



REPUBLIC OF THE MARSHALL ISLANDS

Maritime Administrator

CHEM SINYOO CASUALTY INVESTIGATION REPORT

Fitter Fatal Injury

South China Sea | 21 December 2020

Official Number: 9001

IMO Number: 9248461



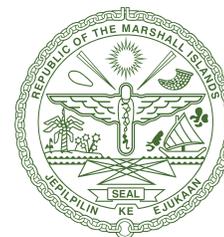
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In accordance with national and international requirements, the Republic of the Marshall Islands Maritime Administrator (the “Administrator”) conducts marine safety investigations of marine casualties and incidents to promote the safety of life and property at sea and to promote the prevention of pollution. Marine safety investigations conducted by the Administrator do not seek to apportion blame or determine liability. While every effort has been made to ensure the accuracy of the information contained in this Report, the Administrator and its representatives, agents, employees, or affiliates accept no liability for any findings or determinations contained herein, or for any error or omission, alleged to be contained herein.

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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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LIST OF ABBREVIATIONS

2/E.....	Second Engineer
3/O.....	Third Officer
ASD.....	Able Seafarer Deck
C/E.....	Chief Engineer
C/O.....	Chief Officer
COVID-19.....	Coronavirus Disease
IMO.....	International Maritime Organization
ISM.....	International Safety Management
m.....	Meter
MRCC.....	Maritime Rescue Coordination Center
NAVTEX.....	Navigational Telex
NM.....	Nautical Mile
PPE.....	Personal Protective Equipment
SMS.....	Safety Management System



PART 1: EXECUTIVE SUMMARY

On 17 December 2020, the Republic of the Marshall Islands-registered chemical/oil products tanker CHEM SINYOO, managed by Global Marine Ship Management Co., Ltd. (the “Company”), departed Singapore and was sailing on a northerly course to Nantong, People’s Republic of China. Meanwhile, the tropical system that would ultimately become Tropical Storm Krovanh was identified on 17 December 2020. The forecast showed it moving west across the Republic of the Philippines before turning to the west-southwest in the central South China Sea.

On 21 December 2020, CHEM SINYOO was steaming into a 6 m head sea resulting from the tropical storm when a water ingress alarm sounded for the Bosun’s Store. Shipping water had been frequently moving across the forecastle and it was suspected that the forecastle deck hatch had been compromised.

The Master determined it was necessary for crewmembers to go forward to investigate the cause of the water ingress and reduce the rate of flooding. The Master first attempted to turn the ship onto a reciprocal course to limit the water across the bow while crewmembers were on deck. However, he was unable to safely turn the ship in the rough conditions.

After completing a risk assessment and Toolbox Talk, the C/E, 2/E, Fitter, Bosun, ASD1, and the Pumpman went forward to the forecastle. They found that the forecastle deck hatch had been damaged on the forward side and was allowing water to enter the Bosun’s Store.

While applying a temporary cover over the hatch, a large wave broke across the bow and knocked the six crewmembers off their feet. The Master saw the crewmembers slide across the deck and strike various objects on the forecastle. He quickly coordinated a rescue team to go forward and bring the crewmembers back to the ship’s Hospital.

The C/E, 2/E, Pumpman, Fitter, and ASD1 were injured and unable to walk back to the Accommodation, while the Bosun was uninjured. The Fitter had a serious head injury and was in critical condition.

Once at the ship's Hospital, all injured crewmembers were immediately provided first aid. Despite their efforts, the Fitter was subsequently pronounced deceased by the Master. The ship diverted to the nearest port where the four remaining injured crewmembers were transferred to a shoreside hospital and eventually recovered from their injuries.

