

Final Report

Man Overboard

Involving

Supply Vessel LEO 38

And Tanker AGIOS NIKOLAS

At

Eastern Bunkering “ALPHA” Anchorage,

Singapore

On 17 May 2022

TIB/MAI/CAS.125

Transport Safety Investigation Bureau
Ministry of Transport
Singapore

15 May 2023

The Transport Safety Investigation Bureau of Singapore

The Transport Safety Investigation Bureau (TSIB) is the air, marine and rail accidents and incidents investigation authority in Singapore. Its mission is to promote transport safety through the conduct of independent investigations into air, marine and rail accidents and incidents.

TSIB conducts marine safety investigations in accordance with the Casualty Investigation Code under SOLAS Regulation XI-1/6 adopted by the International Maritime Organization (IMO) Resolution MSC 255(84).

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ABBREVIATIONS

AAS	Alliances Automation Services
ABS	American Bureau of Shipping
AEBA	Eastern Bunkering “Alpha” Anchorage
ASD	Able Seafarer Deck
GT	Gross Tonnage ¹
HSA	Health Sciences Authority
IMO	International Maritime Organization
ISO	International Organisation for Standardization
MOB	Man Overboard
MSCC	Marine Safety Control Centre ²
OOW	Officer of the Watch
PCG	Police Coast Guard
PFD	Personal Floatation Device
POCC	Port Operations Control Centre ³
PPE	Personal Protective Equipment
SAR	Search and Rescue
TSS	Traffic Separation Scheme

Table 1

¹ Gross tonnage (GT) is a measure of a ship’s overall internal volume and referred to as an overall size of a ship.

² Provides information on various application procedures and guidelines for ship’s related activity which is commonly carried out in the port of Singapore. It is manned 24x7.

³ A shore-based Global Maritime Distress and Safety System facility and Maritime Safety Coordination Centre to monitor distress alerts and calls from ships/crafts, and to co-ordinate SAR operation within Singapore’s Maritime Search and Rescue Region. It also disseminates Maritime Safety Information through the VHF, NAVTEX and Safety NET systems. It is manned 24x7.

SYNOPSIS

On 17 May 2022, at about 2115H, the service boat LEO 38 arrived at Eastern Bunkering Alpha Anchorage, Singapore, to carry out transfer of personnel with the Malta registered oil tanker Agios Nikolas. It was a night of fine weather with good visibility. The wind was South-easterly at about 14 knots with West-southwest tidal stream at about 1.3 knots.

Prior to the occurrence, the Skipper of LEO 38 had safely embarked a crew member to the tanker and awaited three technicians to disembark from the tanker to be taken shore.

While disembarking from the tanker, the first technician safely crossed over from the tanker's accommodation ladder and entered the boat's cabin. When the second technician crossed over from accommodation ladder's bottom platform to the deck of LEO 38, the boat suddenly swayed and rolled. The second technician squatted and fell backwards into the sea. The technician's lifejacket did not inflate, and lifebuoys were deployed by the crew of the tanker and LEO 38. After about ten minutes of being in the water, the technician managed to grab on to a lifebuoy but soon let go of it. The technician was subsequently out of sight.

The Maritime and Port Authority of Singapore coordinated the search and rescue operation which involved the Police Coast Guard and Singapore Civil Defence Force. The body of the technician was recovered on 21 May 2022 (about four days later) in water near Batam, Indonesia.

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

The sudden swells experienced by LEO 38, likely caused by a passing vessel and the backpack of about 10kg carried by the technician, had resulted the technician to lose his balance and fall into the sea.

The technician was wearing a manual activation lifejacket which was later found not inflated. The lifejacket was sent for testing at the Health Sciences Authority and found to be in working condition. It is unclear if the technician was disoriented or in a state of panic or unfamiliar with how to manually inflate the lifejacket or was influenced by the misleading label which included instructions for both manual and automatic activation lifejacket.

The investigation revealed that although risk assessment and control measures for transfer at anchorage were identified to mitigate the risk of falling into water and drowning, the Company of the technician did not have a process in place to discuss the risk assessment prior to each deployment for work onboard vessel at the anchorage.

VIEW OF VESSELS



Figure 1 – LEO 38 (Source: TSIB)



Figure 2 – AGIOS NIKOLAS (Source: Marine Traffic)

PARTICULARS OF VESSELS

LEO 38	
Licence No.	SC4465F
Ship type	Supply Vessel
Year of build	2011
Where built	Tanjung Pinang, Indonesia
Owner	LOH Launch Service Pte. Ltd.
GT	27.9
Length overall	14.5m
Breadth	3.8m
Depth Freeboard	1.8m 1.0m
No. of Passengers certified to carry	12
Lifebuoy onboard	4 (with lines attached) ⁴
Minimum Manning Requirement ⁵	Steersman
Main engine(s) bridge control	One unit of HINO/V22C/10Cyl/ power 350 kW
Licensed Use of Craft	Conveyance of Dry or Packaged General Cargo Conveyance of Passengers
Condition of Licence	Not to carry passengers when carrying cargo

Table 2

⁴ Maritime and Port Authority of Singapore (Harbour Craft) Regulations SECOND SCHEDULE, Regulation 20 require a boat of the size as LEO 38, to carry two lifebuoy (with line attached).

