

Final Report

FATALITY OF CREW ON BOARD NOZOMI IN BANGKA STRAIT, INDONESIA 1 APRIL 2022

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Transport Safety Investigation Bureau
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The Transport Safety Investigation Bureau of Singapore

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SYNOPSIS

On 1 April 2022, after completing the loading of coal cargo, the Singapore registered bulk carrier, Nozomi, was anchored at the Tanjung Api-Api anchorage, South Sumatera, Indonesia.

While waiting for cargo export documents and scheduled pilot to embark, four crew members were tasked to grease the booby hatch dog handles for the No.5 cargo hold. During the greasing process, one of the four crew members, an Able Seafarer Deck (ASD), was discovered lying inside the cargo hold on top of the coal cargo. An emergency rescue was initiated but could not save the ASD.

The Transport Safety Investigation Bureau classified the occurrence as a very serious marine casualty.

The investigation revealed that the ASD had entered the cargo hold to retrieve a dropped dog handle and had likely succumbed to the oxygen deficient atmosphere while exiting the cargo hold. The investigation also determined that the greasing task was unplanned, and the hazards associated with the coal cargo were overlooked.

The investigation also revealed that there was no proper signage to warn the crew to treat the cargo hold as an enclosed space.

DETAILS OF VESSEL

Name	NOZOMI
IMO Number	9558701
Flag registry	Singapore
Classification society	Nippon Kaiji Kyokai (Class NK), Lloyd's Register (LR) ¹
Ship type	Bulk carrier
Hull	Steel
Delivery	14 September 2011
Owner/ ISM Manager²	Golden Galaxie Maritime Pte Ltd / Glory Ship Management Pte Ltd
Gross tonnage	33338
Length overall	190.00m
Moulded breadth	32.26m
Moulded depth	18.50m
Summer draft	13.02m



Nozomi

¹ ClassNK and LR are the Recognised Organisation (RO) for carrying out ISM audit and issuance of ISM related certificates. Statutory survey and issuance of certificates were by LR.

² As per the International management code for the safe operation of ships and for pollution prevention – ISM Code. The “ISM Manager” is referred to as the Company in this investigation report.

1 **FACTUAL INFORMATION³**

All times used in this report are Western Indonesian Time unless otherwise stated. Indonesian Local Time is seven hours ahead of Coordinated Universal Time (UTC+7).

1.1 **Sequence of events**

1.1.1 On 19 March 2022, Nozomi arrived and anchored⁴ at the Tanjung Api-Api (TAA) anchorage, South Sumatera, Indonesia, for loading coal cargo, which took place between 22 and 26 March 2022.

1.1.2 On 1 April 2022, Nozomi waited at the anchorage for cargo export documents, and the departing pilot to embark at about 1200H. At about 1000H, the Bosun asked three ASD's (ASD1, ASD2 and ASD3) to assist him in carrying out maintenance work (greasing) of the shipboard cargo cranes on the main deck. When the group arrived at No. 4 crane at about 1010H, the Bosun was doubtful whether the grease available on board was appropriate for the moving parts of the cranes. The Bosun informed the Chief Officer (CO) via walkie-talkie of the matter and requested the CO to go to the main deck for confirmation.

1.1.3 The CO, who was resting in his cabin, went to the main deck and met up with the group. After discussing with the Bosun, the CO mentioned that he would inform the Company to supply the correct grease for the cranes at the next available port. The Bosun told the CO that the grease was however suitable for lubricating the dog handles⁵ (see **figure 1**) of the booby hatch⁶ accessing cargo holds, and that the crew could grease these dog handles instead. Each booby hatch cover is secured by four sets of internal and external dog handles. Each set of the dog handles has a claw to secure the booby hatch cover internally. The CO agreed with the Bosun's suggestion and thereafter the CO went back to the ship's accommodation to rest.

³ Gathered by interviewing relevant crew members, information collected on board and provided by the Company such as photographs of the incident location and Safety Management System (SMS) requirements.

⁴ Approximate location at latitude 02° 08.3'S, longitude 104° 59.3'E. Her last port of call was Chittagong, Bangladesh for discharging cargo in aggregates and arrived this location in ballast condition for loading coal.

⁵ Comprises a lever which is commonly used on board ships to wedge against typical watertight or weathertight access doors and hatches for isolating adjoining compartments or external access against fire, smoke, and water ingress.

⁶ Also known as Access Lids. A raised or hooded form to access a ladder from the weather-deck to the cargo hold or other hatches.

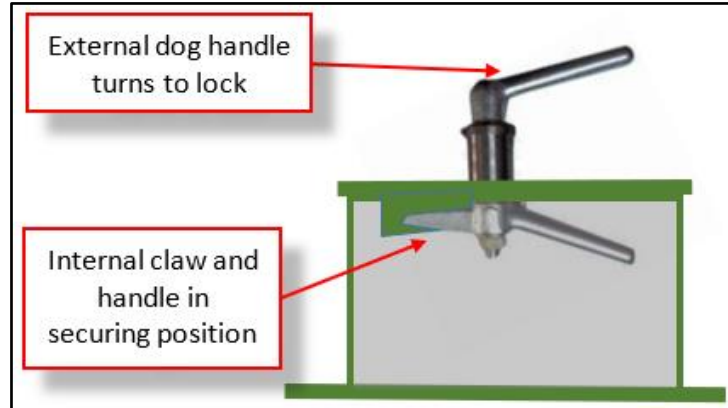


Figure 1 - Illustration of a set of dog handles securing a booby hatch (not to scale)

1.1.4 The Bosun and the three ASDs transferred the grease and tools to the forward booby hatch (for accessing No.5 cargo hold, see **figure 2**). While turning the external dog handles to open the booby hatch cover, two out of the four were found to be seized. The deck crew used a short pipe to slot into the external dog handles and managed to turn them, and thereafter were able to lift open the booby hatch cover.