The marine safety investigation conducted by the Republic of the Marshall Islands Maritime Administrator (the "Administrator") identified the following:

1. Causal factors that contributed to this very serious marine casualty include:
 - (a) CHEM SINYOO's planned voyage towards Tropical Storm Krovanh forecasted path and the resulting heavy seas that were encountered;
 - (b) shipping water over the forecastle which compromised the forecastle deck hatch and resulted in flooding of the Bosun's Store;
 - (c) crewmembers going forward to the forecastle during heavy weather; and
 - (d) crewmembers struck by shipping water while working on the forecastle.
2. Causal factors that may have contributed to this very serious marine casualty include:
 - (a) underestimation of the hazards to crewmembers posed by the shipping water;
 - (b) not consulting the Company about the Bosun's Store flooding and the potential impact on ship stability before deciding to send crewmembers on deck; and
 - (c) not deviating from the planned route early enough to avoid the heaviest seas from Tropical Storm Krovanh.
3. Additional identified issues that did not contribute to this very serious marine casualty include:
 - (a) that the C/E and 2/E went forward in heavy weather which, upon their injury, resulted in two senior engineering officers being incapacitated; and
 - (b) the lack of definition in the Company's SMS as to what constitutes heavy weather to determine which relevant procedures must be implemented.

PART 2: FINDINGS OF FACT

The following Findings of Fact are based on the information obtained during the Administrator’s marine safety investigation. Due to travel restrictions imposed in response to the COVID-19 pandemic, the Administrator was not able to arrange for onboard attendance as part of its marine safety investigation of this very serious marine casualty. All related information available to the Administrator was obtained remotely.

1. Ship particulars: *see* chart to left.
2. CHEM SINYOO is a chemical/oil products tanker with a raised forecastle deck (*see Figure 1*).

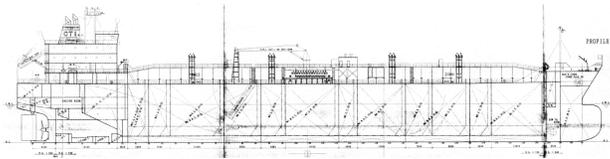


Figure 1: Profile view from CHEM SINYOO's general arrangement plan.

3. On 17 December 2020, the ship departed the Republic of Singapore on a laden voyage, bound for Nantong, People’s Republic of China. Before departing, the Master approved the voyage plan.¹
4. Meanwhile, a tropical system was first identified by the Philippine Atmospheric, Geophysical and Astronomical Services Administration on the evening of 17 December 2020. At that time, the tropical system was 140 NM east-southeast of the City of Davao, Republic of the Philippines and moving west-northwest. The system was about 1,400 NM east-northeast of CHEM SINYOO at that time.

¹ A tropical system was first identified on the same day that the voyage plan was approved, and the ship departed the Republic of Singapore. Because of this, the storm’s position was not considered in the initial voyage planning.

SHIP PARTICULARS

Ship Name
CHEM SINYOO

Registered Owner
CHEMSINYOO Tankers
Company Limited

ISM Ship Management
Global Marine Ship
Management Co., Ltd.

Flag State
Republic of the Marshall Islands

IMO No. 9248461	Official No. 9001	Call Sign V7A4183
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Year of Build 2002	Gross Tonnage 15,148
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Net Tonnage 7,022	Deadweight Tonnage 24,404
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Length x Breadth x Depth
145.0 x 25.0 x 15.2 meters

Ship Type
Type 2 Chemical/Product Tanker

**Document of Compliance
Recognized Organization**
DNV GL

**Safety Management Certificate
Recognized Organization**
DNV GL

Classification Society
DNV GL

Persons on Board
22

5. On 18 December 2020, the tropical system was upgraded to a tropical depression and named Krovanh. At about the same time, CHEM SINYOO began experiencing worsening seas while sailing on a north-northeasterly course at an average of about 11.5 knots.
6. CHEM SINYOO received NAVTEX weather reports several times per day between 19–21 December 2020. These reports included the storm’s actual position, anticipated heading and speed, observed weather and sea conditions, and the forecast position after 24 hours (*see Figure 2*). The storm’s actual path closely matched the forecasts received by CHEM SINYOO.