⁵ Appendix 4 of Minimum Certificated Manning on harbour craft of type SC (less than 100 GT) – A Steersman.

AGIOS NIKOLAS	
IMO Number	9845506
Call Sign	9HA5037
Flag	Malta
Classification society	ABS
Ship type	Oil Tanker
Year of build	2019
Where built	HHI – Ulsan, South Korea
Hull type/ material	Double Hull/ Steel
Owner	Agios Nikolas Ltd
Operator	Enesel S.A.
Gross registered tonnage	160,655
Length overall	333.0m
Breadth	60.0m
Depth	30.4m
Summer draft	22.622m
Summer freeboard	5.033m
Summer deadweight	318,918mt
Remarks	At the time of occurrence, the vessel was in ballast condition: Draught: Forward 8.0m and Aft 11.0m Approx. Freeboard: 18.155m (at mean draught)

Table 3

1 FACTUAL INFORMATION

All times used in this report are Singapore time, also the ship's mean time, which corresponds to the UTC +8H.

In the conduct of marine safety investigation into the circumstances surrounding this Man-Overboard occurrence, the investigation team reviewed information obtained from the Regulator of the Port, the technicians'⁶ Company, the Owner of AGIOS NIKOLAS (AN) and the Owner of LEO 38.

1.1 Narrative

1.1.1 On 17 May 2022 at about 1900H, the Skipper⁷ of service boat, LEO 38, received an order to embark one sign-on crew, an Additional Master⁸ (AM), to the tanker AN at the Eastern Bunkering "Alpha" Anchorage (AEBA⁹). After which, LEO 38 was to return with four shore-based personnel (three technicians and one ABS Surveyor¹⁰) from AN.

1.1.2 At about 2000H, LEO 38 departed Marina South Pier and arrived AEBA at around 2100H. The weather was fine with good visibility and a South-easterly wind blowing at about 14 knots. The tidal stream was West-southwest at a rate of 1.3 knots with slight seas and swells.

1.1.3 As LEO 38 approached the anchored AN (which was on an easterly orientation) from the Northwest, the Skipper noted the presence of a bunker barge, KANTEK 2 on AN's port side. Seeing that it was not possible to carry out the transfer of personnel on AN's port side (the leeward¹¹ side), the Skipper manoeuvred LEO 38 to cross AN's bow and proceeded towards AN's starboard side accommodation ladder at the midship.

1.1.4 After rounding off the bow, the Skipper noted that AN's starboard side had another bunker barge, the VALIANT III secured alongside, with its bow about

⁶ Employee of Alliance Automation Services (AAS).

⁷ A Skipper is the in-charge of a small boat. Under licensing conditions, it is the Steersman. The Skipper held qualifications (Port Limit Steersman) appropriate for operating the boat of this size and was certificated by the Regulator of the Port. It is not a mandatory requirement for boat of this size and engine capacity to be manned by another person in Singapore.

⁸ Term it as Additional Master to differentiate it from AN's existing Master who was already onboard.

⁹ Position Latitude 01°17.4'N / Longitude 104° 03.4'E, the anchor position of AN was less than a mile from the northern edge of the Westbound Lane of the Singapore Strait Traffic Separation Scheme (TSS).

¹⁰ At the time of the occurrence, the Surveyor was not ready for disembarkation.

¹¹ Leeward side is the side opposite from where the wind is blowing. It is usually the preferred side for carrying out embarkation / disembarkation.

2-3m aft of the bottom platform of the accommodation ladder. See **figures 3 and 4**. The accommodation ladder was used instead of a combination ladder.

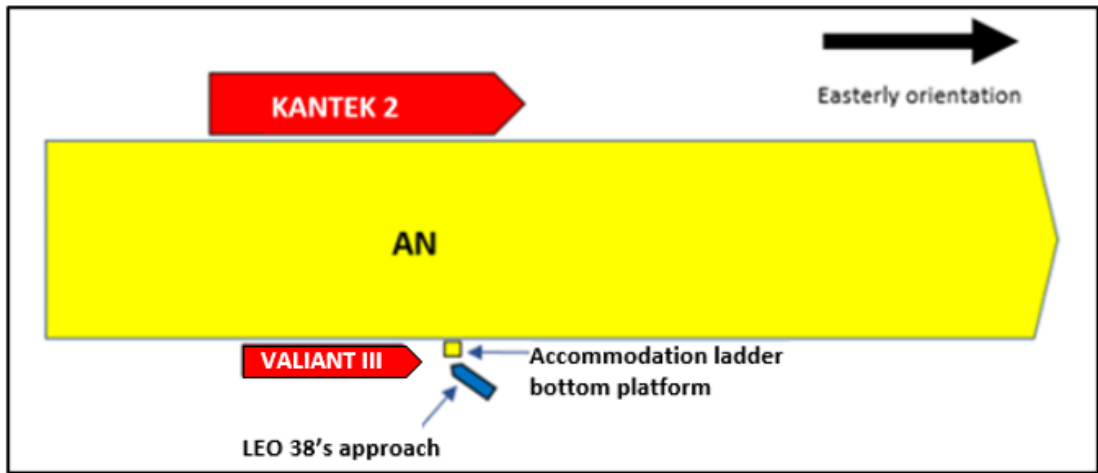


Figure 3 – Plan view of graphical representation of vessels involved and LEO 38's approach (Not to scale).