Figure 2 - No.5 cargo hold forward booby hatch - Source: the Company (Annotated by the TSIB)

1.1.5 To free up the seized dog handles for greasing, the Bosun continued using the short pipe, assisted by the ASD2. At the same time, with the booby hatch cover

in open position, the ASD1 used a hammer to strike the internal dog handle of the other set of seized-up dog handles. After a few strikes, the external dog handle dropped onto the main deck and was picked up by the ASD3. **Figure 3** shows the enactment of the crew's positions at the booby hatch freeing up the dog handles prior to the external dog handle dropping on deck.



Figure 3 - Enactment of the positions of the deck crew
(Source: the TSIB)

- 1.1.6 At about 1030H, the ASD2 heard a sound from No. 5 cargo hold, he looked over the booby hatch and saw the ASD1 lying on the coal cargo. An internal dog handle⁷ was found wedged between the vertical ladder and the side stringer of ship's structure (see **figure 4**). No one was aware that the ASD1 had entered the cargo hold. The deck crew assessed that the ASD1 could have dropped the internal dog handle into the cargo hold while hammering it and tried to retrieve it without informing anyone.

⁷ This internal dog handle was found to be the other part of the external dog handle picked up by the ASD3.



Figure 4 - Red-coloured circles indicating the dog handle and the arrow points to the safety shoes of ASD1 inside the cargo hold
(Source: The TSIB)

- 1.1.7 The Bosun shouted to the ASD1 but did not receive any response. The Bosun ran towards the accommodation to get safety harness and ropes while shouting to attract the attention of other crew members. The ASD2, at about the same time, reported the incident on the walkie-talkie to the Third Officer (3O), who was the duty officer keeping anchor watch on the bridge. The Master and Second Officer (2O) were also on the bridge liaising with ship's local agent in preparation for departure clearance.
- 1.1.8 Upon hearing the report by the ASD2, the Master instructed the 2O to activate the ship's general alarm and made an announcement for rescue operation in cargo hold. Shortly after, the 3O ran down to the main deck.
- 1.1.9 On the way to the main deck, while grabbing two EEBD⁸s, the 3O called the Bosun on the walkie-talkie and asked him to take the stretcher⁹ and the self-contained breathing apparatus (SCBA) with the rescue ropes and safety harness¹⁰.

⁸ Emergency Escape Breathing Device, to be carried on board cargo ships under the Fire Safety Systems Code, Chapter 3. It is a personnel protection device used for escaping from a compartment that has a hazardous atmosphere, and not be used for fighting fires, entering oxygen deficient voids or tanks, or worn by fire-fighters. Its usage duration is about 10mins.

⁹ Neil Robertson stretcher which was stored in the infirmary.

¹⁰ SCBA, rescue ropes and harnesses were stored in the fire locker.

- 1.1.10 A short while later after the 3O left the bridge, the Master instructed the 2O to remain on the bridge and thereafter the Master went to the incident site. The Master noticed that the ASD1 was motionless lying on the coal cargo and recalled seeing some crew arriving at the site with the EEBD, stretcher, safety harness and some other equipment. There was no SCBA brought to the site. The CO and other crew members arrived at the booby hatch separately and noticed some engine crew rigging and pulling two air hoses into the booby hatch.
- 1.1.11 When the 3O arrived at the booby hatch, he put on the EEBD (see **figure 5**) hood and entered the cargo hold through the vertical ladder while the two air hoses were being connected to the air supply. The investigation team gathered that the 3O subsequently came out of the booby hatch, citing that it was difficult to breath and hot in the cargo hold.



Figure 5 - EEBD set used by the 3O

- 1.1.12 The Chief Cook (CCK), on his own accord, took the two air hoses, safety harness and ropes climbed into the cargo hold to rescue the ASD1.
- 1.1.13 After about 3-5 minutes, the CCK managed to secure the safety harness below the arms of ASD1 and the crew on the main deck pulled the ASD1 out. The CCK climbed out of the cargo hold soon after by himself. The crew assessed that the ASD1 was not breathing and there was no heartbeat or pulse. They took turns to perform CPR¹¹ on the ASD1. According to the Master, the SCBA was brought to the site after the CCK had entered the cargo hold. Subsequently, the Master called the local agent and the local port authorities for assistance.
- 1.1.14 By about 1200H, the local port health officials came on board with a medical

¹¹ Cardiopulmonary resuscitation.

team and examined the ASD1¹² before conveying the ASD1 to a local hospital. The Master was later informed by the agent that the ASD1 had passed away, as assessed by the hospital on arrival. Nozomi departed TAA anchorage on 5 April 2022 and sailed for the next port of call, Singapore.

1.2 The ship and her past voyages

1.2.1 Nozomi is a Handymax size¹³ bulk carrier, with four cargo cranes mounted on deck along the centreline for loading / discharging of cargo from its five cargo holds. She was in tramp service and capable of carrying many types of bulk cargo.