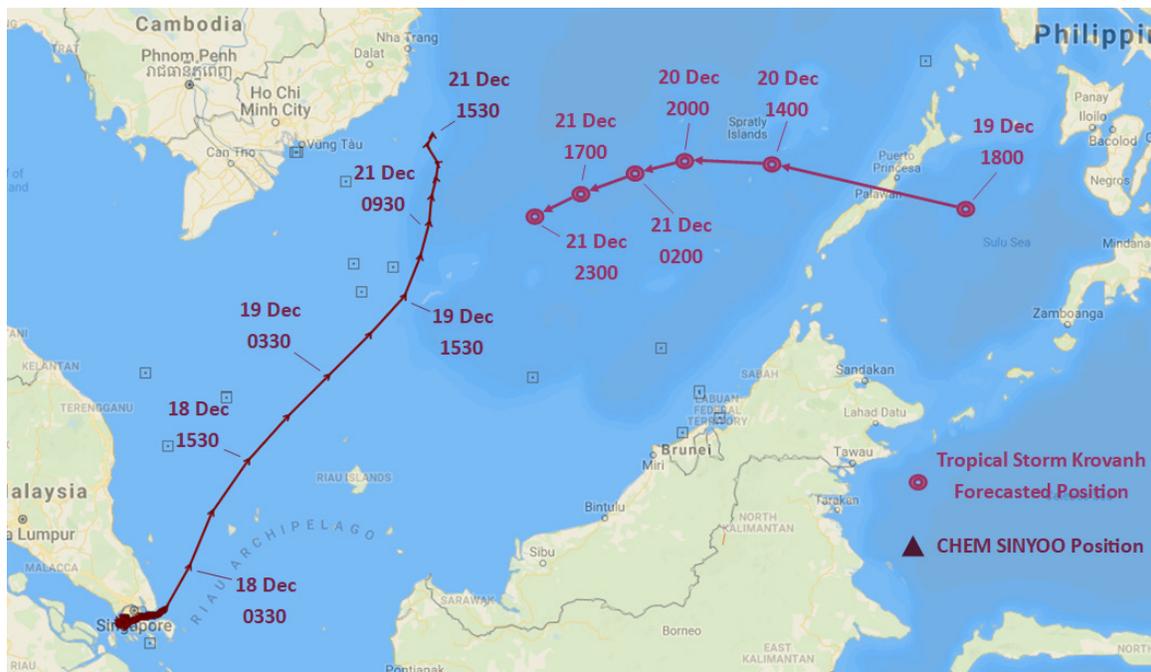


Figure 2: Forecast positions for Tropical Storm Krovanh between 19–21 December 2020.

7. On 19 December 2020, the Company sent a notice to CHEM SINYOO about the storm and the required preparations in anticipation of heavy weather.² The voyage plan was updated to reflect a course change to the north and a speed reduction.
8. By the evening of 19 December 2020, CHEM SINYOO was experiencing 6 m head seas and northerly winds up to 50 knots. This resulted in water frequently shipping over the bow and forecastle. CHEM SINYOO’s speed was reduced to about 6 knots and a northerly heading was maintained. Due to the prevailing conditions, the Master restricted the crew from working on deck, except in an emergency.
9. At 2300³ on 20 December 2020, Krovanh was upgraded to a tropical storm. Seas were forecast up to 6 m near the storm’s center, with a swell of 3 m over the southern part of the South China Sea. The storm then was about 225 NM east of CHEM SINYOO and forecast to move west-southwest at about 8 knots. The

² The Company’s SMS includes requirements for preparing for heavy weather. See Findings of Fact, “SMS” in this report.

³ Unless otherwise stated, all times are ship’s local time (UTC +8).

ship's speed was further reduced to about 4 knots while maintaining the northerly heading. The Master ordered only manual steering be used for the duration of the storm.