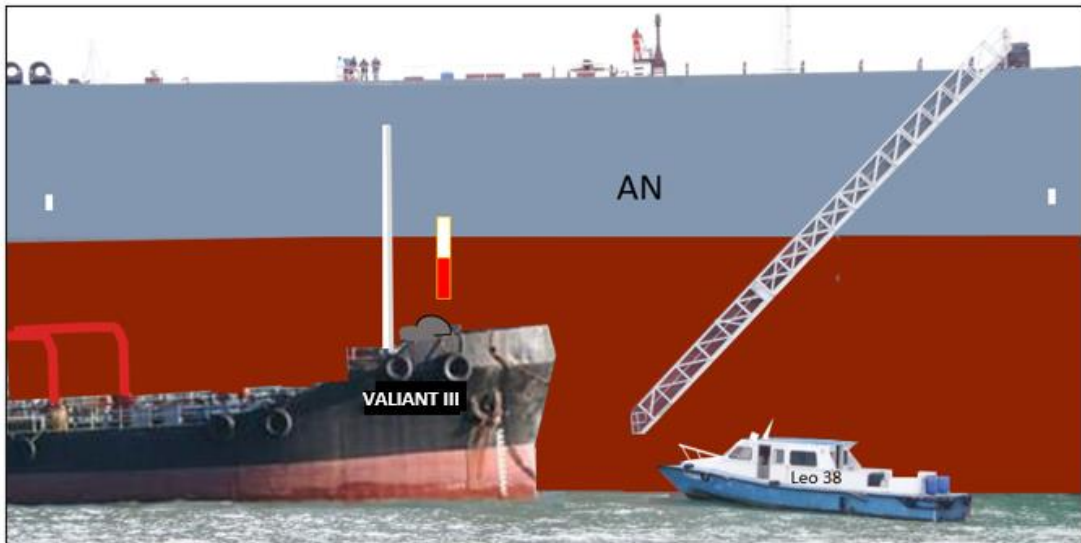


Figure 4 – Profile view of the vessels involved and LEO 38's approach (Not to scale). Valiant III's Image *Source*: Marine Traffic (annotation by TSIB)

- 1.1.5 At about 2110H, before approaching AN's accommodation ladder for the transfer operation, as a routine, the Skipper assessed the weather condition to be safe for the transfer, sounded the boat's whistle to attract the attention of AN's crew manning the accommodation ladder. The Skipper then used the

boat's search light, shining it directly towards the accommodation ladder and gave hand signals from the conning position to AN's crew to adjust the height of the bottom platform of the accommodation ladder.

- 1.1.6 After receiving confirmation from AN's crew for LEO 38 to come alongside, and satisfied with the conditions, i.e. height of the bottom platform of the accommodation ladder to be in line with LEO 38's deck level, area sufficiently illuminated¹² and clear of obstructions, the Skipper manoeuvred LEO 38's bow towards the bottom platform. By this time, the AM was standing by at the boat's starboard bow ready to cross over to the accommodation ladder.
- 1.1.7 The Skipper manoeuvred LEO 38's starboard bow closer towards the accommodation ladder's bottom platform. By about 2115H, the AM safely crossed over to the accommodation ladder. After the AM had commenced ascending the accommodation ladder, the Skipper moved LEO 38 away from the accommodation ladder and waited for the shore personnel to disembark from AN.
- 1.1.8 The AM was received by the Second Officer, who was the OOW, and an ASD onboard AN.
- 1.1.9 According to the crew of AN, the three technicians¹³ (TECH), each carrying a backpack arrived at the top of the accommodation ladder and were met by two AN's crew. According to TECH-1 and TECH-3¹⁴ the accommodation ladder was sufficiently illuminated.
- 1.1.10 A few minutes later, at about 2118H, TECH-1 descended the accommodation ladder while TECH-2 and TECH-3 remained at the top platform, waiting for TECH-1 to cross over to LEO 38.
- 1.1.11 The Skipper, seeing TECH-1 descending the accommodation ladder, manoeuvred LEO 38's starboard bow towards the accommodation ladder's bottom platform. With LEO 38's starboard bow touching the bottom platform, TECH-1 safely crossed over to the boat, grabbed hold of the boat's safety handrail, and walked into the boat's cabin. TECH-2 then began his descent while TECH-3 remained at the top platform.

¹² At that time, the accommodation ladder area was illuminated by the ladder downlight and boat search light.

¹³ Of the three only TECH-2 was wearing a lifejacket.