1.2.2 At the time of occurrence, Nozomi was carrying about 57,000MT of non-coking type of Indonesian steam coal in all cargo holds, as per the cargo manifest provided to the Master, and drawing a draught of 13.3m. According to the ship's voyage records, since December 2020, this was the fourth loading of steam coal at the TAA anchorage and a total of nine voyages had been on coal carriage consignments out of the 15 voyages in the same period. The most recent consignment of coal was loaded on 24 October 2021 and discharged on 11 November 2021.

1.3 The crew

1.3.1 There were 24 crew of four nationalities on board Nozomi. All of them held valid STCW¹⁴ competency certificates required for their respective positions on board, and the working language was English.

1.3.2 The qualification and experience of the Master, relevant officers and crew are tabulated below.

Designation on board	Nationality	Age	Qualification	Duration onboard (month)	In rank service (Year)	Service in Company (Year)	Working schedule on board
Master	South Korean	64	COC – Master / STCW II/2, IV/2	4.6	15	8	N/A

¹² Confirming no visual external injuries nor bleeding.

¹³ A way of categorising bulk carriers basing on ship's capacity, a Handymax sized ship is typically about 35000-59000 deadweight (DWT).

¹⁴ The International Convention on Standards of Training, Certification and Watch keeping for Seafarers (or STCW), 1978 sets qualification standards for masters, officers and watch personnel on seagoing merchant ships.

Chief Officer	South Korean	60	COC – Master / STCW II/2, IV/2	9.9	13	0.8	Day worker
Third Officer	Indonesian	26	COC – OOW / STCW II/1, IV/2	10	4	0.8	0800-1200 2000 - 0000
Bosun	Chinese	53	Deck/Catering Rating per STCW II/5	12	23	29	Day worker
ASD1	Chinese	48		12.2	26	26	0800-1200 2000 - 0000
ASD2	Indonesian	58		10	34	26	0800-1200 2000 - 0000
ASD3	Indonesian	53		0.2	30	27	Day worker
Chief Cook	Chinese	50		12	22	22	Day worker

- 1.3.3 Both the CO and the 3O were first time with the Company and joined Nozomi in June 2021. The others listed in the table had served with the Company for many years. All the crew received their familiarisation¹⁵ training after joining ship as per the Company's training requirements. In addition, the CO and the 3O had received a briefing at the shore office before joining the ship.
- 1.3.4 The 3O had six years of sailing experience on bulk carriers including on ship carrying coal cargo. Prior to the incident, he was not aware of the booby hatch maintenance work while keeping watch on the bridge.
- 1.3.5 The ASD1 was declared medically fit for service at sea dated 15 March 2021 in accordance with the STCW Code¹⁶, by an international travel health care centre which was authorised by the China Maritime Safety Administration for seafarers' medical check-up. The medical certificate was valid for two years, without any limitations or restrictions on fitness. According to the medical certificate, the ASD1 was about 1.70m in height and weighed about 70 Kg.
- 1.3.6 According to Nozomi's work / rest hour records, in the past 24-hour prior to the occurrence, the ASD1 had 16 hours of rest and in the last 7-day period, he had 107 hours of rest, indicating compliance with the STCW and MLC Convention's

¹⁵ A template form named as "The record of onboard familiarisation". Once completed, the original copy of the form was to be kept in the Company, with one copy for the individual crew and another to retain on board.

¹⁶ STCW Code, A-1/9 which defines the standards of medical fitness for seafarers.

requirements concerning the hours of work and rest¹⁷, as documented.

1.4 The booby hatch

1.4.1 The booby hatch structure typically has a coaming height of about 0.8m above the main deck. All booby hatches on board Nozomi are of the same design, having four sets of dog handles to lock the four sides of the hatch for watertightness. As shown in **figure 2**, the booby hatch that was open for maintenance at the time was located at the forward of No.5 cargo hold.

1.4.2 The outer side of the booby hatch was marked “KEEP CLOSE AT SEA” and “NO.5 HOLD ACCESS” (see **figure 2**). On the inner side, a red metal plate on the hatch marked the number of the cargo hold for access together with “CHECK SAFETY BEFORE ENTRY” (see **figure 6**). These markings were a part of the ship’s original design from the shipyard. There was no other sign or notice in the vicinity indicating that the cargo hold was an enclosed space or that the cargo hold was carrying coal at the material time.



Figure 6 – The booby hatch cover for No.5 cargo hold
(Source: The Company, annotated by the TSIB)

1.4.3 Access to the cargo hold from the booby hatch is via two connecting vertical ladders which end at an intermediate platform (with a grating) and from there, via a spiral ladder. The internal dog handle was wedged at about 1.4m from the booby hatch cover on the upper vertical ladder. The top of coal cargo was about

¹⁷ STCW Chapter VIII and MLC, Reg 2.3 with regards to rest hour - Minimum hours of rest shall not be less than i) ten hours in any 24-hour period; and ii) 77 hours in any seven-day period. Hours of rest may be divided into no more than two periods, one of which shall be at least six hours in length, and the interval between consecutive periods of rest shall not exceed 14 hours.

3.5m from the hatch cover, where the ASD1 was seen lying. The intermediate platform is about 4.1m from the hatch (see **figure 7**).