10. At 0740 on 21 December 2020, a water ingress alarm for the Bosun's Store sounded in the Engine Control Room. The Duty Engineer immediately notified the Officer on Watch, who was the C/O, on the Bridge. It was suspected that the forecastle deck hatch to the Bosun's Store had been compromised, allowing water to enter the Bosun's Store.
11. Access to the Bosun's Store from the forecastle is through a 1.4 m by 1 m deck hatch. This is located near the ship's centerline, forward of the anchor windlasses (see Figure 3). The hatch cover is counterweighted and hinged forward, with three manual dogs on each side.

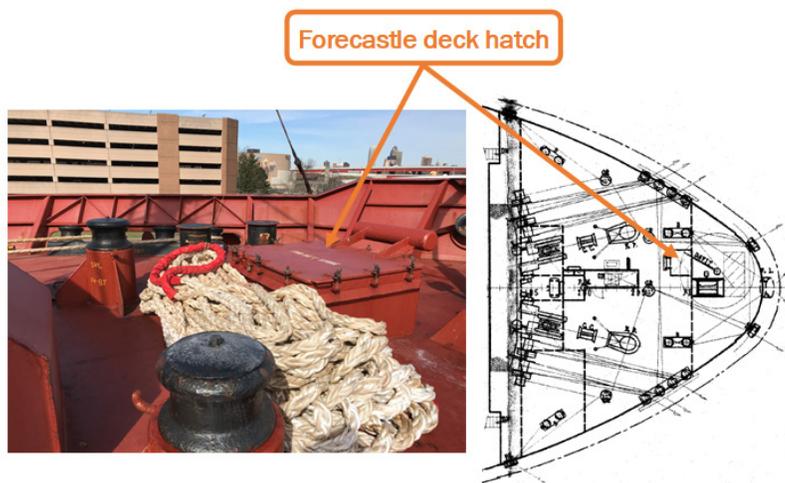


Figure 3: General arrangement and photo of CHEM SINYOO's forecastle, showing the deck hatch to the Bosun's Store.

12. The condition of the hatch or if it was properly secured before being damaged is not known. DNV GL conducted the last load line annual survey on 15 November 2020. No issues with the forecastle deck hatch were noted. Additionally, no damage or defect to the hatch had been reported to the Administrator before the incident.
13. The Master determined that uncontrolled flooding of the Bosun's Store could have an adverse effect on the ship's trim and stability. He decided that immediate action must be taken to investigate and eliminate the source of the water ingress. The Master did not seek assistance from the Company with calculating the effect of the flooded Bosun's Store on the ship's stability nor was the Company notified of the water ingress.
14. At about 0755, the Master mustered the C/E, C/O, 3/O, 2/E, Fitter, Bosun, Pumpman, and ASD1 on the Bridge. A risk assessment was completed for going forward in heavy weather to investigate the source of the flooding and to slow the rate of ingress. The risk assessment identified the following hazards and control measures:

Identified Hazard	Control Measure
Lack of proper PPE and tools	<ul style="list-style-type: none"> • Ensure proper PPE is worn • Carry extra PPE, when appropriate • Check PPE for damage prior to use
Increase in swell / wave height	<ul style="list-style-type: none"> • Ensure work party is aware of actions to take in the event of increasing swell / wave height • Conduct safety briefing prior to starting work • Bridge crew to continue monitoring sea state and report any changes to work party
Weather deterioration	<ul style="list-style-type: none"> • Review and understand weather forecast • Anticipate any changes of weather • Continue to monitor available weather reports
Heavy rolling and pitching	<ul style="list-style-type: none"> • Adjust course and speed to reduce rolling and pitching • Stop work if rolling or pitching becomes heavy
Breaking waves on forecastle	<ul style="list-style-type: none"> • Monitor wave pattern from Bridge • Inform work party of any unusually large or threatening waves • Reduce breaking waves by altering course and speed • Stop work immediately if waves breaking on forecastle
Water accumulation on forecastle deck	<ul style="list-style-type: none"> • Monitor for breaking waves from Bridge • Monitor pitching motion • Work party to use safety harness with lifelines attached to a strong point
Sea sickness	<ul style="list-style-type: none"> • Crewmembers feeling seasick must stop work and be replaced by another crewmember • Wear warm clothes, if required • Medication
Falling / slipping	<ul style="list-style-type: none"> • Stop work if ship is rolling or pitching heavily • Wear safety shoes • Avoid slippery areas
Wind speed increase	<ul style="list-style-type: none"> • Review and understand weather forecast • Anticipate weather changes • Continue to monitor weather reports and report to work party on forecastle
Crew accident / injury	<ul style="list-style-type: none"> • Keep first aid kit ready and available • Keep stretcher ready • Conduct briefing with work party