¹⁴ TECH-3 is also the Service Manager / Owner of AAS.

- 1.1.12 About a minute later, around 2120H, with LEO 38's starboard bow still touching the bottom platform, TECH-2 descended to the bottom platform. According to the Skipper, nothing seemed to be amiss, like any other personnel doing the transfer, TECH-2 waited for a few seconds before crossing over. When TECH-2 stepped onto the bow of LEO 38, TECH-3 commenced his descent at about the same time.
- 1.1.13 According to the Skipper and TECH-3, when TECH-2 set both feet onto LEO 38, LEO 38 experienced some swell causing it to sway and roll¹⁵. TECH-2 was seen squatting and attempting to balance himself (without holding the safety handrails at the time) but eventually fell backward into the sea (See **figure 5**).

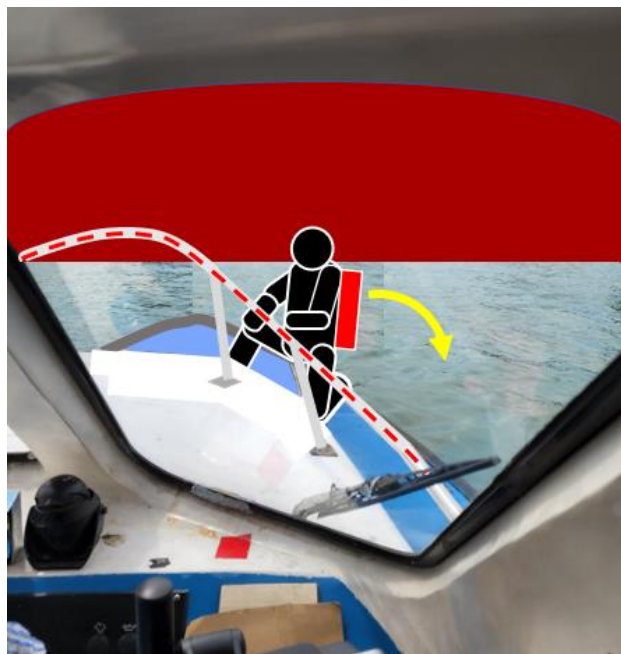


Figure 5 – Illustration of view from the Skipper's conning position, depicting TECH-2's approximate position when squatting down before falling overboard (in the direction of the yellow arrow) – Not to scale (Source: TSIB – annotation by TSIB)

- 1.1.14 The Skipper witnessed the fall of TECH-2 into the water and shouted MOB. TECH-1, who was inside the boat's cabin, upon hearing the MOB call from the Skipper, ran out to the forward of the boat and saw TECH-2 in the water trying

¹⁵ It was later established that there was a passing vessel, and these movements could have been because of that vessel.

to stay afloat (See **figure 6**).

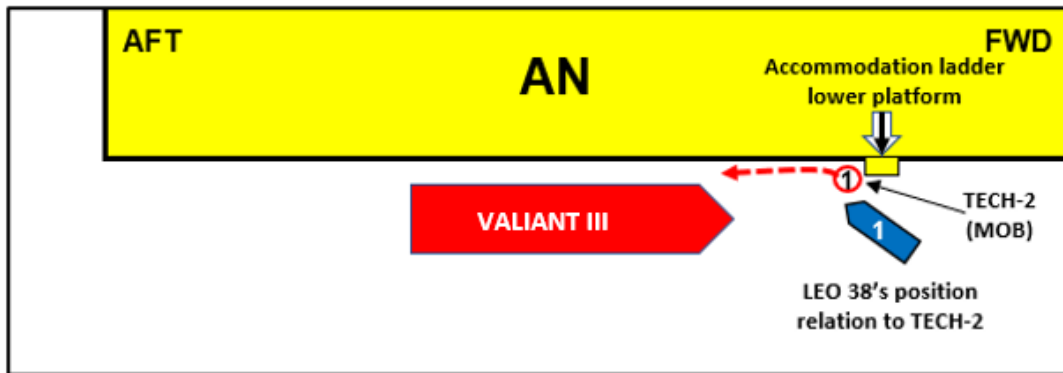


Figure 6 - Depicting LEO 38's positions in relation to TECH-2's drift (Not to scale)

- 1.1.15 Meanwhile, TECH-3 seeing the occurrence during his descent, also shouted MOB. TECH-3 then ran up the accommodation ladder and requested the crew of AN for assistance. During this time, TECH-3 saw TECH-2 was drifting between AN and Valiant III.
- 1.1.16 The Skipper instructed TECH-1 to grab a lifebuoy from the aft part of the boat and throw it to TECH-2, as he manoeuvred LEO 38 towards TECH-2 while keeping clear of the accommodation ladder and the bow of VALIANT III. TECH-1 threw the lifebuoy to TECH-2, who was conscious, but TECH-2 did not grab it (See **figure 7**).

