

[MSI Report 2023-001]



Marine Safety Investigation Report

– Fatal Accident on LNG Tanker Hyundai Technopia –

Date of Accident : 16 June 2021

Date of Publication : 23 March 2023



**Korea Maritime Safety Tribunal
Marine Safety Investigation Team**

Note

This marine safety investigation report aims to identify the cause of the marine accident and prevent similar marine accidents or incidents in the future under Article 18.3 of the Act on the Investigation of and Inquiry into Marine Accidents. It is therefore advised that this report not be used for assigning blame or determining liability.

This report quotes the names of the relevant acts and agencies that were in place at the time of writing.

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section

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Executive Summary

1. Executive Summary

- 1.1 The LNG tanker, Hyundai Technopia, entered drydock at a shipyard in Tongyeong City, South Gyeongsang Province, the Republic of Korea (ROK), on 24 May 2021. After completing hull maintenance and inspection, the tanker left the shipyard and departed at 15:06 on 16 June 2021.
- 1.2 At 16:30 on the same day, the chief officer (C/O) called the bosun, AB (able seaman), OS (ordinary seaman) A, and OS B to hold a toolbox meeting (TBM). There he ordered them to secure the drums stacked onto the poop deck in order to prepare for the severe weather conditions reported by the weather forecast.
- 1.3 At 16:40, the C/O decided to secure a toolbox placed on the electrical cable tray while walking on the catwalk above cargo tanks and checking the deck maintenance. He ordered the bosun to secure the toolbox with ropes before he headed back his office to finish up paperwork.
- 1.4 The bosun, who had received the order, handed the rope over to the AB and told him to secure the toolbox with the two ordinary seamen. Then, he proceeded to the bow area on patrol. The AB took out some tools from the box and tried to lift and move it together with OS A and B.
- 1.5 At 16:52 on the same day when the AB, OS A and B were facing one another and lifting the toolbox, OS B lost his balance and fell towards the chain railings, plunging about 18 meters onto the upper deck.
- 1.6 When the accident occurred, crewmembers, including the C/O, administered first-aid treatment to OS B by ensuring his airway was open and suturing the wounded area. At 17:25 on the same day, he was shifted onto a tug which rushed to the scene, and he was then transported from a pier to an ambulance. At 18:35, he arrived at the hospital but eventually died.

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2

Findings of Fact

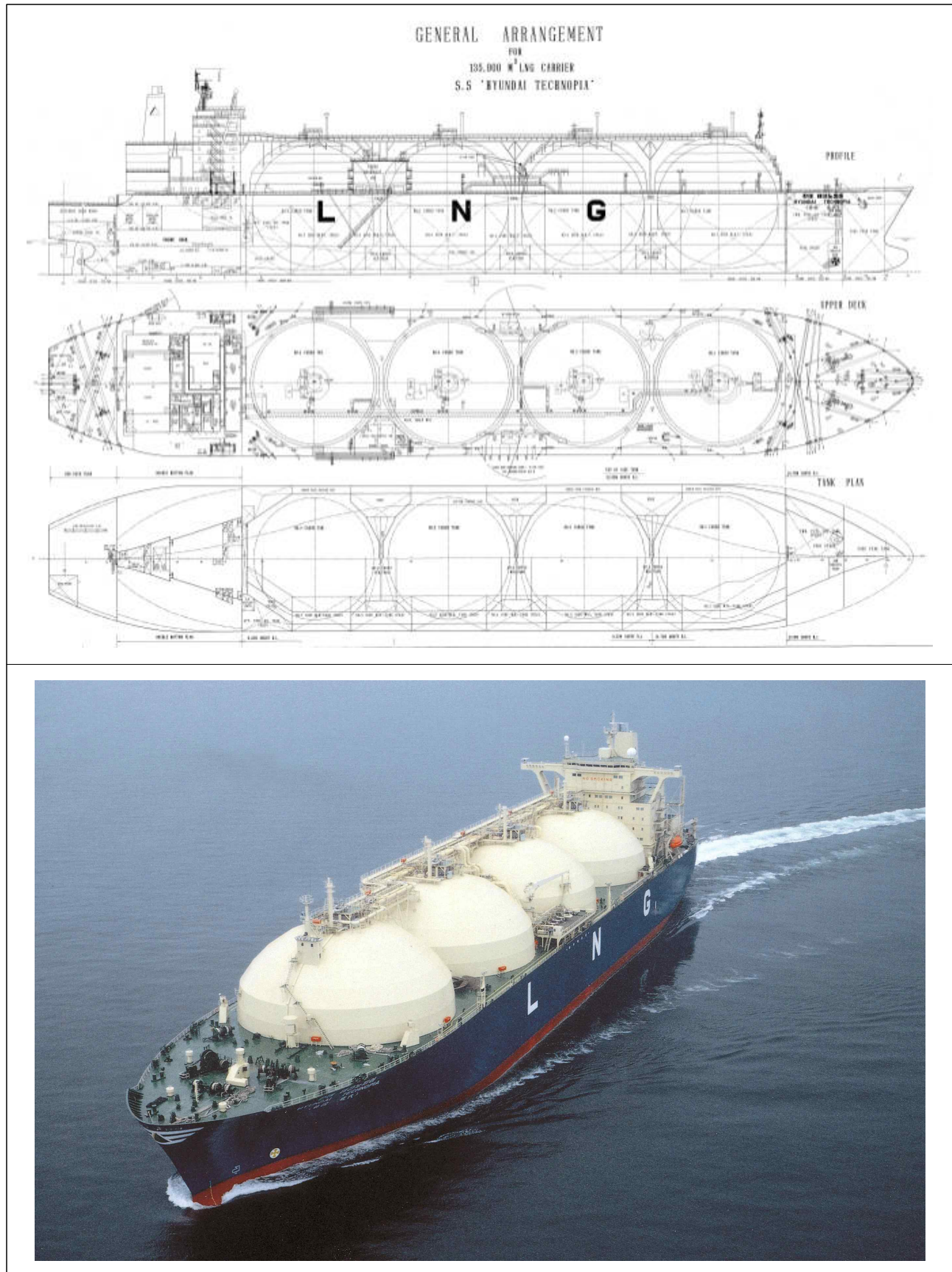
2. Findings of Fact

2.1 Ship particulars

2.1.1 Principal particulars of Hyundai Technopia

| | |
|---------------------------|------------------------------------|
| Ship Name | Hyundai Technopia |
| Flag State | Republic of Korea |
| Port of Registry | Jeju |
| IMO No. | 9155145 |
| Ship Type | LNG Tanker |
| Owner | Hyundai LNG Shipping Co., Ltd. |
| Safety Management Company | Hyundai LNG Shipping Co., Ltd. |
| Max. No. of Crew (Pers.) | 46 |
| Builder | Hyundai Heavy Industries Co., Ltd. |
| Date of Keel Lay | 13 Oct. 1997 |
| Date of Launch | 4 Apr. 1998 |
| Classification Society | Korean Register of Shipping (KR) |
| Gross Tonnage (t) | 113,998 |
| Length (m) | 278.33 |
| Beam (m) | 48.20 |
| Depth (m) | 22.85 |
| Deadweight Tonnage (t) | 77,584 |
| Main Engine | Steam turbine |
| Max. Output | 39,000 hp (BHP) × 86 RPM |
| Propeller | 1 (solid screw-type) |
| Rudder | 1 |
| Service Speed | 18.9 kts (ballast) |