15. A Toolbox Talk was conducted with the crewmembers involved in the task. The risk assessment was reviewed, and the planned work discussed. It was determined that the following PPE was required:
 - (a) overalls;
 - (b) safety shoes;
 - (c) rain jackets;
 - (d) gloves;
 - (e) safety helmets;
 - (f) safety glasses;
 - (g) lifejackets; and
 - (h) safety harnesses with lifelines.
16. After the Toolbox Talk, the Master took command of the ship. The ASD2 was assigned to continue steering by hand for the duration that crewmembers were on deck. The 3/O was also on the Bridge to assist. They attempted to bring CHEM SINYOO about on a southerly course to reduce the shipping water on the forecandle but were unable to do so.
17. The ship began to roll up to 35 degrees while attempting the turn and at that angle it was determined to be unsafe to continue. The ship was returned to a northerly course, which was adjusted frequently to limit rolling and pitching. The ship's speed was also reduced to 3.5 knots.
18. The C/E, 2/E, Fitter, Bosun, ASD1, and Pumpman went on deck and made their way forward to the forecandle. They were wearing the required PPE, including lifejackets and safety harnesses. The crewmembers also had portable radios.
19. When they got to the forecandle, all crewmembers attached the lifelines of their safety harnesses to strong points on the forecandle.
20. They investigated and found that the forward edge of the deck hatch and coaming had been slightly deformed inward. This created a small gap between the hatch cover gasket and the hatch coaming which was allowing water to flow into the Bosun's Store with each wave that broke over the bow.
21. It was decided that the entire hatch would be covered to slow the water ingress. The crew began to bind rubber and plastic over the damaged hatch.
22. At about 0910, a large wave broke over the bow of CHEM SINYOO. The crewmembers working forward were knocked off their feet and swept across the deck. All the crewmembers' lifelines were still attached at the time. Seeing this, the Master raised the alarm and ordered additional crewmembers to don the necessary PPE for working on deck. The Master remained on the Bridge while the rescue party went forward with first aid supplies and the stretcher. The C/E, 2/E, Fitter, Pumpman, and ASD1 were injured. The Bosun was uninjured.

23. By 1300,⁴ all five injured crewmembers were carried from the forecandle and taken to the ship's Hospital. First aid was immediately provided.
24. The Fitter had suffered a significant injury to his forehead and was in critical condition. The other four crewmembers had serious injuries but were in stable condition.
25. At about 1310, the Master altered the ship's course to proceed to the nearest port, Nha Trang, Socialist Republic of Vietnam.
26. Despite the crew's efforts, the Master pronounced the Fitter deceased at 1405 on 21 December 2020.
27. At about 1600, the Master notified MRCC Vietnam and requested medical evacuation of all five crewmembers. The MRCC acknowledged the report and directed the ship to proceed to the nearest port.
28. At 0705 on 22 December 2020, the Master notified authorities in Nha Trang of the injured crewmembers and requested emergency medical assistance.
29. CHEM SINYOO arrived to Nha Trang at about 1036 and emergency medical personnel immediately boarded the ship.
30. The four injured crewmembers and the Fitter's body were transported to a local hospital. The C/E, 2/E, Pumpman, and ASD1 were admitted with the following injuries:
 - (a) C/E: fracture of right clavicle, lumbar spine degeneration, open head wound;
 - (b) 2/E: laceration to right arm and left leg;
 - (c) Pumpman: closed fracture of right femur and patella, open fracture of left femur; and
 - (d) ASD1: laceration to forehead, laceration to lower back.
31. The death certificate issued by the Forensic Medicine Center of Ho Chi Minh City, Socialist Republic of Vietnam, stated the Fitter's death resulted from the injuries he sustained during the incident.