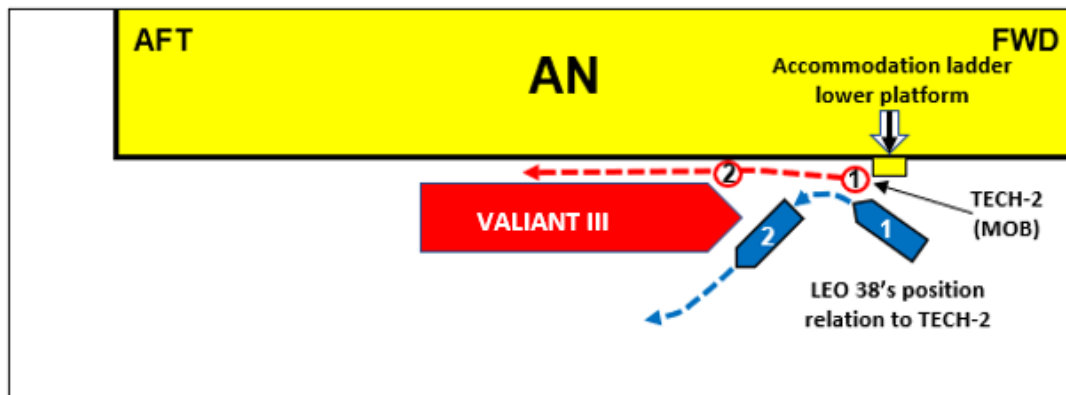


Figure 7 - Depicting LEO 38's positions in relation to TECH-2's drifting (Not to scale)

- 1.1.17 Meanwhile, the crew of AN shouted to VALIANT III's crew on deck to assist TECH-2. Subsequently VALIANT III's crew too, threw a lifebuoy (with line) towards TECH-2, who again did not grab it¹⁶.
- 1.1.18 Witness accounts recalled that TECH-2 was drifting between AN and VALIANT III, in a westerly direction. The Skipper then manoeuvred LEO 38 and headed towards the stern of VALIANT III, to look out for TECH-2 (See **figure 8**).

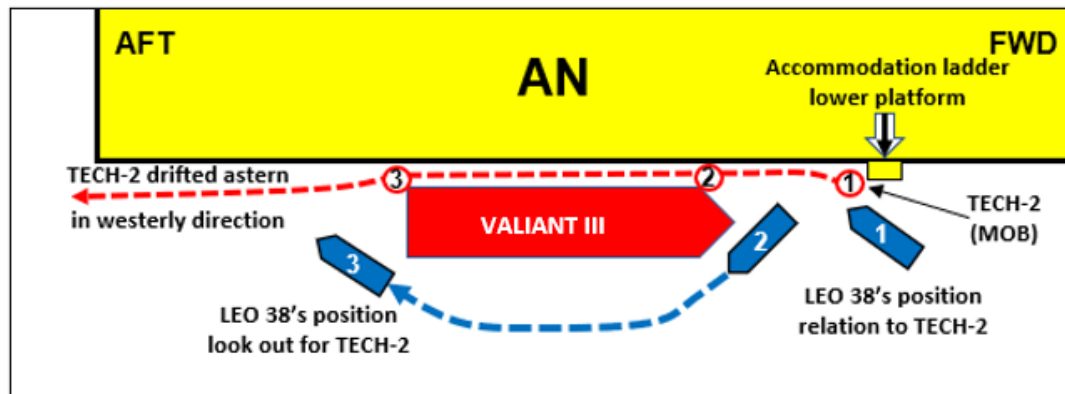


Figure 8 - Depicting LEO 38's positions in relation to TECH-2's drifting (Not to scale)

- 1.1.19 Concurrently, the Skipper reported the MOB occurrence to the Owner's office by phone and requested for assistance. The office personnel on receiving the call immediately reported the MOB occurrence to MSCC¹⁷ and requested for assistance.
- 1.1.20 When LEO 38 arrived at the stern of VALIANT III, as observed by the Skipper, the crew of the VALIANT III threw a lifebuoy (with line)¹⁸ towards TECH-2 which was again not grabbed by TECH-2.
- 1.1.21 The Skipper manoeuvred LEO 38 closer to VALIANT III's stern, stopped the engine and waited for TECH-2 to drift clear of the hull of VALIANT III. As soon as TECH-2 cleared from VALIANT III's stern, TECH-1 threw a lifebuoy again to TECH-2. At this time TECH-2, appeared tired and out of breath, was about 5m away from LEO 38 and was successful in grabbing onto the lifebuoy.

¹⁶ The crew of VALIANT III retrieved the lifebuoy.

¹⁷ At about 2141H, MSCC upon receiving the MOB report, informed PCG and Singapore Civil Defence Force.

¹⁸ The lifebuoy retrieved earlier.