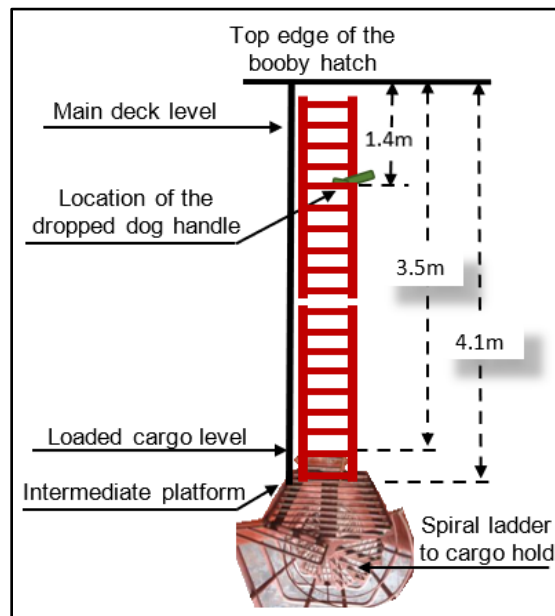


Figure 7 – Illustration of various heights (not to scale)

1.5 SMS on enclosed space entry and booby hatch maintenance

- 1.5.1 The Company managed three types of ships, i.e. bulk carrier, oil and chemical tanker. A full-term Document of Compliance certificate was issued to the Company by ClassNK on 19 October 2017 based on the audit completed on the same date and it was valid until 22 October 2022. The last verification audit for this issuance was carried out on 20 October 2021.
- 1.5.2 A full-term Safety Management certificate was issued by LR for Nozomi on 2 July 2018, based on the audit completed on the same date and was valid until 8 September 2023. The last intermediate verification was conducted on 21 April 2021.
- 1.5.3 The last Port State Control inspection was carried out on 14 April 2021. Six deficiencies were raised, but none of them were related to safety procedures on board. The last Flag State Control inspection was conducted on 17 April 2019. Four deficiencies were issued, which were also not related to safety procedures and were rectified subsequently.
- 1.5.4 The Company's SMS procedures in English has a section of "enclosed space

entry procedures” which describes the characteristics of an enclosed space as - *limited opening for entry and exit, inadequate ventilation and not designed for continuous work occupancy, such as cargo space, fuel tank, void space, etc.* The procedures state that these spaces would be hazardous and could result in rapid death from harmful gases and/or lack of oxygen and should never assume a cargo hold or tank is safe.

- 1.5.5 The SMS procedures also state that *any cargo hold which had been sealed¹⁸ must be assumed to have a dangerous atmosphere and consequently be deemed unsafe for entry* without the protection of breathing apparatus. Unprotected entry should not be attempted until a competent person¹⁹ has made an assessment and taken the appropriate measures to ensure the space is safe for entry.
- 1.5.6 The SMS procedures further highlight that the Master is responsible to identify hazardous spaces and establish procedures for safe entry. According to the SMS, the Master or the CO must ensure that an enclosed space is safe for entry by identifying potential hazards, ensuring the space is ventilated, the atmosphere is tested at different levels for oxygen deficiency and enclosed procedures (according to the SMS) are instituted before and after entry. An enclosed space entry checklist is required to be completed prior to the entry.
- 1.5.7 The same procedures also require crew members with enclosed space entry or rescue responsibilities to participate in enclosed space and rescue drills²⁰ held on board the ship at least every two months. The scope of the drills includes checking and using of gas measuring instrument, donning of PPE²¹, coordinating with other squad teams, demonstrating the use of rescue equipment²² as well as identifying hazards and recognising signs and symptoms caused by exposure to hazards during enclosed space entry.
- 1.5.8 In the event of an emergency, and after the ship’s general alarm is raised, under no circumstances should the attending crew member enter the enclosed space before help arrives and the situation has been evaluated to ensure the safety of those entering the enclosed space to undertake rescue operations.

¹⁸ Openings to cargo hold are closed, such as hatch covers and booby hatches.

¹⁹ A person, referred to the Master and the CO having sufficient theoretical knowledge and practical experience to make an informed assessment of the likelihood of a dangerous atmosphere being present or subsequently arising in the space.

²⁰ SOLAS, Chapter III, Regulation 19, Emergency training and drills.

²¹ Personal protective equipment.

²² Such as SCBA, Neil Robertson stretcher and rescue rope and harness.

Personnel performing rescue operations in enclosed spaces should be trained and equipped.

1.5.9 The records on board Nozomi obtained by the investigating team indicate that both the ASD1 and the 3O acknowledged reading the related SMS procedures and had attended familiarisation training within the same month after joining the ship. The records also indicate that the ASD1 and the CCK had participated in at least six enclosed space entry and rescue drills, and the 3O had participated in four such drills.

1.5.10 The Company has in place a Deck Maintenance Inspection and Record system. The system includes the general inspection of booby hatch. The investigation team could not establish whether any maintenance had been done on the booby hatch of dog handles in the past. The investigation team noted that there were no spare dog handles carried on board the vessel for replacement.

1.6 Carriage of coal and related procedures

1.6.1 According to the ship's cargo stowage plan, there was 11,700MT of coal loaded in No.5 cargo hold. The significant hazards information contained in the Material Safety Data Sheet (MSDS) for this type of the cargo is as follow:

- Dust irritates the respiratory tract and chronic inhalation may lead to decreased pulmonary function;
- Wear appropriate mask to avoid direct inhalation of content (when in physical contact with the coal); and
- Cargo is black in appearance and odourless.

1.6.2 Section 3 of the IMSBC²³ - The Safety of Personnel and Ship, highlights that some solid bulk cargoes are susceptible to oxidation, which may result in oxygen depletion, emission of toxic gases or fumes and self-heating. Many solid bulk cargoes are liable to cause oxygen depletion in a cargo space such as coal cargoes.