SMS

32. As required by the ISM Code, the Company's SMS provided procedures for shipboard tasks including navigation under adverse weather conditions. The SMS also included requirements for PPE use, crew training, and hazard identification and mitigation.
33. The Company's SMS includes requirements specific to navigating in heavy weather, although what constitutes "heavy weather" is not defined. It requires that Masters regulate speed to reduce the likelihood of damage to the ship and cargo. The SMS also requires checking the following items before encountering heavy weather including:
 - (a) securing all weather deck openings;
 - (b) closing and securing all watertight doors with all dogs;
 - (c) properly securing all loose objects and equipment;

⁴ The rescue efforts were considerably hampered due to the weather conditions and the number of crewmembers who required transport from the forecandle.

- (d) providing warning/instruction to crewmembers regarding access to the weather decks;
- (e) rigging safety lines, where necessary;
- (f) continuously monitoring weather reports; and
- (g) prohibiting access to the weather deck unless approved by the Master.

- 34. The SMS requires that an entry be made in the deck logbook after completing heavy weather preparations.
- 35. It is reported that these requirements were implemented, but a corresponding deck logbook entry was not made to document implementation.
- 36. The SMS requires overalls, safety shoes, safety helmet, and safety glasses be worn while working on deck.
- 37. Also, the Company’s SMS requires that crewmembers complete initial shipboard familiarization training upon joining the ship. This includes familiarization with the Company’s SMS requirements and the use of PPE. Records on board indicate that all crewmembers involved in this incident had completed this training.

CHEM SINYOO Crew

- 38. CHEM SINYOO had a complement of 22 crewmembers, six more than required by the Minimum Safe Manning Certificate issued by the Administrator.
- 39. All involved seafarers held the appropriate Republic of the Marshall Islands-issued seafarer documentation for their positions.
- 40. Experience of relevant crewmembers:

RANK	TIME ON BOARD CHEM SINYOO	TIME IN RANK	TIME WITH COMPANY	TOTAL TIME AT SEA
Master	1 month, 6 days	7 years	2 months	18 years, 3 months
C/O	11 months, 26 days	2 years, 10 months	1 year	8 years, 1 month
3/O	5 months, 29 days	1 year	5 years	5 years
C/E	5 months, 29 days	7 years	8 years	17 years, 7 months
2/E	3 months, 17 days	4 years	6 years	12 years
3/E	10 months, 2 days	2 years	2 years, 7 months	5 years, 6 months
Fitter	1 year, 4 months, 1 day ⁵	2 years	7 years	8 years
Bosun	5 months, 11 days	1 year	4 years	8 years
Pumpman	1 month, 6 days	2 years	2 months	7 years, 9 months
ASD1	1 month, 6 days	2 years	3 years	3 years
ASD2	5 months, 11 days	4 years	5 years	6 years

⁵ It is reported that the Fitter was unable to be repatriated during previous attempts by the Company due to restrictions implemented by coastal States in response to the COVID-19 pandemic. It is also reported that the Fitter did not object to remaining on board past 12 months.

41. The Administrator found no indication that any crewmembers involved with this incident failed to receive the amount of rest mandated by the Seafarers' Training, Certification and Watchkeeping Code, Section A-VIII/1, paragraphs 2 and 3, and Maritime Labour Convention, 2006, Regulation 2.3.
42. Alcohol testing was conducted on all crewmembers, apart from the Fitter. The presence of alcohol was not detected.
43. All crewmembers involved in the incident were found to be fit for duty without restrictions during their most recent medical examination.