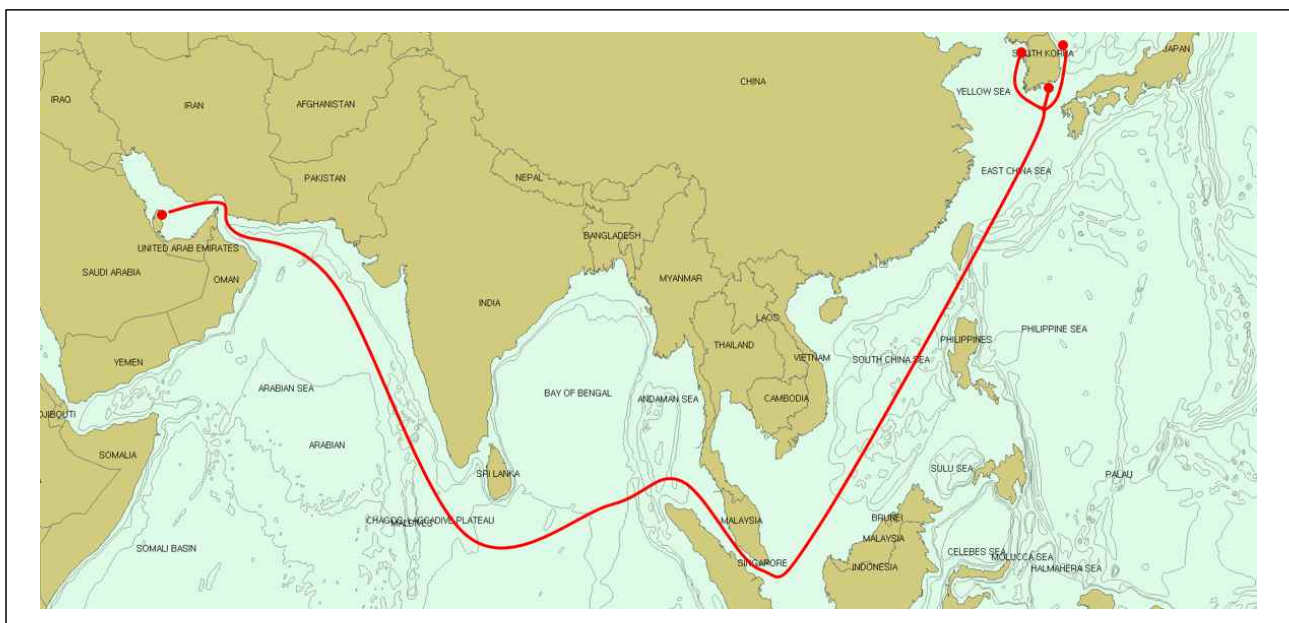
2.1.2 Hyundai Technopia, built by Hyundai Heavy Industries Co., Ltd., based in Ulsan, ROK, is an LNG carrier with a gross tonnage of 113,998 tons, a length of 278.33 meters, a beam of 48.20 meters, a depth of 22.85 meters, and four moss-type cargo tanks.



<Figure 1> General arrangement and photo of Hyundai Technopia

2.2 Shipowner and operation

- 2.2.1 This tanker was launched on 4 April 1998 and at the time of the accident was owned by Hyundai LNG Shipping Co., Ltd., which also was directly in charge of the tanker's safety. She has been operated under the name, "Hyundai Technopia," since 30 July 1999.
- 2.2.2 This vessel is dedicated to the transport of LNG and has been mainly travelling between Qatar (Ras Laffan Port) in the Middle East and the ROK (the ports of Incheon, Tongyeong, or Hosan) in East Asia, since a 20-year charter agreement was concluded with Korea Gas Corporation (KOGAS) to provide a stable supply of LNG to the Korean market.



<Figure 2> Major shipping routes of Hyundai Technopia

2.3 Ship surveys

- 2.3.1 Hyundai Technopia was classed by Korean Register of Shipping (KR). At the time of the accident, she was holding ship survey certificates¹⁾ valid till 29 July 2023.

1) Cargo Ship Safety Construction Certificate (SC), Cargo Ship Safety Equipment Certificate (SE), Cargo Ship Safety Radio Certificate (SR), etc.

2.3.2 This tanker had received and completed a special survey in Singapore on 29 July 2018; an annual survey in Incheon, ROK, on 28 August 2020; and an intermediate survey in Tongyeong, ROK, on 15 June 2021.

2.4 Crew composition

2.4.1 At the time of the accident, 29 Korean crewmembers were on board Hyundai Technopia: in deck department, deck officers, including the master, the C/O²⁾, the 1/O, the 2/O, the 3/O, and the radio officer (R/O); and ratings, including one bosun, four able seamen (AB), and two ordinary seamen (OS).

2.4.2 The Hyundai Technopia master had about one year and eight months' service experience as a master. Before that, he had mainly served aboard LNG carriers (as an officer).

2.4.3 The C/O had about six years and three months of service experience as a C/O as well as a 1/O. Mostly he had served aboard LNG tankers, and he had boarded Hyundai Technopia twice (in 2011 and 2018).

2.4.4 The bosun had about 26 years and six months' experience at sea, during which he had served as a bosun for eight years and three months. He had served on this tanker six times before.

2.4.5 The AB³⁾ who was at the accident site had about 26 years and three months of experience at sea, during which he had worked as a bosun for 14 years and eight months. Mostly he had served on crude oil tankers and LNG carriers, and he had been aboard Hyundai Technopia twice (in 2011 and 2015).

2.4.6 OS A had about one year and nine months' experience at sea, serving as an OS on three ships, all of which were LNG carriers.

2) The C/O is in charge of loading/offloading and management of cargoes as well as deck maintenance. Navigational watch is assigned to the 1/O, the 2/O, and the 3/O. In dangerous waters, such as channels, however, the C/O also joins navigational watch with other officers for the sake of navigational safety.

3) It was confirmed that he had been called an apprentice bosun on board during the investigation. Since it is not an official position prescribed in the seafarers' list, he is stated as "the bosun" here.

2.4.7 OS B, who died in the accident, was his first voyage aboard Hyundai Technopia. Before boarding, he had completed a basic training program on safety, oil and chemical tankers, and liquefied gas tankers at the Korea Institute of Maritime and Fisheries Technology (KIMFT) from January to March in 2021. He joined Hyundai LNG Shipping Ltd. in June 2021 and boarded Hyundai Technopia on 14 June 2021 for the first time. It was the third day of his time on board when the accident occurred.

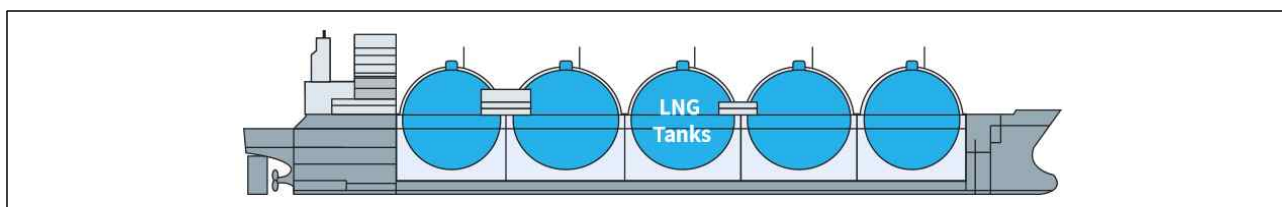
<Table 1> Crew composition of Hyundai Technopia

| Dept. | Rank | | No. of Crew |
|--------|---------|----------------------|-------------|
| Deck | Officer | Master | 1 |
| | | Chief Officer (C/O) | 1 |
| | | 1st Officer (1/O) | 1 |
| | | 2nd Officer (2/O) | 1 |
| | | 3rd Officer (3/O) | 1 |
| | | Radio Officer (R/O) | 1 |
| | Rating | Bosun (BSN) | 1 |
| | | Able Seaman (AB) | 4 |
| | | Ordinary Seaman (OS) | 2 |
| | | Chief Steward | 1 |
| | | Cook | 1 |
| | | Messman | 1 |
| | Etc. | Deck Cadet | 1 |
| Engine | Officer | Chief Engineer | 1 |
| | | 1st Engineer | 1 |
| | | Gas Engineer | 1 |
| | | 2nd Engineer | 2 |
| | | 3rd Engineer | 2 |
| | Rating | No.1 Oiler | 1 |
| | | Oiler | 2 |
| | | Wiper | 1 |
| | Etc. | Engine Cadet | 1 |
| Total | | | 29 |

2.5 Ship structures

2.5.1 Hyundai Technopia bridge is located in the stern area, and four moss-type cargo tanks are located forward of the bridge. The tanker's summer deadweight tonnage⁴⁾ is 77,584 tons.