1.6.3 The Appendix in the IMSBC re-emphasised that the properties and characteristics of coal may be subject to oxidation, leading to depletion of oxygen and an increase in carbon dioxide or carbon monoxide concentrations

²³ International Maritime Solid Bulk Cargoes Code – facilitating the safe stowage and shipment of solid bulk cargoes by providing information on the risks associated with its shipment and procedures to be adopted for carriage.

- in the cargo space. Carbon monoxide is an odourless gas, slightly lighter than air and is toxic by inhalation, with an affinity for blood haemoglobin over 200 times that of oxygen.
- 1.6.4 In accordance with the IMSBC, the coal cargo carried on board Nozomi was declared²⁴ under group B which possesses a chemical hazard and could give rise to a dangerous situation on a ship such as fire, release of toxic gas and corrosion. This cargo is also not considered liable to emit significant²⁵ quantity of methane as checked in the shipper's declaration.
- 1.6.5 One of the requirements of the IMSBC is for the Master of a ship or his representative to be provided with information about the cargo, such as toxicity, corrosiveness, and propensity for oxygen depletion (if applicable). In this case, the Master of Nozomi was made aware of the propensity for oxygen depletion of coal cargo loaded on board.
- 1.6.6 The same section also highlights appropriate procedures prior to entry into an enclosed space on board should be followed. Personnel shall not be permitted to enter the cargo space unless the space has been ventilated, the atmosphere tested and to be gas-free to have sufficient oxygen to support life.
- 1.6.7 An emergency entry into the cargo space may be permitted without ventilation, or testing the atmosphere, provided that the entry into the cargo space is undertaken only by trained personnel wearing SCBA with protective clothing, under the supervision of a responsible officer.
- 1.6.8 The COSWP²⁶ was incorporated into the Company's SMS procedures and was carried on board its fleet of ships, including Nozomi. Chapter 15 of COSWP highlights that dangerous space may not necessarily be enclosed on all sides, e.g. ships' holds may have open tops, but the nature of the cargo makes the atmosphere in the lower hold dangerous. The atmosphere of such spaces may become dangerous because of a change in the condition inside or in the degree of enclosure or confinement, which may occur intermittently. Personnel need to exercise caution before entering any space on board a ship that has not been

²⁴ Shipper's declaration.

²⁵ There was no explanation on how much is quantified as significant.

²⁶ Though not a mandatory publication for carriage on Singapore registered ships, the Company's SMS had incorporated the Code of Safe Working Practices for Merchant Seafarers (COSWP) as the part of procedures for reference. The COSWP, edition 2015, published by the UK Maritime and Coastguard Agency (MCA), provides best practice guidance for improving health and safety on board ships. A copy of COSWP was on board at the time of the accident.

open for some time.

- 1.6.9 The same Chapter also highlights that for entrances to all unattended dangerous spaces aboard a ship should be kept locked or secured against entry. Any hatches readily accessible to enclosed spaces should be marked as the entrance to a dangerous space. When the space is open for work to be carried out, an attendant should be posted, or a barrier and warning sign put in place. As far as possible, work should be arranged in such a way that no one has to enter the space.
- 1.6.10 An IMO Resolution A.1050(27)²⁷ highlights the Company's responsibilities under the safety management for entry into enclosed space. One of them is to ensure that a risk assessment is conducted to identify all enclosed spaces on board its ships. This risk assessment should be periodically revisited to ensure its continued validity. The Resolution also emphasised that no person should open or enter an enclosed space unless authorised by the master or the nominated responsible person **and** unless the appropriate safety procedures laid down for the particular ship have been followed. Entry into enclosed spaces should be planned and the use of an entry permit system, such as the use of a checklist.
- 1.6.11 The investigation team gathered that there is no standardisation of signage for enclosed spaces at the time of occurrence. The Implementation of IMO Instruments (III) Sub-Committee²⁸ invited the CCC Sub-Committee²⁹ to consider a review of Res. A.1050(27) in 2022 involving entering enclosed spaces aboard, regarding the standardisation of signage for enclosed spaces.
- 1.6.12 According to the information obtained by the investigation team, there was no list of enclosed spaces on board the Company's fleet of ships. A reminder to not to open any hatch including booby hatch of a cargo hold carrying coal was given by the Master when he first joined the ship, which was confirmed by the CO. There was no evidence to confirm whether any notices were placed, or reminders given to the ship's crew when this cargo of coal was loaded for this

²⁷ The International Maritime Organization (IMO) Resolution A.1050(27) - Revised Recommendations for Entering Enclosed Spaces Aboard Ships. The same Resolution was addressed under Shipping Circular No.4 of 2012 of the Maritime and Port Authority of Singapore (the Flag Administration of Nozomi) to inform its shipping community.

²⁸ Brings together flag, port and coastal States to consider IMO instruments implementation issues and deals in casualty analysis and issuing lessons learned from marine accidents.

²⁹ The Sub-Committee on Carriage of Cargoes and Containers deals with the carriage of packaged dangerous goods, solid bulk cargoes, bulk gas cargoes and containers. The Sub-Committee keeps updated the IMSBC and reviews other Codes.

voyage, from 22 March 2022 to the day of occurrence.