- 1.1.22 Upon seeing that TECH-2 had grabbed the lifebuoy from LEO 38, AN's Second Officer reported the occurrence to the Master, who was in his cabin receiving the AM.
- 1.1.23 According to the Skipper, when TECH-2 was being pulled towards the boat using the line attached to the lifebuoy, he still had the backpack and lifejacket on and was conscious. TECH-1 and the Skipper kept calling out to TECH-2 to keep his morale high.
- 1.1.24 When TECH-2 was about 2-3m away from LEO 38, he appeared to lose consciousness, and was seen to let go of the lifebuoy and drifting away.
- 1.1.25 The Skipper immediately started the engine and instructed TECH-1 to keep a look out. After a short while TECH-1 reported that he had lost sight of TECH-2. Thereafter, LEO 38 remained on site and searched the area for TECH-2. Witness accounts could not confirm whether the lifejacket was inflated when TECH-2 was in the water.
- 1.1.26 At about 2145H, two patrol boats from the Regulator of the Port, and one PCG craft arrived at the location and commenced SAR operation. Navigational broadcast was also issued to vessels in the vicinity to look out for TECH-2 and any sighting to be reported to MSCC and POCC.
- 1.1.27 At about 2158H, AN received information from VALIANT III that TECH-2 had not been recovered and that LEO 38 was conducting SAR operation. Additional crew members were deployed to look for TECH-2. At about 2159H, AN reported the MOB occurrence to MSCC.
- 1.1.28 On 21 May 2022 (about four days later), the body of TECH-2 was recovered outside Singapore waters¹⁹, and the lifejacket retrieved was found not inflated. (More details on lifejacket in 1.7)
- 1.2 SAR operation
- 1.2.1 For this MOB occurrence, two boats from the Regulator of the Port and one boat from PCG were deployed to conduct the SAR operation²⁰. In addition to the active search, POCC issued navigational broadcast to vessels in the vicinity

¹⁹ Body was recovered in Batam, Indonesia, about 6.6 nm Southwest of the incident site.

²⁰ The SAR operation which commenced on 17 May 2023 was terminated on 21 May 2023.

to keep a good lookout and report sighting to POCC.

1.3 Design of the vessels

1.3.1 Supply vessel LEO 38

1.3.1.1 LEO 38 is a typical harbour craft launch of its size and type with a single deck and a single cabin housing the conning position and seating for the passengers. Its hull material is of fibreglass reinforced plastic.

1.3.1.2 The investigation team boarded LEO 38 at Marina South Pier and noted that, for access and to move around the boat, continuous handrails are provided in most areas, see **figures 9, 10 and 11** – depicting the location of two lifebuoys²¹, red dashed line indicating handrails and highlighted yellow indicating the main deck of the boat being coated with anti-slip paint.

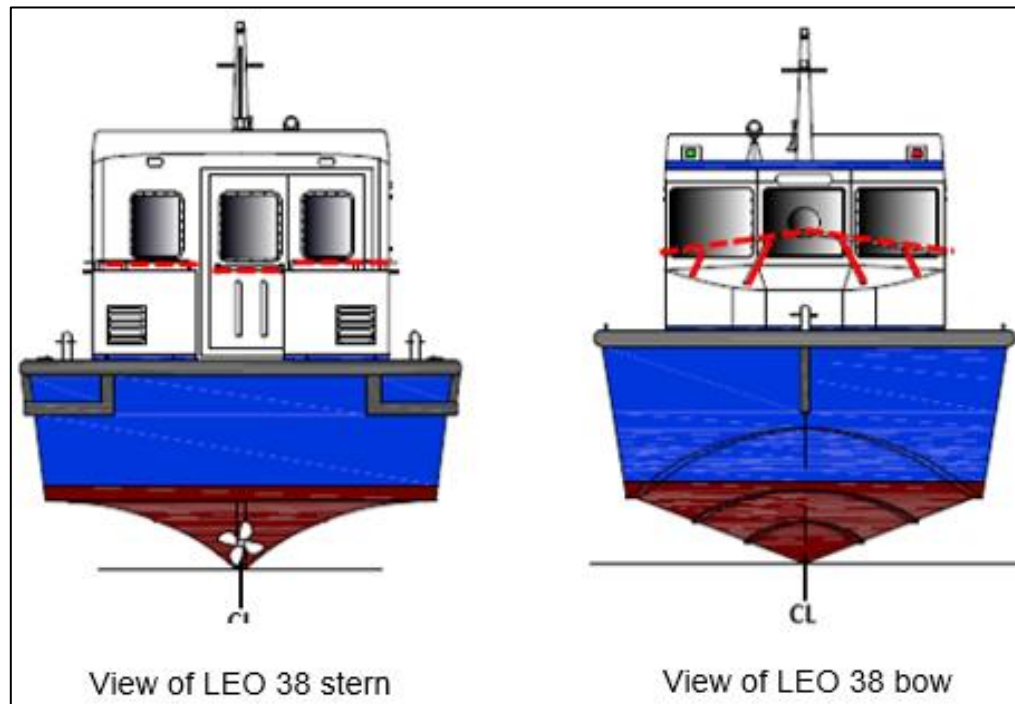


Figure 9 – Bow and stern view. (Source: Owner of LEO 38 — annotation by TSIB)

²¹ The other two were inside the locker of LEO 38.