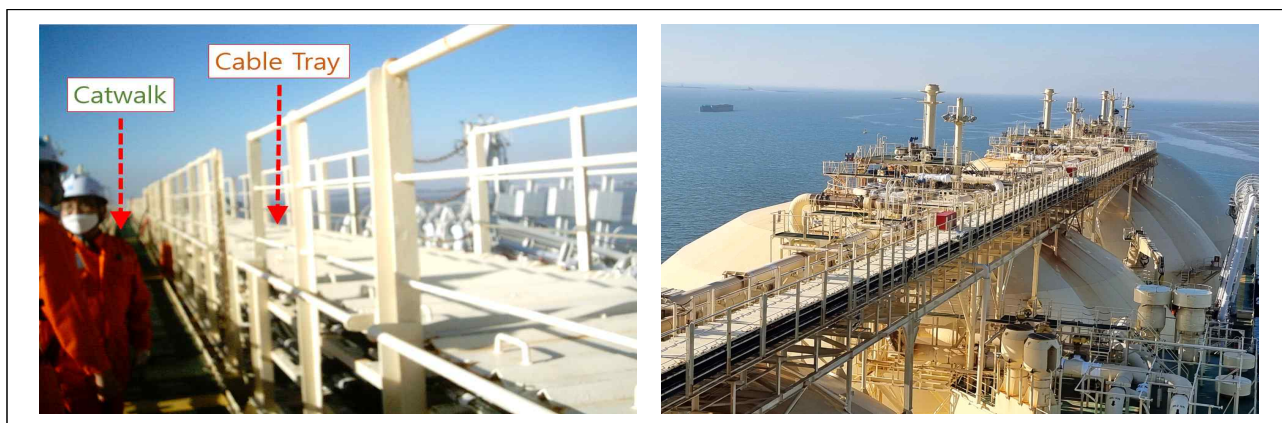
2.5.2 A moss LNG tank is a spherical tank that is loaded onto, rather than built into, the hull. This self-supporting storage unit is designed to liquified and transport natural gas cargo. A catwalk is placed on top of the tanks for crewmembers to move to the bow or stern areas and perform deck operations or maintenance while walking between the tanks.



<Figure 3> Moss-type cargo tanks (blue)

2.6 Catwalk and electrical cable tray

2.6.1 A catwalk is a steel-legged platform frequently used on chemical or LNG carriers that store and transport cargo in tanks. This walkway is installed on top of pipes or tanks so that it connects from the bridge and the accommodation to the bow area.



<Figure 4> A catwalk atop tanks of Hyundai Technopia

4) Cargo, fuel oil, fresh water and ship's provision weights are included

2.6.2 An electrical cable tray is a steel structure which protects electrical lines and cables installed on cargo tanks. It is located right next (on the starboard side) to the catwalk, which is slightly (approx. 96 cm) lower than the tray. It is not originally designed to be used as a regular passageway for crewmembers.⁵⁾



<Figure 5> A catwalk (green) and an electrical cable tray (ivory)

2.7 Weather conditions

2.7.1 The following [Table 2] illustrates weather conditions on the day of the accident based on the logbook of Hyundai Technopia and the data submitted by the Korea Meteorological Administration (KMA) and the Korea Hydrographic and Oceanographic Agency (KHOA).

<Table 2> Weather conditions recorded in the deck logbook⁶⁾

| Date and Time (LT) | Wind and Waves | | | | | Air | |
|--------------------|----------------|---------------------|------------------|---------------------|-----------------|----------|-------|
| | Wind Dir. | Wind Beaufort Scale | Wind Speed (m/s) | Wave Beaufort Scale | Wave Height (m) | Weather | Temp. |
| 2021/06/16 12:00 | SW | 3 | 3.4-5.4 | 2 | 0.2-0.3 | Cloudy | 23 |
| 2021/06/16 16:00 | SW | 3 | 3.4-5.4 | 2 | 0.2-0.3 | Overcast | 25 |
| 2021/06/16 20:00 | E | 4 | 5.5-7.9 | 2 | 0.2-0.3 | Overcast | 24 |

5) In case of emergencies, such as fire, however, crew can use it as a walkway for firefighting, since a fire hose box and other equipment are placed along the cable tray.

6) The wind speed (m/s) and wave height (m) are based on the Beaufort Scale.

| Location | Date and Time | Maximum Wave Height (m) | Significant Wave Height (m) | Mean Wave Height (m) | Wave Period (sec) |
|--------------------|------------------|-------------------------|-----------------------------|----------------------|-------------------|
| Jam Island (22484) | 2021-06-16 13:00 | 0.3 | 0.2 | 0.2 | 5 |
| Jam Island (22484) | 2021-06-16 14:00 | 0.2 | 0.2 | 0.1 | 4.1 |
| Jam Island (22484) | 2021-06-16 15:00 | 0.2 | 0.1 | 0.1 | 4.5 |
| Jam Island (22484) | 2021-06-16 16:00 | 0.4 | 0.2 | 0.1 | 3.9 |
| Jam Island (22484) | 2021-06-16 17:00 | 0.3 | 0.2 | 0.1 | 4.2 |
| Jam Island (22484) | 2021-06-16 18:00 | 0.3 | 0.2 | 0.1 | 4.3 |
| Jam Island (22484) | 2021-06-16 19:00 | 0.2 | 0.2 | 0.1 | 5.2 |
| Jam Island (22484) | 2021-06-16 20:00 | 0.1 | 0.1 | 0.1 | 5.1 |

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section

3

Development of Accident

3. Development of Accident

3.1 Operation before the accident

- 3.1.1 Hyundai Technopia unloaded all of her LNG cargo at Pyeongtaek Port (ROK) on 17 May 2021. Then on 24 May 2021 she entered drydock for hull maintenance and inspection at the shipyard of HSG Sungdong Shipbulding Co., Ltd., based in Tongyeong City, South Gyeongsang Province (ROK).
- 3.1.2 At 15:06 on 16 June 2021, the tanker left the shipyard and set sail after three weeks of work, including hull maintenance.

3.2 Accident occurrence

- 3.2.1 At 15:21 on the same day, after finishing departure assistance for Hyundai Technopia, a tugboat was detached from the tanker. Once the dockmaster⁷⁾ left the tanker, the C/O, who had been assisting with departure on the bridge, went down to the poop deck at 15:39.
- 3.2.2 About 15 drums of lubricating oil were on the poop deck, delivered in the morning of the same day. The C/O expected that the tanker would encounter significantly strong wind and waves on the voyage based on weather information received from weather service providers, so he decided to secure these drums to ensure they would not move.
- 3.2.3 At 16:30 on the same day, the C/O called the bosun, the AB, OS A, and OS B and held TBM on topics, including the need to be careful about slipping during the operation. He then joined them in finishing up the securing of the drums with ropes.

