,865

Net Tonnage	Deadweight Tonnage
22,274	73,919

Length x Breadth x Depth
219.9 x 32.2 x 20.6 meters

Ship Type
Oil Tanker

Document of Compliance
Recognized Organization
Lloyd's Register

Safety Management Certificate
Recognized Organization
Lloyd's Register

Classification Society
American Bureau of Shipping

Persons on Board
21

10. The 4/E rushed to the ECR to notify the others that the 3/E had fallen. The C/E then notified the Officer on Watch, who sounded the general alarm and made an announcement over the public address system.
11. The Messman² went to the Engine Room and determined that the 3/E was not breathing and did not have a pulse. It was also reported that he had a significant injury to his head. CPR was started immediately. Once the remaining crewmembers mustered, a neck brace was fitted on the 3/E and he was taken by stretcher to the ship's Hospital.
12. At 1415, the 3/E was determined to be deceased and resuscitation efforts were stopped. The ship diverted to the nearest port, Doha, State of Qatar.
13. The Ministry of Public Health in Qatar issued a death certificate which listed the cause of death as multiple blunt injuries consistent with a fall from height.

Height of Fall

14. Although no one witnessed the start of the fall, it is believed that the 3/E was on the ladder between the second deck and the upper deck when he fell. He was seen starting to climb the ladder and the C/E estimated that only eight seconds had elapsed from when the 3/E started climbing and when he heard something falling to the deck.
15. The main engine cylinder head intermediate platform is about 11.3 m below the upper deck and about 6 m below the second deck. It is estimated that the 3/E may have fallen between 6 to 11.3 m.

Construction of Inclined Ladder

16. The ladder between the Engine Room's second deck and upper deck is inclined at about 56 degrees (°) and is 76 centimeters (cm) in width (*see Figure 1*).



Figure 1: Photo of the inclined ladder, taken from the second deck.

² The Company reported that the Messman is a medical doctor.

17. The ladder has 28 millimeter (mm) diameter handrails on both sides. These handrails are 80 cm vertically above the ladder treads and 40 cm from the side stringers, when measured perpendicularly (see Figure 2).



Figure 2: Dimensions of inclined ladder between the second deck of Engine Room and the upper deck. (Note: Rope which is affixed in the position of an intermediate railing was not in place at the time of the incident.)

18. The design specification for the railing indicates that the railings on this ladder should be 50 cm from the stringers. An intermediate railing was not included in the design, nor was one fitted during new building. There was not an intermediate railing present at the time of the incident.
19. The treads are parallel, spaced 25 cm vertically from each other, and 20 cm in depth. The treads are made of diamond plate steel with a rounded nose.

Relevant Regulations and Recommendations

20. The International Maritime Organization (IMO) Fire Safety Systems (FSS) Code, Resolution MSC.98(73), Chapter 13 Regulation 3 requires that stairways used as a means of escape have at least 70 cm of clear width between the handrails. The FSS Code also requires that the inclination of means of egress from machinery spaces not be greater than 60°. The FSS Code does not include requirements for the height of handrails or for an intermediate railing.
21. The International Association of Classification Societies (IACS) Recommendation No. 132 Human Element Recommendations for structural design of lighting, ventilation, vibration, noise, access and egress arrangements, issued in 2013, provides guidance for the design of stairs and ladders. It recommends that stairs should have an angle of inclination of 38° to 45°, while vertical ladders should be between 80° to 90°. It does not provide guidance for inclined ladders, with inclinations greater than 45° but less than 80°. However, it recommends that stairs with both sides exposed should be fitted with two-tier handrails, between 40 mm and 50 mm in diameter, on both sides.

22. The American Bureau of Shipping (ABS) Guidance Notes on the Application of Ergonomics to Marine Systems (the “Guidance Notes”) include recommendations regarding the design of inclined ladders. The Guidance Notes state that inclined ladders should have an angle of inclination between 45° to 60°. It also recommends that handrails be between 40 mm and 50 mm in diameter and at a height of 91.5 cm to 100 cm above the leading edge of the tread. Treads should be equally spaced vertically between 20 cm and 30 cm apart and be at least 10 cm in depth. The Guidance Notes were first published in 1998 and were last amended in 2018. Recommendations relating to stairs and ladders were first incorporated into the Guidance Notes in 2013.

Personal Protective Equipment (PPE)

23. The Company’s Safety Management System (SMS) required that a boiler suit, safety helmet, hearing protection, and safety shoes be worn while working in the Engine Room. The 3/E was reported to be wearing the required PPE when he fell, except that he was not using the chin strap on his safety helmet.

Working Conditions

24. On the day of the incident, the temperature in the Engine Room was reported to be 43° to 48° Celsius (C). The Company reported this was normal for ships operating in the Arabian Gulf.

25. POLAR COD’s ECR is air conditioned and this was reported to be working before and at the time of the incident.

26. It was reported that POLAR COD was not rolling or pitching significantly from the 0.5 m swell encountered at the time of the incident.