PART 3: ANALYSIS

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

Tropical Storm Krovanh

Tropical Storm Krovanh was first identified as a tropical system on 17 December 2020 and was about 1,400 NM east-northeast of CHEM SINYOO. By the next day, the system was upgraded to a tropical depression and was forecast to move west-southwest across the South China Sea. The depression was subsequently upgraded to a tropical storm on the evening of 20 December 2020.

On the same day the tropical system was first detected, CHEM SINYOO departed Singapore sailing on a northeasterly course towards Nantong, People's Republic of China.

At the time, Krovanh was east of CHEM SINYOO moving on a westerly course. The ship was receiving multiple NAVTEX forecasts per day, which provided the storm's location, observed conditions, projected path, and projected conditions. These forecasts indicated that the storm would shift to a west-southwesterly course and that conditions would deteriorate across the southern half of the South China Sea. Krovanh's actual track closely matched the forecasts, as did the conditions observed by CHEM SINYOO.

Heavy Weather Preparations

On 19 December 2020, CHEM SINYOO began experiencing the effects of the storm, seas of 6 m and winds of 50 knots. The storm was still about 225 NM to the east. In accordance with the Company's SMS, heavy weather precautions were initiated. These included the Master ordering the ship's speed reduced from 11.5 to 6 knots and the heading altered to the north to reduce the effects from the increasing sea state. The Master also ordered using hand steering for the storm's duration.

The ship's speed was further reduced to 4 knots on the evening of 20 December 2020, to reduce the likelihood of damage from shipping water.

The Company's SMS does not define what constitutes "heavy weather" and when the relevant procedures must be implemented. In this instance, the Company had informed the Master of the likelihood of heavy weather and the requirement to implement the SMS procedures.

Actions to Avoid Tropical Storm Krovanh

CHEM SINYOO was sailing on a north-northeasterly course in the South China Sea. The tropical system that became Tropical Storm Krovanh was first identified around the time the ship departed from Singapore and therefore was not considered in the voyage plan. Shortly after departure, the Company sent a storm notification to the ship, along with the actions that were required.

The voyage plan was amended to include a course change to the north and a speed reduction in anticipation of adverse sea conditions. These changes were implemented on the evening of 20 December 2020, however, the ship was already experiencing seas of 6 m and winds up to 50 knots. An earlier course deviation or speed reduction, or both, may have increased the distance between the ship and the center of Tropical Storm Krovanh, lessening the exposure to its effects.

Forecastle Deck Hatch Failure

The deck hatch to the Bosun's Store is near the centerline, forward of the anchor windlasses. It was reported that shipping water was washing over the forecastle starting on 19 December 2020.

When the crewmembers arrived at the forecastle and inspected the hatch, they found the forward coaming edge deformed inwards slightly. This created a small gap between the compression bar of the hatch coaming and the hatch cover packing, allowing water to enter the Bosun's Store.

The condition of the hatch before the heavy weather is not known. Additionally, it is not known if the hatch was properly secured prior to being damaged by the shipping water.

Water Ingress Alarm Response

Once the alarm sounded, the Master decided that coming about to a southerly course would reduce the amount of shipping water across the forecastle and reduce the risk to the crewmembers who would be working on deck.⁶ He tried several times to initiate the turn to the south but was unable to do so. He reported that the ship began to roll up to 35 degrees when initiating the turn and that this was an unacceptable risk to the ship.

The Master decided that the risk to the ship warranted sending crewmembers forward while steaming into the head sea. He was concerned that additional water entering the Bosun's Store could negatively affect the ship's trim and stability. The Company was not consulted on the possible impact of the flooding on the ship's stability before deciding to send crewmembers forward. It is not known if the Master perceived an imminent risk to the ship if the flooding continued.

⁶ When the alarm activated, the ship was sailing into a head sea. Coming about to a southerly course would have resulted in a following sea and reduced the frequency of shipping water across the forecastle.