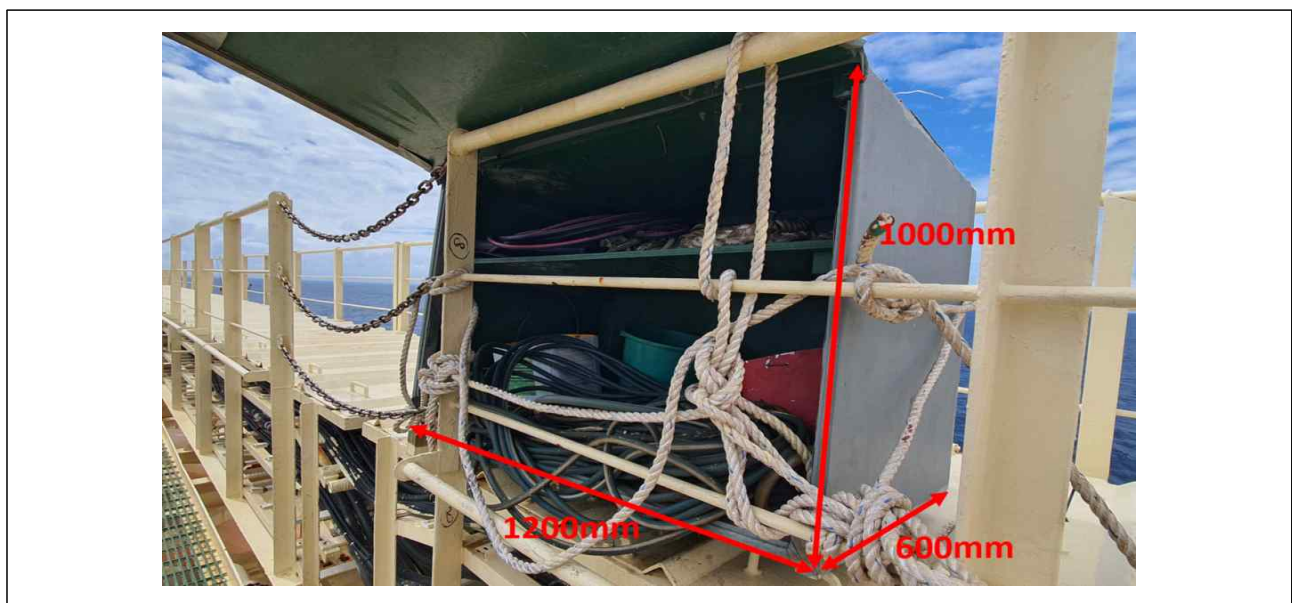
7) The dockmaster is a person who boards a ship for her operation when going into and out of drydock at a shipyard.

3.2.4 At 16:40, When the C/O was patrolling on the catwalk, he noticed that a toolbox⁸⁾ had shifted from its original place atop the electrical cable tray over Cargo Tank No. 3. He assumed that workers at the shipyard had moved while fixing steel plates and supporters of the electrical cable tray. The C/O felt the toolbox might move and even fall during bad weather, so he wanted to secure it.

3.2.5 Thus, the C/O ordered the bosun to lashing the toolbox⁹⁾ but did not tell him how to do it specifically. After that, the C/O went back to his office inside the accommodation to organize documents related to the drydock operation.

3.2.6 The bosun relayed the order to secure the toolbox to the AB, handing him ropes. However, the bosun did not mention that the toolbox had shifted and then proceeded to the bow area on patrol.

3.2.7 Along with OS A and B, the AB arrived at the electrical cable tray where the toolbox was located and prepared to tie it down. While doing so, they were unable to shut the cover of the toolbox as it was caught in the railing nearby. Thus, they decided to move it about one meter towards the bow and secure it.

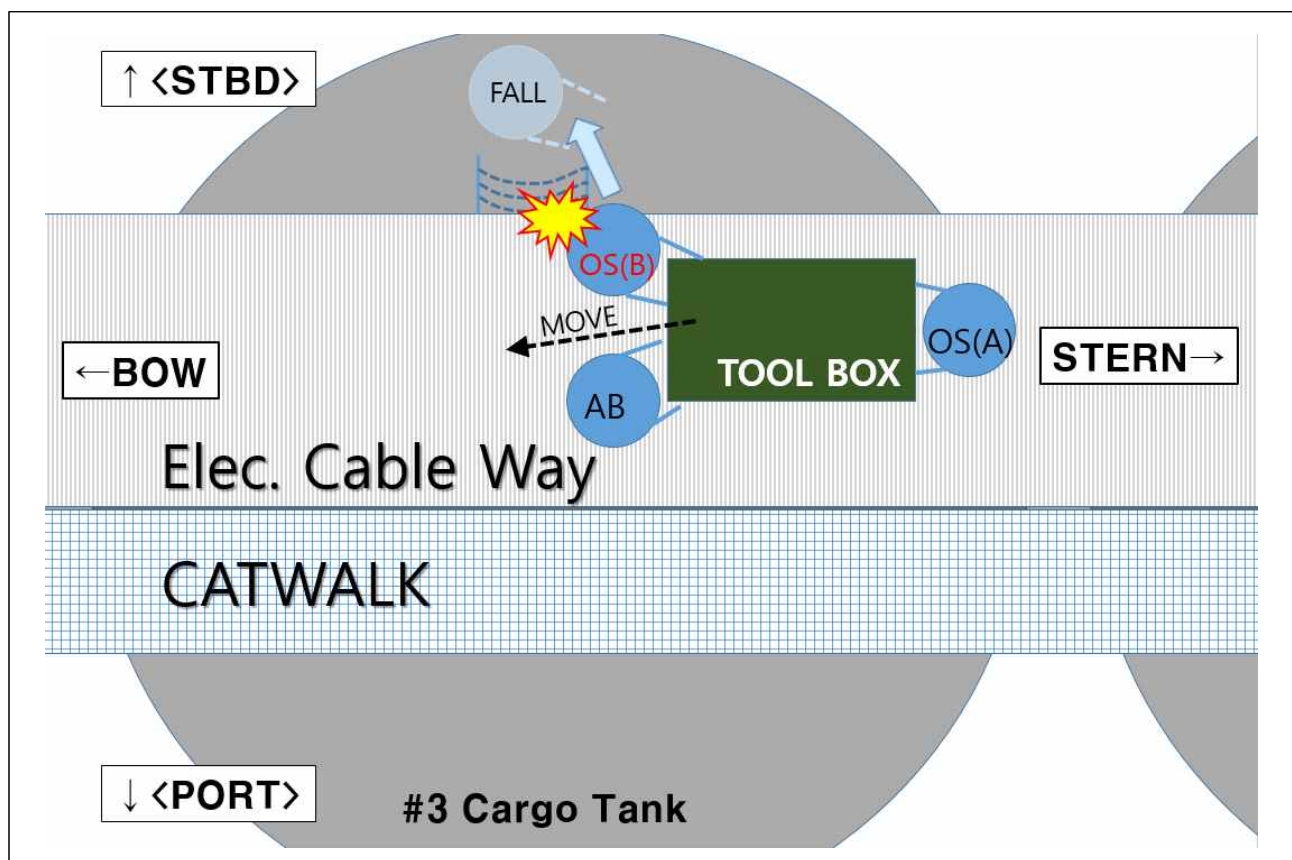


<Figure 10> Uncovered toolbox (fitted on a different tanker of the same company)

8) This toolbox is a type of wooden boxes covered with canvas. It was not built on board, but produced at a shore-based store and sent to the tanker(ship). Other tankers of Hyundai LNG Shipping were also using similar types of the product.

9) The C/O stated that he had said to the bosun at that time, "please tell them to lash it."

- 3.2.8 The toolbox contained chain blocks, spanners, bolts, nuts, air hoses, and various ropes. These items weighed some 30–40 kilograms¹⁰⁾, so the AB decided to take out several of the heavy tools before moving the toolbox. At 16:45 on the same day, he started the operation.
- 3.2.9 OS B was a new arrival on the ship, so OS A told him, "Don't come up to the tray; stay where you are." Although this was the first time for OS B to be aboard the tanker, he voluntarily came up to the electrical cable tray from the catwalk to help the others to take the tools out of the box.
- 3.2.10 After removing some tools from the box, the AB, OS A, and OS B agreed to assume a position on the port bow, in the center of the stern, and on the starboard bow of the toolbox respectively, facing one another, and lift the toolbox and shift it fore.