27. The treads of the ladder from which the 3/E fell were found to be clean and free of any foreign debris or contamination (such as oil, grease, etc.).

3/E’s Experience and Work/Rest Periods

28. The 3/E had been sailing since 2004 and was on his 17th contract. He started as an Engine Cadet and was promoted to Oiler in 2008, 4/E in 2012, and 3/E in 2014. He had a total sea time of about seven years, three of which were as an Officer in Charge of an Engineering Watch. He had been with the Company for about 8 years and 6 months, all of which had been on tankers.

29. He joined POLAR COD on 24 February 2019. His contract for employment was for five months, plus or minus one month.

30. The 3/E held the Republic of the Marshall Islands seafarer documentation appropriate for his position.

31. The 3/E held a current medical certificate and was reported to be fit for duty without restrictions. Additionally, there was no indication that the 3/E was taking any medication and he had not reported any illness or injury to the Company while on board.

32. The Administrator did not find any indication that the 3/E did not receive the amount of rest mandated by the IMO Seafarers Training, Certification and Watchkeeping (STCW) Code, Section A-VIII/1,

paragraphs 2 and 3 and the International Labour Organization's Maritime Labour Convention, 2006, regulation 2.3. It is reported that he had nine hours of rest prior to returning to the ECR at 1300 on 14 May 2019.

33. On joining POLAR COD, the 3/E completed the required familiarization training. This was verified by the Chief Officer and 2/E.
34. While on board POLAR COD, the 3/E had also completed numerous safety training courses. These included special training sessions to discuss lessons learned from incidents on other ships in the Company's managed fleet which involved falls from ladders and while working in the Engine Room.

3/E's Diet and Weight Loss Efforts

35. During the Administrator's investigation, crewmembers stated that the 3/E had been dieting to lose weight since he had been on board POLAR COD. The Messman stated that he did not see the 3/E eat lunch or dinner for the four days prior to the incident. On the day of the incident, the Messman also stated that the 3/E did not eat lunch in the messroom before going to the Engine Room.
36. Crewmembers reported that the 3/E had lost significant weight during his time on board POLAR COD.

PART 3: ANALYSIS

The following Analysis is based on the above Findings of Fact.

3/E's Fall

Although the start of the 3/E's fall was not witnessed, it is believed that he was climbing the ladder between the second deck and the upper deck when he fell.

The C/E reported that he saw the 3/E begin to climb the ladder and then about eight seconds later he heard a banging noise. This was determined to be the 3/E falling to the main engine cylinder head intermediate platform. The elapsed time between seeing the 3/E start to climb and the noise was not likely enough time for the 3/E to have reached the upper deck.

The bottom of the ladder was about 6 m above the main engine cylinder head intermediate platform and the top was about 11.3 m above. Therefore, it is believed that the height of the 3/E's fall was between 6 to 11.3 m.

Based on the information available to the Administrator, it appears that the 3/E's fall was accidental. What caused him to fall is not known. Ship movement is not considered to be a causal factor. The ship was not reported to be pitching or rolling significantly at the time of the incident.

Inclined Ladder Construction

POLAR COD's design specification indicated that the perpendicular distance from the ladder's side stringer to the handrail top was supposed to be 50 cm. However, it was found that the handrail on the ladder between

the second deck to the upper deck was only 40 cm. This put the railing a vertical distance of 80 cm above the ladder treads.

IMO regulations do not prescribe a minimum height or design of handrails on stairs, ladders, or inclined ladders. The FSS Code requires that the clear distance between the handrails must be 70 cm for stairways used as a means of escape and that the angle of inclination of ladders in machinery spaces should be not more than 60°. In this section of ladder, the handrails are 76 cm apart and had an inclination of about 56°, which complies with these requirements.

IACS does not provide requirements or recommendations relevant to the design of inclined ladders. IACS Recommendation No. 132 addresses stairs (having an angle of inclination between 38° to 45°) and vertical ladders (with angle inclinations between 80° to 90°). No guidance is provided in this document regarding the design of any ladders having an angle of inclination between 46° and 79°. However, Recommendation No. 132 does indicate that stairs which are exposed on both sides be fitted with a two-tier railing on both sides. Also, it is recommended that the handrails be between 40 mm and 50 mm in diameter. While this document was first issued in 1998, recommendations regarding the design of ladders were not added until 2013, after POLAR COD's keel was laid. However, the recommendations provide a standard to which the ladder involved can be compared.

The classification society for the ship, ABS, provides Guidance Notes on the design of inclined ladders. Included in these Guidance Notes is the recommendation that inclined ladders have an inclination of 45° to 60° and that handrail height (from the leading edge of the tread) be between 91.5 cm and 100 cm. It is also recommended that treads be equally spaced vertically between 20 cm and 30 cm apart and be at least 10 cm in depth. However, these are recommendations and are not enforceable during design and construction.

The handrails of the inclined ladder that the 3/E likely fell from were only 80 cm above the leading edge of the tread. The design specification of POLAR COD indicated that the perpendicular distance from the stringer to the top of the handrail was supposed to be 50 cm. However, it was found that the handrail of the inclined ladder from the second deck to the upper deck was only 40 cm perpendicularly from the stringer. The railing, therefore, was 80 cm above the ladder treads, lower than designed.