Risk Identification and Control

Before sending crewmembers to the forecastle, the Master completed a risk assessment which was thorough and identified numerous risks associated with the planned task. The risk assessment also listed many countermeasures to implement in order to minimize risks to the extent possible.

The Master also conducted a Toolbox Talk with the crewmembers assigned to go forward, as well as those remaining on the Bridge. He informed them that overalls, safety shoes, rain jackets, gloves, safety helmets, safety glasses, lifejackets, and safety harnesses with lifelines were required for all crewmembers on deck.

Incident

While working on the forecastle, the C/E, 2/E, Fitter, Bosun, ASD1, and Pumpman were struck by a wave which broke over the bow of CHEM SINYOO. All of them were knocked from their feet and slid across the deck, striking various objects. They all were wearing safety harnesses with the lifelines attached to strong points, which limited the distance they slid. It is also likely the safety harnesses prevented the crewmembers from being washed overboard.

The C/E, 2/E, Fitter, ASD1, and Pumpman were all injured and unable to walk to the accommodation. Seeing the incident occur, the Master prepared a rescue team to retrieve the crewmembers. Due to the weather conditions and ship movement, it took nearly four hours to carry the five crewmembers to the ship's Hospital.

Fitter

Although not considered a causal factor, it is noted that the Fitter had been on board CHEM SINYOO for over 16 months before the incident. It is reported that the Company had made attempts to relieve the Fitter and repatriate him but were unable to because of coastal States' restrictions due to the COVID-19 pandemic. Although the Fitter was on board CHEM SINYOO for an extended period, it is not believed that this contributed to the incident.

Work Party Composition

The C/E, 2/E, and Fitter all went forward with the work party assigned to investigate and eliminate the water ingress source. While not considered a contributing factor of this incident, it resulted in the two senior engineering officers and the Fitter being incapacitated.

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. Causal factors that contributed to this very serious marine casualty include:
 - (a) CHEM SINYOO's planned voyage towards Tropical Storm Krovanh forecasted path and the resulting heavy seas that were encountered;

- (b) shipping water over the forecastle which compromised the forecastle deck hatch and resulted in Bosun's Store flooding;
 - (c) crewmembers going forward to the forecastle during heavy weather; and
 - (d) crewmembers struck by shipping water while working on the forecastle.
2. Causal factors that may have contributed to this very serious marine casualty include:
 - (a) underestimation of the hazards to crewmembers posed by the shipping water;
 - (b) not consulting the Company about the Bosun's Store flooding and the potential impact on ship stability before deciding to send crewmembers on deck; and
 - (c) not deviating from the planned route early enough to avoid the heaviest seas from Tropical Storm Krovanh.
 3. Additional identified issues that did not contribute to this very serious marine casualty include:
 - (a) that the C/E and 2/E went forward in heavy weather which, upon their injury, resulted in two senior engineering officers being incapacitated; and
 - (b) the Company's SMS did not define what constitutes "heavy weather" to determine which relevant procedures must be implemented.

PART 5: PREVENTIVE ACTIONS

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

1. A safety alert was sent to all ships in the Company's managed fleet to share the lessons learned from this incident.
2. A safety campaign was carried out to ensure that watertight openings on all ships in the Company's managed fleet are properly sealing and in good condition.
3. The Company has amended its orientation program for joining crewmembers to ensure increased familiarization with the SMS.
4. The Company sent a monsoon advisory to all ships in the Company's managed fleet. The advisory included a checklist for pre-departure preparations when storm conditions are expected.

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 the Company:
 - (a) consider including a requirement in the SMS which prohibits the Master and C/O or C/E and 2/E from working on deck at the same time during heavy weather or other high-risk situations;
 - (b) consider including a heavy weather definition in the Company's SMS for determining when the relevant procedures must be implemented; and
 - (c) consider sending a reminder regarding safe navigation practices in the vicinity of tropical revolving storms to all ships in the Company's managed fleet.

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