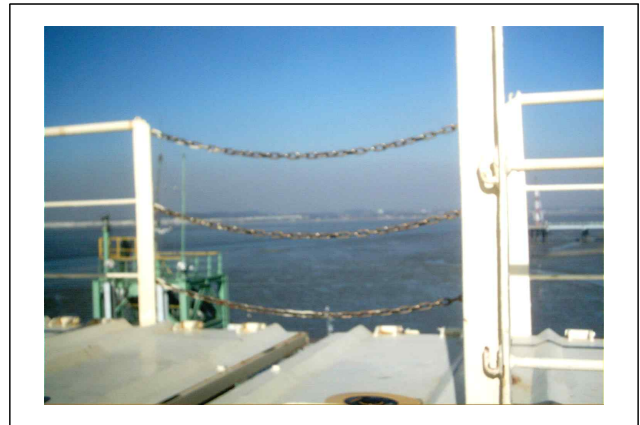


<Figure 11> Situations at the time of the accident (bird's-eye view)

10) The statement given by the crew

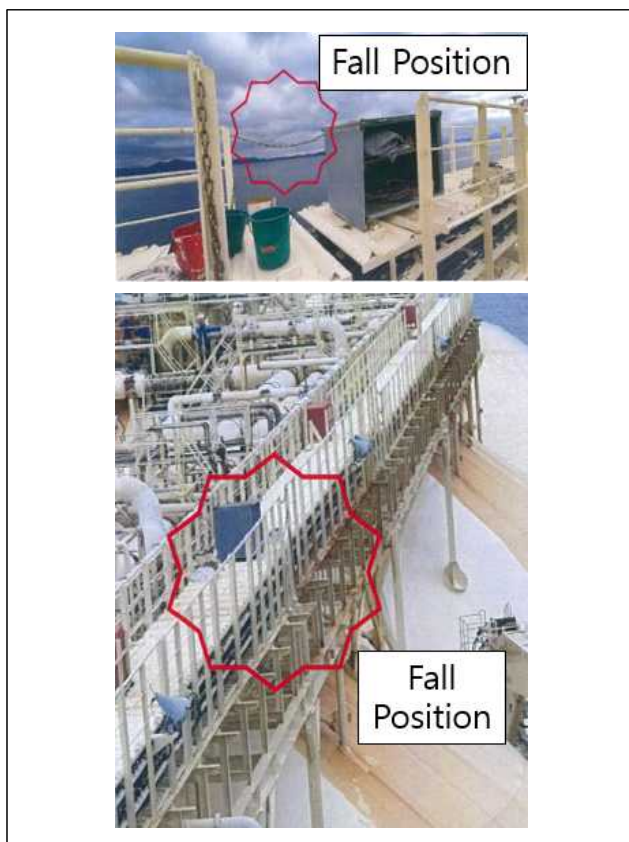


<Figure 12> Electrical cable tray (topside)

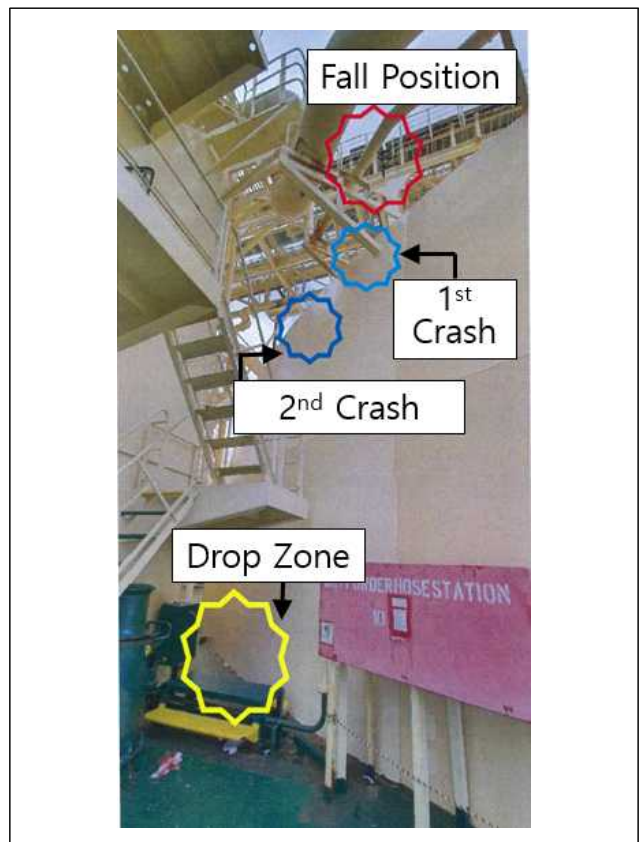


<Figure 13> Chain railings

3.2.11 When those three crewmembers tried to lift and move the toolbox together, OS B lost his balance and fell over three chains hung on his left side.¹¹⁾ At the same time, among those, two chains hung in the middle and the lowest became unhooked, creating a void through which OS B fell. It was 16:52.



<Figure 14> Photo taken on the day of the accident



<Figure 15> Fall position

11) Based on the viewpoint of OS B facing the stern from the bow.

3.3 Measures taken after the accident

- 3.3.1 At that time, the C/O picked up all of the documents related to maintenance and repair the tanker had received at the shipyard from the office at the accommodation. While he was on his way to the elevator to go the bridge, he received an urgent radio call from the AB saying that "a person had fallen down" and rushed to the accident site.
- 3.3.2 At 16:54 on the same day, the pilot, who had heard the same call on the bridge, reported it to the Korea Coast Guard (KCG) and requested an emergency response via VHF radio and his mobile.
- 3.3.3 The C/O who arrived at the scene checked OS B and confirmed bleeding from the back of his head; a 7-centimeter laceration on his left forehead; and breathing difficulty as his tongue was curled up.
- 3.3.4 The C/O ordered the 3/O on the bridge to bring first-aid equipment such as an oropharyngeal airway (OPA), respirator, and automated external defibrillator (AED). As soon as he got them, the C/O directly inserted the OPA into OS B's airway and helped him to breathe. Then he sutured the occipital region and tried to stop the bleeding by stapling the wound.
- 3.3.5 After these measures had been taken, OS B came around only enough to repeat, "It hurts; help me." He was not conscious enough to ask or respond to questions rationally.
- 3.3.6 At 17:07 on the same day, P-127, a patrol vessel from the Changwon Coast Guard Station, and a rescue boat from Busan New Port arrived in the waters near Hyundai Technopia. The crew placed OS B in a stretcher, covered him with nets and plywood, and tried to land him onto the patrol vessel by using a ship's crane, which however was not possible.¹²⁾

12) The tug crew stated that the patrol vessel had been swayed by the current nearby the tanker's hull and that it had been difficult to land the injured crew onto the vessel as she had a sharp and narrow shape.