1.7 Post incident information

Oxygen level in the No.5 cargo hold

1.7.1 The oxygen level for all the five cargo holds was measured by the CO on 4 April 2022 (three days after this occurrence). The sampling tube was extended down from the booby hatches (forward and aft) at about 2-3m and the two readings taken: first reading at the opening of booby hatch and second reading after 10mins, were recorded in the table below:

	No.1	No.2	No.3	No.4	No.5	Remarks
% of oxygen (1)	Forward - 7.7 Aft - 20.1	Forward - 6.9 Aft - 6.3	Forward - 6.2 Aft - 6.1	Forward - 9.6 Aft - 6.9	Forward - 6.8 Aft - 7.5	First open
% of oxygen (2)	Forward - 13.1 Aft - 20.1	Forward - 6.9 Aft - 6.3	Forward - 8.2 Aft - 8.1	Forward - 12.7 Aft - 13.6	Forward - 8.3 Aft - 15.2	After 10mins

Enclosed space entry and rescue drills

1.7.2 According to the records obtained by the investigation team, a physical enclosed space entry drill was conducted at the duct keel on 10 October 2021, where the pre-entry checks and risk assessment were carried out, the SCBA, stretcher and other equipment (See **figure 7**) were deployed, the rescuing operation was simulated, and the outcome of the drill was documented as satisfactory. All the crew listed in the table (paragraph 1.3.2) participated in that drill.



Figure 7 – Deployment of the SCBA, stretcher, rope and harness for the rescue drill (simulated at ship's duct keel)
(Source: photographs 1&2 from the Company, 3&4 from the TSIB)

1.7.3 The ship's records also indicated that the last two enclosed space entry and rescue drills (in the form of tabletop), prior to the occurrence, were conducted at a void space tank and one of water ballast tanks on 23 November³⁰ 2021 and 18 February 2022, respectively. The two tabletop drills did not include demonstration of wearing of the SCBA for entering the enclosed spaces or the use of a Neil Robertson³¹ stretcher for rescuing a casualty out from the enclosed spaces.

Additional information regarding the rescue operation

1.7.4 When asked by the investigation team on the rationale of using an EEBD, the 3O recalled that the EEBD was one of the listed equipment to be used for enclosed space rescue operation, and it was used for all the enclosed space entry and rescue drills on board, which was confirmed by the Master. Both the ASD2 and the ASD3 also had the same understanding that using the EEBD for rescue operation in enclosed space was permitted on board Nozomi.

1.7.5 The 3O informed the investigation team of his understanding that the EEBD has a duration of 10mins usage and cited in desperation to save his fellow shipmate, resorted to the use of the EEBD.

1.7.6 In an emergency involving enclosed space, according to the muster list, the Emergency Squad, comprising the CO, Bosun, two ASDs and two ordinary seamen, is to assess the situation first and respond accordingly at the incident site. The Emergency Squad is to be assisted by the Support Squad led by the 2O. The Master is the overall in-charge under the Command Squad.

1.7.7 The CCK is assigned to the First Aid Squad, together with the Steward, led by the 3O. The roles of the First Aid Squad are to provide first aid to casualties in an emergency, mobilise a stretcher, convey the casualty to a safer place for first aid treatment and other duties directed by the Master.

1.7.8 The Company confirmed that as per the SMS, the EEBD was not listed as a rescue device for enclosed spaces, and that the SCBA would be used instead. The training and physical drill for enclosed space conducted on 10 October 2021 did not record EEBD as part of the rescue equipment. The reasons for

³⁰ It was scheduled to be in December, the Master brought it forward few days due to the anticipated voyage.

³¹ This type of stretcher is used for moving a casualty safely from a difficult place where the ordinary stretcher with stiff poles would be useless. It can be bent slightly in turning sharp corners in narrow passages, as when being hoisted up the ladder ways from engine rooms or through the hatches of cargo tanks.

the misperception of the crew of Nozomi, for the use of EEBD in drills, or how long had it been so, could not be established.

Understanding of the greasing work

- 1.7.9 The maintenance work (greasing of the booby hatch dog handles) was an unplanned activity. Neither the Master nor the 3O, as the officer of the watch, was aware of the booby hatch maintenance work (possibility of opening the booby hatch) on deck while both were on the bridge waiting for the pilot to board.
- 1.7.10 According to the CO, the task of greasing the dog handles did not require entering the cargo hold. As such, the CO did not remind the deck crew not to enter the cargo hold or to seek his permission if there was a need to enter the cargo hold. The Bosun had similar thoughts as the CO's, i.e. greasing of the booby hatch dog handles did not require entering the cargo hold. The ASD2 and ASD3 did not object the opening of the booby hatch by the Bosun for greasing the dog handles.

Cause of death

- 1.7.11 The body of ASD1 did not undergo an autopsy examination, a death certificate was issued on 1 April 2022 by the Bhayangkara Mohamad Hasan Hospital, Palembang, Indonesia. The exact cause of death of the ASD1 could not be confirmed.

1.8 Environmental condition

- 1.8.1 At the time of occurrence, Nozomi's logbooks indicated that there was southerly gentle breeze of about 7-10 knots (Beaufort wind force 3), the sea condition was slight about half to one metre. The sky was cloudy but good visibility. The ambient air temperature was at about 30 degrees Celsius.