The treads of the inclined ladder conform to the current ABS recommendations. The treads were parallel to the deck, evenly spaced within the recommended riser height, and provided with a non-slip surface. There was no indication that any foreign debris or contamination (such as oil, grease, etc.) was present on the treads when the 3/E fell.

Engine Room Temperature

It was reported that the usual temperature in the Engine Room was 43° to 48° C while the ship was operating in the Arabian Gulf. It was also reported that the ECR of POLAR COD was fully air conditioned. Upon returning to the Engine Room at 1300, the 3/E went directly to the ECR. He remained in the ECR until leaving at about 1330 to investigate the source of the high-level alarm for a waste oil tank. Prior to this, it was reported that he had not engaged in any strenuous work. Although he had not been exposed to the high temperatures

for an extended period, he may have experienced increased physiological stress while climbing the ladder due to the high temperature in the Engine Room.

3/E's Diet and Weight Loss Efforts

Crewmembers reported that the 3/E was following a restricted diet to lose weight and he had observably lost weight during his time on board. Additionally, the Messman stated that he had not seen him take lunch or dinner during the four days prior to the incident. He also stated that the 3/E did not eat lunch in the messroom before reporting to the Engine Room on the day of the incident. It is possible that the 3/E ate in his cabin prior to going to the Engine Room. However, the restricted diet may have resulted in a caloric deficit in the days leading up to his fall and may have amplified any physiological or psychological affects resulting from working in the hot Engine Room.

PPE

It was reported that the 3/E was wearing all of the required PPE, however, the chin strap for his safety helmet was not worn at the time that he fell. However, it is not considered a causal factor in this incident as the safety helmet and chin strap are not designed to provide protection in a fall of this height.

3/E Work/Rest

The 3/E was working in the Engine Room from 0000 to 0400 the morning of the incident. At 0400, he was relieved before going to his cabin for rest. He returned to the Engine Room at 1300, after about nine hours of rest. Work/rest records on the ship indicate he had the required rest each day during May 2019. Additionally, the 3/E was under three months into a five month, plus or minus one month, contract. It is not believed that fatigue due to workload or a lack of rest was a casual factor in the 3/E's fall.

PART 4: CONCLUSIONS

The following Conclusions are based on the above Findings of Fact and Analysis and shall in no way create a presumption of blame or apportion liability.

1. The cause of the 3/E's fall cannot be determined since there were no witnesses. However, the following causal factors which may have contributed to this very serious marine casualty include:
 - (a) the height of the handrails on the inclined ladder between the second deck and the upper deck of POLAR COD's Engine Room were lower than the design specification;
 - (b) possible physiological or psychological stresses arising from the 3/E's weight loss efforts; and
 - (c) high ambient temperatures in the Engine Room while the ship was in the Arabian Gulf.
2. An additional factor identified which did not contribute to this marine casualty was the 3/E's failure to use the chin strap of his safety helmet at the time of his fall.

PART 5: PREVENTIVE ACTIONS

In response to this very serious marine casualty, the Company has taken the following Preventive Actions.

1. The height of the handrail on the involved inclined ladder was immediately raised and an intermediate guard between the stringer and the handrail was fitted. The same modification was also implemented on a sister ship under the Company's management.
2. A circular was sent to all ships in the Company's managed fleet which detailed the lessons learned from this incident.
3. The inclined ladders on all ships in the Company's managed fleet were inspected to ensure adequate fall protection was provided. As a result, inclined ladders on four ships were modified to provide greater protection to the crewmembers.
4. Another circular was sent to all ships in the Company's managed fleet, as well as all officer staff, which discussed the safe use of stairs.
5. A fleetwide safety campaign was implemented regarding the use of chin straps when wearing safety helmets. This included the requisition of additional chin straps to ensure they were immediately available to crewmembers at all times.
6. An article was published in the Company's newsletter regarding the incident and the lessons learned. The dangers associated with excessive dieting were specifically discussed in this article.
7. The lessons learned were discussed during a safety meeting held on all ships in the Company's managed fleet.
8. An additional, dedicated safety meeting was held on all ships in the Company's managed fleet to review the lessons learned.
9. The Company's full investigation report was sent to all ships in the Company's managed fleet to raise awareness.

PART 6: RECOMMENDATIONS

The following Recommendations are based on the above Conclusions and in consideration of the Preventive Actions taken.

1. It is recommended that IACS consider amending Recommendation No. 132 to address the design of inclined ladders (those having an angle of inclination greater than 45° but less than 80°), including recommendations relating to handrail height above tread, handrail diameter, and use of two-tier handrails on exposed sides.

2. It is recommended that the Administrator consider submitting a proposal to the IMO to develop and implement prescriptive requirements for the design of stairs, ladders, and inclined ladders, including the design of handrails and means of fall protection.

The Administrator's marine safety investigation is closed. It will be reopened if additional information is received that would warrant further review.