- 3.3.7 Thus, the pilot who was on board the tanker called an adjacent tug, 601 Baekryong, and asked for rescue assistance. At 17:25, the tug arrived at the tanker and took OS B.
- 3.3.8 At 17:59 on the same day, 601 Baekryong arrived at the pier of Busan New Port and handed him over to the paramedics who were waiting at the pier. At 18:11, they took him to an ambulance and headed to Samsung Changwon Medical Center.
- 3.3.9 At 18:35 on the same day, OS B arrived at the hospital and received medical treatment. However, he died at 20:14.

section

4

Analysis

4. Analysis

4.1 Cause of Crew's death

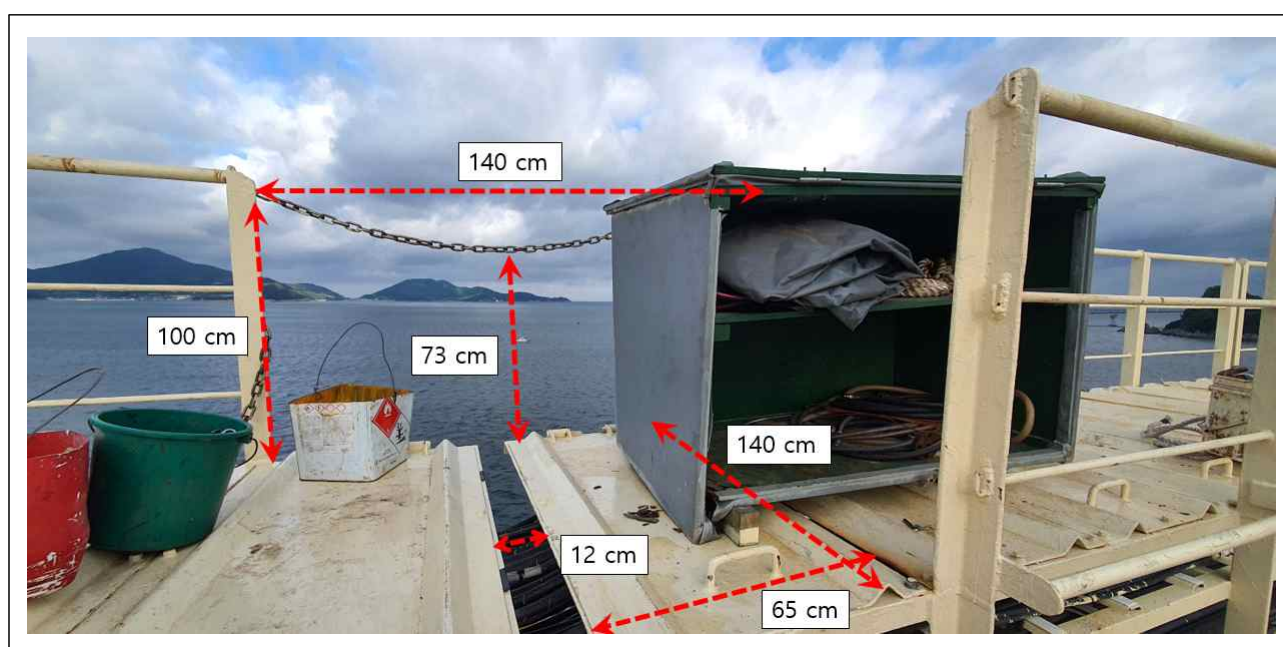
- 4.1.1 Each of the crewmembers working on the electrical cable tray at the time of the accident was concentrating on lifting the toolbox while looking forward. Thus, none of them witnessed the moment when OS B lost his balance and fell.¹³⁾
- 4.1.2 While investigating this case, however, the Marine Safety Investigation Team of the Korean Maritime Safety Tribunal (KMST) identified the following facts as a risk factor of this accident: the railings at the accident site are not made of fixed steel handrail; and triangular protrusions on the surface of the electrical cable tray may hamper workers from stepping stably and compromise their safety.
- 4.1.3 Meanwhile, OS B was examined at the hospital where he was transported after his fall, and the medical staff identified his injuries, including a laceration in a cephalad direction; a femoral fracture; and a bruise on the knee. The immediate cause of his death was determined to be a severe head damage caused by the fall.
- 4.1.4 Therefore, it is determined that while OS B was lifting the toolbox, he either overexerted himself, causing him to lose his balance, or he tripped over the structures on the electrical cable tray floor while he was stepping backward. As he went over the chain railings, his body fell against them, causing the chains to become unhooked and creating a void through which OS B suffered his fatal fall.

¹³⁾ However, one crewmember who had been working with OS B stated that he had overestimated the weight of the toolbox, and so he exerted too much effort when lifting the toolbox. While doing so, OS B fell onto the chain railings, and at that moment, he probably fell, as chains came unhooked, according to his statement.

4.2 Hull structures at the accident place

4.2.1 OS B fell about 18 meters height from the electrical cable tray atop cargo tanks of Hyundai Technopia, onto the upper deck.

4.2.2 Although this electrical cable tray was not originally built for passage or movement of the crew, steel railings are fitted at the edge on both sides on the tray floor. Those railings are not continuously linked along the tray ; at some intervals the steel railings are connected by chains.¹⁴⁾



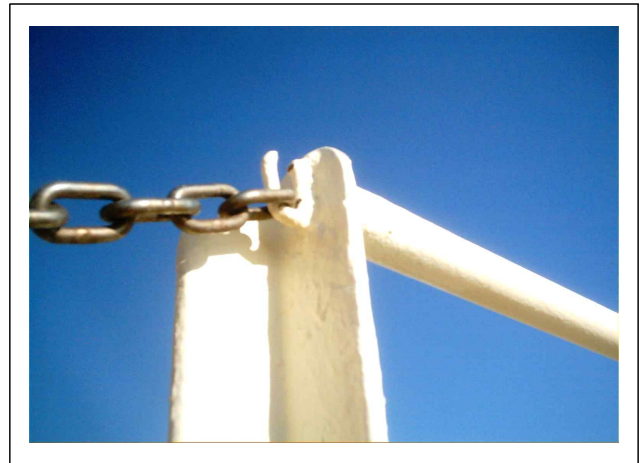
<Figure 16> Photo taken right after the fall accident

4.2.3 The width of the chain railings fitted at the fall accident site span a space about 1.4 meters (140 centimeters) wide. The three steel chains were hung horizontally, one above the other, onto U-shaped hooks (with the upper part open) on both sides of the interval between the steel railings.

14) The company explained that it is to protect the hull from bending stress, such as hogging and sagging, which is likely to occur on the voyage.



<Figure 17> An area where steel railings are connected with chains



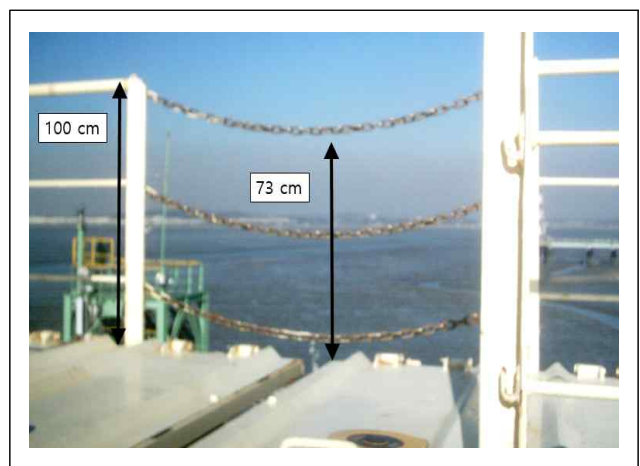
<Figure 18> A chain hook

4.2.4 The chain railings fitted along the top of the electrical cable tray are supposed to be one meter high, equal to a minimum height of railings required at all exposed areas, such as the upper deck and the superstructure deck, in order to prevent crew from falling according to both International Convention on Load Lines, 1966 (ICLL)¹⁵⁾ and the domestic regulation, Standards for Ship's Facilities¹⁶⁾.

4.2.5 However, the height of the top chain hung between the steel railings at the accident site was 0.73 meters (73 centimeters) at its lowest point, less than one meter.