2 ANALYSIS

2.1 The likely cause of death

- 2.1.1 The ASD1 was found motionless on the coal cargo and there were no bodily injuries as observed by the crew. The exact cause of death of the ASD1 could not be determined as the body did not undergo an autopsy examination.
- 2.1.2 Based on available evidence, the ASD1 was medically fit without limitations or restrictions for servicing at sea and had 16 hours of rest in the past 24-hours. He had not performed any strenuous activity since the morning and was last known to be working in freeing up the internal dog handle of the booby hatch's securing mechanism.
- 2.1.3 The investigation team considered the possibility of the ASD1 accidentally falling into the cargo hold. Correlating the build (height) of the ASD1, the position where the ASD1 before being discovered and the coaming height (0.8m) of the booby hatch, it is probably unlikely that the ASD1 accidentally fell into the cargo hold. An accidental fall would have caught the attention of the other crew members as well as resulted in some injuries sustained by the ASD1, which was not the case.
- 2.1.4 Nozomi was carrying coal, of which 11,700MT was loaded in No.5 cargo hold. The cargo hold had been sealed (closed) for five days after loading. As seen in paragraphs 1.6.2 and 1.6.3, coal may be subject to oxidation (leading to depletion of oxygen), resulting in an increase in concentrations of carbon dioxide or carbon monoxide, which can be lethal. The oxygen readings taken after the occurrence (three days later) were at 6.8% and 8.3%, lower than what is needed for supporting human life (minimum acceptable level at 19.5%³²). Having been sealed for more than three days (cargo operation ended on 26 March 2022) prior to the opening on 1 April 2022 for booby hatch's securing mechanism maintenance, it is likely that the oxygen content inside No.5 cargo hold would have been lower than those taken post occurrence.
- 2.1.5 The investigation team considered the probability that the internal dog handle had dropped into the cargo hold when the ASD1 was attempting to free it. The ASD1 then entered the cargo hold to retrieve it without informing the other crew. When the ASD1 had retrieved the internal dog handle and was climbing up the

³² IMO Resolution A.1050(27), steady readings of 21% oxygen by volume by oxygen content meter for enclosed space entry purposes.

ladder, due to the depleted oxygen condition in the cargo hold, he lost consciousness and fell, leaving the dog handle wedged between the ladder and the stringer.

2.1.6 This hypothesis is further corroborated by the height of the ASD1 and the location where the dog handle was found. From the location where the dog handle was found to the coal level, it is about 2.1m (see **figure 7**). When a person climbs up a vertical ladder, both hands are extended to hold the sides of the ladder. With the height of 1.70m and the arms' length of about 0.5m, it is likely that the ASD1 was either about to climb up the ladder or making the first couple of steps on the ladder, before losing consciousness. The fall was from a low height which explains the reason for no visible injuries sustained by the ASD1. The investigation team opined that the ASD1 might have deemed the cargo hold to be safe for entry and that retrieving the dog handle was a simple task which could be done quickly.

2.1.7 The occurrence serves as a reminder that a cargo hold can have a dangerous atmosphere and should not be assumed to be safe for entry. An assessment should be performed, and appropriate measures implemented before any entry is made.

2.2 Unplanned maintenance on booby hatch and risk assessment

2.2.1 The greasing of booby hatch dog handles was an impromptu task while Nozomi was waiting for departure. According to the CO and the Bosun, the task was expected to be straightforward and did not require entering the cargo hold. As such, there was no risk assessment done for entering enclosed space as per the SMS procedures.

2.2.2 The last maintenance (greasing) of the booby hatch dog handles was unknown. While the nature of the task understandably did not require entering the cargo hold, the task required opening of the booby hatch to grease the dog handles, which increased the risk of crew working in the vicinity. In addition, the risks associated with the greasing of the dog handles, such as the dropping of the dog handle into the cargo hold, was not anticipated by the crew. It would have been prudent for the crew to conduct the risk assessment for the task, more so when the cargo carried in the cargo hold was hazardous, and to anticipate the worst-case scenario of the need to enter the cargo hold.

2.2.3 Had a risk assessment for enclosed space been done, the ASD1's reactions

may have been different.

2.3 Awareness of cargo hazards

- 2.3.1 The Master had reportedly reminded all the crew on board not to open any hatch including booby hatch of a cargo hold carrying coal after he joined ship. In the Master's opinion, all the crew had a clear understanding of his instructions.
- 2.3.2 The CO had agreed for the deck crew to grease the dog handles and the booby hatch cover had been opened to facilitate the greasing. There was no evidence that reminders had been given to the crew about the hazards of the coal inside the cargo hold when the booby hatch cover was opened.
- 2.3.3 While the crew may be expected to remember or recognise the hazards associated with the cargo carried on board, the occurrence had proven that such important aspect could be overlooked. For the crew's safety, it is important to remind them of the hazards of the cargo carried.

2.4 Rescue operation

- 2.4.1 The SMS procedures document that in an emergency, personnel performing the rescue operation in enclosed space, i.e. the Emergency Squad, should be trained and equipped with SCBA. Based on the muster list, the personnel for the Emergency Squad were supposed to be the CO, Bosun and two ASDs. Instead of these persons performing the rescue operation, the 3O entered the cargo hold with an EEBD out of desperation, and subsequently the CCK entered the cargo hold with two air hoses, to rescue the ASD1.
- 2.4.2 It could not be established why the trained Emergency Squad did not undertake the rescue operation as per the muster list.
- 2.4.3 While the attempts by the 3O and the CCK to rescue a workmate were understandable, they could put themselves in danger and fallen victims themselves when performing the rescue operation using inappropriate equipment.
- 2.4.4 The Master was aware of the risk associated with the carriage of the coal cargo. Despite being the overall in-charge under the Command Squad (expected to provide direction for the rescue operation), the Master did not intervene when the CCK entered the enclosed space with air hoses.

2.4.5 It is fortunate that no further injuries resulted from the rescue attempt which was conducted by personnel who were not assigned to conduct the rescue. While it is understandable that crew would want to rescue their fellow workmate unless exceptional circumstances required, it is important that crew follow the assigned roles. In addition, appropriate equipment should be used for conducting the rescue.