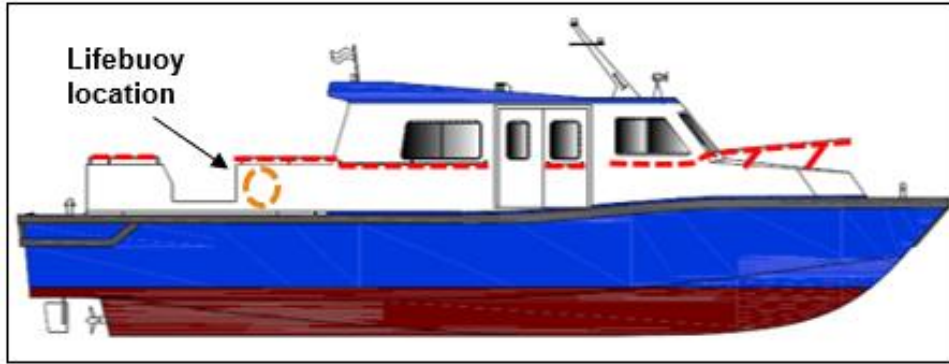


Figure 10 - Starboard side view of LEO 38 (Source: Owner of LEO 38 - annotation by TSIB)

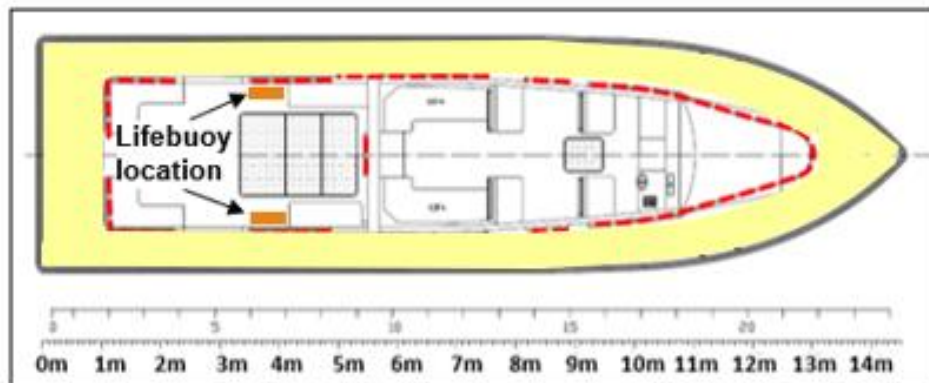


Figure 11 - Plan view of LEO 38 with highlighted yellow indicating the main deck coated with anti-slip paint (Source: Owner of LEO 38 – annotation by TSIB)

1.3.1.3 According to the Skipper, the conning position of the boat (located closer to the boat's starboard side) has an unobstructed view of the starboard bow (the location from where TECH-2 fell overboard). From the conning position, the Skipper could see the accommodation ladder's bottom platform clearly. At the time of the occurrence, LEO 38 was operated by the Skipper alone²².

²² A safety recommendation was issued by the TSIB to the Regulator of the Port in 2021 to consider a review of the existing licensing framework of one-man operation for service boats to ensure safe transfers of personnel at the anchorage. In response, the Regulator of the Port advised that it was satisfied with the Safety Management System of harbour craft operators to ensure operational safety, and that the associated risk assessments of the operators taking into consideration the typical manning of their craft, has been considered by the Regulator of the Port prior the issuance of their license. MPA deemed the owner/operator/charterer have the responsibility to conduct risk assessment to ensure the craft have sufficient manpower if required, above the minimum licensed manning requirement to perform the intended operations/purpose in which the craft is employed for.