<Figure 19> Comparing the height of the railings

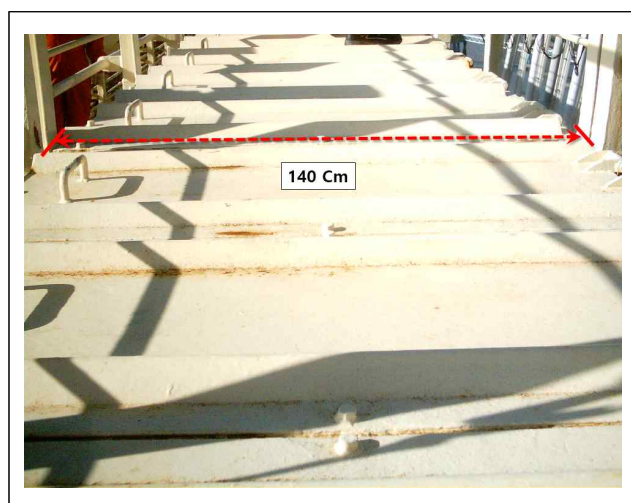


<Figure 20> Height of the chains

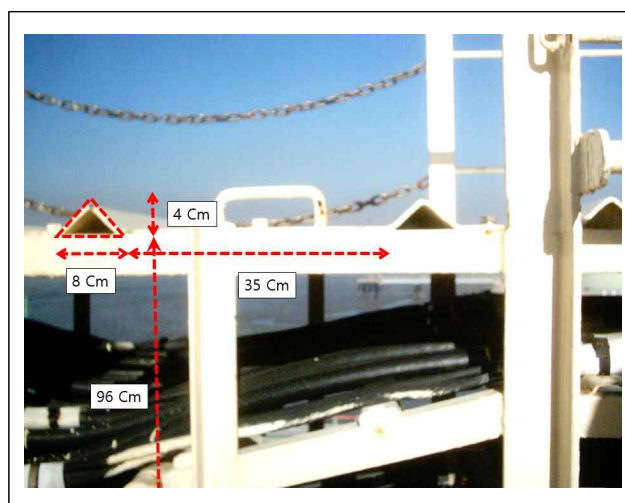
15) Regulation 25: Protection of the Crew (ICLL, 1966, ANNEX I, Ch.2)

16) Article 36 of the Standards for Ship's Facilities

4.2.6 Also, the electrical cable tray floor was made of steel plates¹⁷⁾ layered one after another over the cables fitted atop the cargo tanks. Those steel plates were also about 12 centimeters apart, considering bending stress during ship operation. Moreover, some parts of the floor have a triangular protrusion (approx. four centimeters high) to disperse the stress applied on the plates.



<Figure 21> Electrical cable tray floor



<Figure 22> Side of the electrical cable tray
(view from the catwalk)

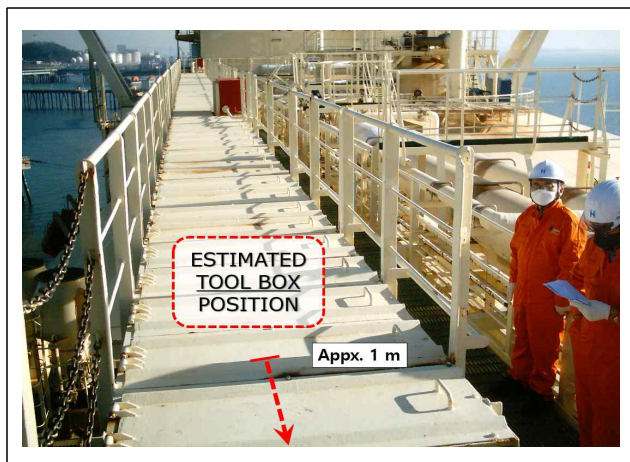
4.3 Securing of the chain railings

4.3.1 Before the accident occurred, three chains had been hung at an interval along of the electrical cable tray.¹⁸⁾ At the time of the accident, the chains hanging in the middle and the lowest one became unhooked, thereby failing to prevent OS B's fall.

4.3.2 The span for the chain railings is 1.4 meters wide, while the chains are about 1.5 meters long. Thus, when they are hung onto the railings, they sag slightly. Among the three chains, the lowest point in the sag of the uppermost chain is about 0.73 meters above the surface, while that of the middle chain is knee-high, at about 0.50 meters; and the lowest one is ankle-high, or about 0.27 meters, at its lowest point.

17) The steel plates are about 140 centimeters long and about 35 centimeters wide.

18) The crew of the tanker stated in common during the interview that all of the three chains had been hung, and investigative agencies also ruled out the possibility where chains would have been released before the operation.



<Figure 23> The toolbox position and the distance that crewmembers walked



<Figure 24> Accident position

- 4.3.3 The chain hook is U-shaped with its upper part open, allowing the chain to be hung from top to bottom. If the chain is pulled upward or a force is applied upward to the hook, the chain can be released.
- 4.3.4 Under these circumstances regarding the hooks, that chains could have become unhooked at the time of the accident if OS B had lost his balance and lifted the middle chain with his left hand while pushing it. At the same time, some part of his body, such as an ankle, could be gotten hung up in the lowest chain, pushing the hook upwards and possibly unhooking the chain.
- 4.3.5 Likewise, it has been determined that chain railings are incomplete railing structures, as the chains can easily come loose depending on a passer-by's posture against them.

4.4 Safety of the toolbox

- 4.4.1 The crew of Hyundai Technopia kept several necessary tools, such as chain blocks, spanners, bolts, nuts, air hoses, and various ropes, inside a toolbox placed atop the electrical cable tray for the sake of their operational convenience.
- 4.4.2 An electrical cable tray serves as an elevated work area, about 18 meters above the upper deck. If any of the tools kept inside the toolbox drop, it poses the risk of an accident, as the tool may strike an LNG tank or a person walking on the upper deck.

- 4.4.3 Another concern is the possibility that the toolbox on the electrical cable tray may block people from passing¹⁹⁾ in the event of a fire or other emergency.
- 4.4.4 Therefore, it is deemed necessary to enhance safety to ensure that the tools in the toolbox fitted onto the electrical cable tray drop and the toolbox does not prevent people from passing.

4.5 Appropriateness of training for newly boarded crew

- 4.5.1 The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW)²⁰⁾ requires all seafarers newly engaged onboard a ship to receive familiarization training on safe working before being assigned to shipboard duties.
- 4.5.2 Also, the International Safety Management (ISM) Code²¹⁾ requires the company to establish procedures to ensure that new personnel are given proper familiarization with their duties. The company must also develop and provide in document form instructions that must be given before the ship is underway on its voyage.
- 4.5.3 Although OS B received Crew Shipboard Familiarization instructions on his duties and personal safety when he arrived at Hyundai Technopia, documents signed by him, a reviewer, and an approver are not existed.
- 4.5.4 It may seem understandable that the schedule was too tight to collect signatures on the instructions immediately, considering the tanker had just departed, and the pilot was about to leave the tanker. Still, concern can be raised on safety grounds that OS B had been directly assigned to his duties without first receiving any confirmation from his superiors on his adequate understanding of the duties and familiarization with the tanker.

19) The width of the electrical cable tray and the toolbox is 140 and 60 centimeters each; the minimum passage width is 80 centimeters.

20) Chapter VI. Standards regarding emergency, occupational safety, security, medical care and survival functions (STCW Section A-VI/6)

21) 6. Resources and personnel (ISM Code, Part A-Implementation, Article 6)

- 4.5.5 Meanwhile, safety training is provided under the C/O's direction for new personnel such as OS B to ensure they understand their duties and assignments during emergencies as well as such topics as marine pollution prevention and security²²⁾. However, training for hull structures and safety was not on the list of subjects covered.
- 4.5.6 Likewise, Hyundai Technopia conducted such training for OS B, as prescribed in the international conventions. Unfortunately, his training and familiarization was inadequate with respect to certain topics such as the dangers when walking or working in elevated spaces. Such instruction might be deemed necessary for safe work and passage on the electrical cable tray and the catwalk, given the nature of LNG tankers.