2.5 Enclosed space signage

2.5.1 The investigation team recognises that a cargo hold may not be considered as an enclosed space all the time, especially when its hatch covers are open for loading or discharging of cargo, or its cargo spaces have been adequately ventilated throughout the voyage. However, if a cargo hold carries dangerous goods (such as coal or other cargo that emit harmful gases) and has been sealed (without ventilation), it would pose a risk to the safety of personnel entering or working in the vicinity.

2.5.2 The booby hatch of the No.5 cargo hold was marked “KEEP CLOSE AT SEA” on the outside, to remind the crew to ensure the watertight integrity of the cargo space. The inside booby hatch was marked “CHECK SAFETY BEFORE ENTRY” which was meant to serve as a reminder to the crew who intend to enter the cargo hold. While such a reminder can prompt an individual to carry out some checks, it does not highlight the risks associated with enclosed spaces entry.

2.5.3 It is thus desirable that proper signage be placed to warn the crew that cargo hold should be treated as enclosed space when it has been sealed for some time.

2.5.4 The investigation team noted that there was no standard signage for enclosed spaces for use on ships, and while a standard is being developed by the IMO, there is merit for the Company to consider posting a graphic or infographic signage in conspicuous places on the ship. The signage should be in a manner that is understandable by all crew to provide a constant reminder of the risks of entering the cargo hold.

2.6 Incidental observations

EEBD being used as a rescue equipment

2.6.1 As highlighted under the IMO’s Fire Safety Systems Code, the EEBD is meant

for escaping from a compartment that has a hazardous atmosphere and should not be used for entering oxygen deficient voids or tanks on board ships. In the attempt to rescue the ASD1, the 3O used the EEBD to enter the cargo hold and subsequently had to leave the cargo hold due to difficulty in breathing, in addition to the hot environment.

- 2.6.2 The perception that EEBD is appropriate for rescue operation seemed to be a common understanding on board Nozomi. Besides the 3O, the Master, the ASD2 and the ASD3 also had the same understanding that using the EEBD for rescue operation in an enclosed space was permitted on board Nozomi., including the Master. Reasons for this perception could not be established. The crew also mentioned that the EEBD was one of the listed equipment used for enclosed space entry and rescue drills on board. It is pertinent for the Company to correct this misperception and to ensure that the correct type of rescue device is being used for enclosed space entry and rescue drills.

3 CONCLUSIONS

From the information gathered, the following findings are made. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

- 3.1.1 The ASD1 had likely entered the No.5 cargo hold without the knowledge of the other crew members to retrieve a dog handle. The cargo hold had low concentrations of oxygen due to the cargo of coal. The ASD1 collapsed while climbing out of the cargo hold.
- 3.1.2 The maintenance of the booby hatch was an unplanned task and did not require entering of cargo hold. The dropping of parts into the cargo hold was not anticipated for this maintenance. The risks associated with working in the vicinity of a hazardous environment (cargo hold loaded with coal) had not been identified, a risk assessment was not carried out.
- 3.1.3 The hazards associated with the coal cargo had been overlooked when the maintenance of booby hatch was being carried out.
- 3.1.4 There was a misconception on board the ship that EEBD could be used for rescue operation and the crew used inappropriate equipment to rescue the ASD1. The crew also did not follow the assigned duties as per the muster list.
- 3.1.5 There were no signages to warn the crew to treat cargo hold as enclosed space when it has been sealed for some time.

4 SAFETY ACTIONS

During the course of the investigation and through the discussions with the investigation team, the following safety actions were initiated by the relevant stakeholders.

4.1 Actions taken by the Company

4.1.1 Immediately after the occurrence, the Company sent out an email broadcast to its fleet of bulk carriers, informing them of the loss of life accident, reminding the importance of safety of personnel on board ships and clear understanding with entry into enclosed space procedures established in its SMS. The Company also instructed Masters to discuss this occurrence with all the crew on board for lessons learnt.

4.1.2 The Company shared also an article with its fleet of bulk carriers the Loss Prevention Briefing³³ on the topic of enclosed spaces, re-emphasising the IMO Resolution A.1050 (27) on the recommendations for entering enclosed spaces aboard ships.

4.1.3 After its internal investigation, the Company disseminated a safety bulletin to the fleet sharing additional details of the occurrence, learning points and measures for preventing similar occurrence:

- Raising safety awareness to all ship's crew on board, senior officers must take the lead to guide ship's crew accordingly on the safety to avoid incident/accident from happening;
- Duty officers on the bridge should be made aware of the deck work for the day;
- Improving relationships among all the crew on board, especially between senior officers and crew;
- Placing posters of job hazards and dangers associated when working at or near an enclosed space, at the common areas and crew living quarters for awareness; and
- Planning emergency drills with proper scenarios and practising it by ground deployment.

³³ Issued by the North of England P&I Association, edition of People/April 2012.

5 SAFETY RECOMMENDATIONS

A safety recommendation is for the purpose of preventive action and shall in no case create a presumption of blame or liability.

5.1 For the Company:

- 5.1.1 To ensure signages are placed in conspicuous places on board to warn ship's crew to treat cargo hold as enclosed space when it has been sealed for some time. **[TSIB-RM-2022-06]**
- 5.1.2 To ensure ship's crew perform rescue operation according to the muster list. **[TSIB-RM-2022-07]**
- 5.1.3 To ensure appropriate equipment are used for rescue operation in enclosed space and rescue drills on board its fleet of ships. **[TSIB-RM-2022-08]**