4.6 Work safety management

- 4.6.1 The tanker's ISM manual²³⁾ prescribed that the master should order the responsible officer (a person with the highest rank among members at the site) to hold TBM with all crewmembers assigned to the operation before they begin or resume the operation and prevent accidents by ensuring they are aware of incomplete actions or conditions which could occur during the operation.
- 4.6.2 Also, the company is running a permit-to-work system to identify and eliminate risk factors for hazardous onboard operations, such as working at a height of 2 meters or above²⁴⁾.
- 4.6.3 Therefore, the crewmembers are required to wear a safety helmet, safety shoes, safety gloves, and a safety harness with lifelines secured when working at a height of 2 meters or above.

22) Nine persons, including the 2/O, from 16:45 to 17:30 (local time) on 14 Jun. 2021

23) PS-204. Safe Working Practices (the company's ISM manual)

24) According to the ISM manual, a permit-to-work system can be applied to operations using "auxiliary tools" at a height of two meters or above from the floor. Thus, one could conceivably determine that a permit to work would not be necessary for a simple task without using auxiliary tools, such as "lifting and shifting," in spite of heights.

- 4.6.4 In this case, however, the responsible officers, including the C/O, neither completed the permit to work nor the checklist, and none of the workers at the site was wearing a safety belt or had a secured lifeline at the time of the accident.
- 4.6.5 Also, the C/O and the bosun left their position only after giving orders, meaning that they did not check or supervise whether the operation was duly carried out at the site.
- 4.6.6 They simply gave the orders and left the site as they determined that the work could be easily carried out.²⁵⁾ In fact, however, the work assigned to the crew was not a simple lashing job. They were carrying out operations, such as taking tools out of the toolbox and shifting the box, which differed from what they had been originally ordered to do.
- 4.6.7 Therefore, the following elements are considered insufficient to a certain extent: assessing risk for the given task; judging the probability of such risk leading to an accident; and supervising work safety.

4.7 First-aid treatment and time consumed for rescue

- 4.7.1 At 16:52, the accidental fall occurred on board Hyundai Technopia. At 18:11, the injured crewmember was handed over to the onshore paramedics of 119 and the ambulance left. And at 18:35, the injured crewmember arrived at the hospital.
- 4.7.2 When the accident occurred, the crewmembers swiftly made an initial response to OS B by ensuring he had an open airway and suturing the wounded area with a medical stapler. However, when he was being transported to the hospital, he bled excessively. After arriving at the hospital, despite emergency medical treatment, he ended up expiring.
- 4.7.3 The coast guard station who had control over rescue operations at that time determined that a high-speed vessel would be appropriate to transport the patient.

²⁵⁾ The statement given by the crew

However, the vessel deployed for the rescue operation was not able to approach to the tanker and transport the patient. Thus, he was picked up only after a tugboat had been additionally dispatched.

4.7.4 In this case, the rescue operation was attempted relatively rapidly. However, it was partly delayed as the following factors were not anticipated: the tanker's size and freeboard at the time of the accident; and the hull motions and narrowness of the deck area aboard the first dispatched patrol vessel when the injured crewmember was transported by an onboard crane.

4.7.5 However, a rescue operation such as this could be carried out much faster in the future if rescuers examine the situation and features of the tanker in advance.

section

5

Conclusions

5. Conclusions

- 5.1 This is a fatal accident on board Hyundai Technopia where OS B, who was shifting the toolbox placed on the electrical cable tray on the tanker's cargo tanks, lost his balance, fell onto the upper deck, and eventually died.
- 5.2 At the time of the accident, chain railings were in place at the site where OS B fell, and chains were hung to connect the steel railings.
- 5.3 Under such circumstances, the AB, OS A and OS B who were on the electrical cable tray tried to lift and move the toolbox. While OS B was stepping back, he lost his balance, tripped over, and fell against the chain railings. At that moment, one of the hanging chains became undone, which is assumed to have allowed him to fall onto the deck below.
- 5.4 This accident occurred at the chain railings, an elevated work site which has potential hazards. The following facts are considered to have contributed to the accident: (1) failure to assess the elevated work site risk prior to the operation, as prescribed in the tanker's ISM manual; (2) failure to follow applicable procedures, such as conducting supervision and using appropriate safety equipment while working; and (3) mistakes and negligence of the crew who were not familiar with the tanker structures and operation.

section

6

Recommendations

6. Recommendations

6.1 Strengthening risk assessment and supervision for working at heights

- 6.1.1 The ISM manual of Hyundai Technopia requires the crew to receive a permit to work in order to identify and eliminate risk factors when working at a height of two meters or above, strap on a safety belt, and have a secure lifeline.
- 6.1.2 At the time of the accident, however, the crew failed to assess the risk of working in an elevated place, document the permit to work and the checklist, or strap on safety belts and lifelines at the work site.
- 6.1.3 Therefore, if the work corresponds to working at a height, the responsible officer, including the master and the C/O, should assess the risk factors associated with the work in advance; develop a permit to work and a checklist through meetings, such as TBM; and wear personal protection equipment (PPE), including safety belts and lifelines, as pursuant to the ISM manual. Also, the work should be thoroughly supervised to ensure that it is duly performed at the designated site.
- 6.1.4 And, in addition to the "case where a person shifts heavy objects at a height of two meters or above," the company should consider revising its ISM manual by clarifying that "cases where a person works at a place with risk of falls" also belongs to working at a height.²⁶⁾
- 6.1.5 Also, the company should continuously provide safety training for crewmembers so that they do not work carelessly without assessing risk factors on the grounds of their experience, practices, and work efficiency.

26) PS-204. Safe Working Practices: The company should review whether to erase the phrase "using auxiliary tools" from the article 1.4.2.4, "operations using auxiliary tools at a height of 2 meters or above from the floor," and add "cases of working at a place with risk of falling."

6.2 Reinforcing safety training for newly boarded crew

- 6.2.1 The accident occurred at an elevated work area, 18 meters above the upper deck, and the railing chains in particular could become unhooked. Therefore, extra attention is needed, such as offering safety training for those who work at a place near such railings, so that they can recognize the associated risk in advance.
- 6.2.2 The deceased crewmember had never been aboard Hyundai Technopia before, so he was not familiar with the tanker's structures and work environments. Thus, he would not have fully recognized the risk of working at a height, the structural features of the electrical cable tray, and the hazard along its top.
- 6.2.3 Therefore, those in charge on board, including the master, should consider such factors when providing safety training for newly arrived personnel. Also, measures should be taken to better manage work intensity and safety, if a crewmember, who has newly arrived, engages in hazardous work onboard.

6.3 Reviewing and improving safety of the railings of the electrical cable tray

- 6.3.1 Hyundai Technopia's electrical cable tray railings are basically made of steel. However, intervals in them are connected via chains, and these chains do not reach high enough, which may result in an accidental fall.
- 6.3.2 Therefore, the company should ensure the chain railings are at a safe height of one meter or above in order to prevent any risk of falling, install them as a carabiner type²⁷⁾ to ensure that chains cannot become unhooked unintentionally, and review how to improve the hooks, such as changing them into a closed eye type, so as to prevent the chains from coming loose.

27) It has a round steel frame loaded with a spring so that it can be clipped, and comes with different shapes, such as O and D.

6.4 Ensuring working tools are properly stored and used

- 6.4.1 Tools used for deck operations were placed inside a toolbox installed on the electrical cable tray of Hyundai Technopia.
- 6.4.2 The electrical cable tray, which is an elevated work area, fitted on the top of LNG cargo tanks, poses the risk of an accident, as tools may drop from above. Thus, such tools should be organized, kept, and maintained at a designated place, such as the upper deck or a storage compartment.



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