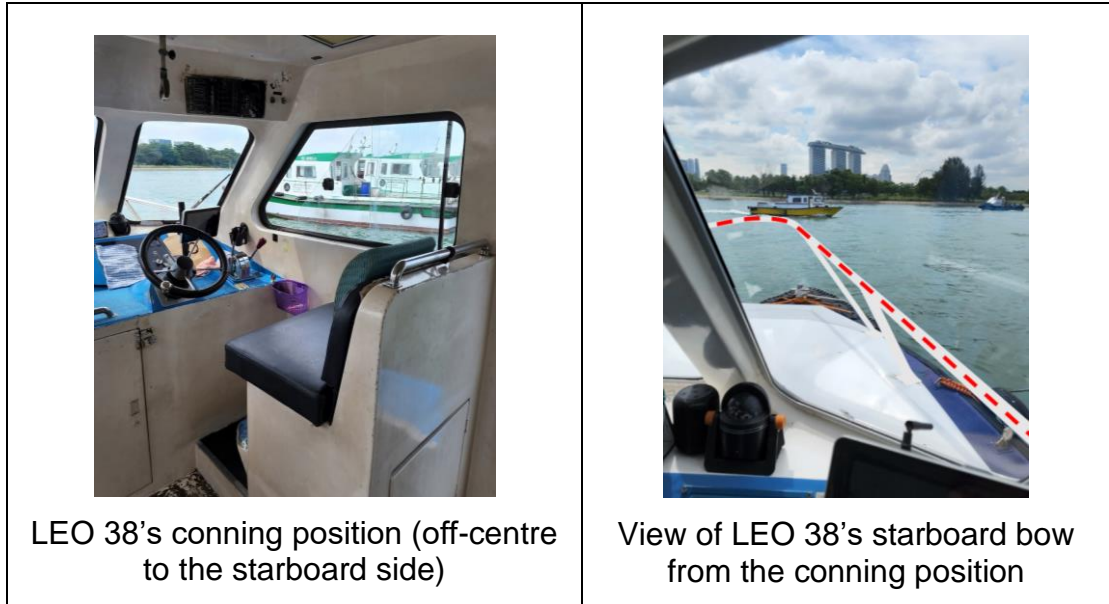


Figure 12 - Showing view of and from the conning position. (Source: Owner of LEO 38 - annotation by TSIB)

1.3.2 Tanker AN

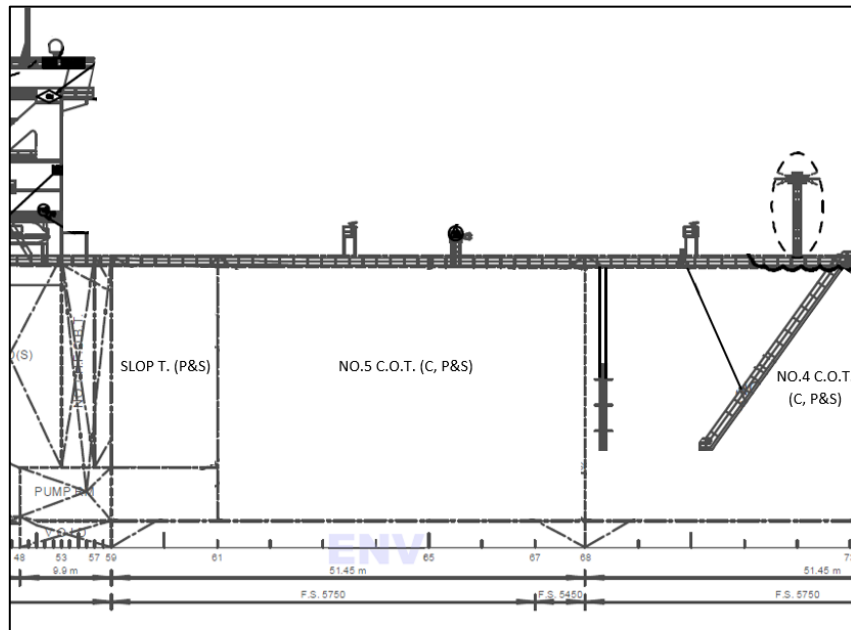


Figure 13 – Schematic drawing of AN at its midship section indicating location of the starboard accommodation ladder (Source: Owner of AN).

1.4 Qualification, experience, and training (personnel directly involved)

Skipper of LEO 38	
Gender / Age	Male / 60
Nationality	Singapore
Experience as Skipper	30 years
Certificate held	Singapore Harbour Craft Manning Licence
Work hours	Daily 0800 to 1800 hours ²³
Service with Company	4 years
Service onboard LEO 38	4 years

TECH-1	
Gender / Age	Male / 56
Nationality	People's Republic of China (Singapore permanent resident)
Designation	Engineer
Experience as Engineer	27 years ²⁴
Work hours	Daily 8 hours ²⁵
Service with Company	8 years
Any maritime/ industrial related courses	Shipyard Safety Supervisor

TECH-2 - MOB	
Gender / Age	Male / 59

²³ Office hours with weekend off (Last rest period from 1800H on 16 May 2022 till the morning of 17 May 2022 0800H)

²⁴ Embarking vessels at the anchorage.

²⁵ Daily 8 hours of working. If there is a plan to board a ship in the evening, then the technician would be given time-off accordingly.

Nationality	Singapore
Designation	Technician
Experience (former Able Seafarer Deck for about 8 years)	27 years
Work hours	Daily 8 hours
Service with Company	8 years
Any maritime/ industrial related courses	Shipyard Safety Instruction

TECH-3	
Gender / Age	Male / 49
Nationality	Singapore
Designation	Service Manager
Experience at Technician	25 years
Work hours	Daily 8 hours
Service with Company	10 years
Any maritime/ industrial related courses	Shipyard Safety Instruction

- 1.5 Eastern Bunkering “Alpha” Anchorage (AEBA)
- 1.5.1 Located at the eastern sector of Singapore, AEBA²⁶ is one of the designated anchorages for vessels of 20,000GT and above, other than Liquefied Petroleum Gas (LPG), Liquefied Natural Gas (LNG) vessels, chemical tankers, oil rigs and drill ships, to take bunkers under the Special Bunkering Anchorage Scheme.
- 1.5.2 The quadrilateral shape anchorage, considered as protected waters by the port authority, has an east-west orientation with its longest side of about 3 nautical miles to the south and adjacent to the Singapore Port Limit and the westbound lane of the TSS.

²⁶ AN's anchored location Lat 1°18.346'N Long 104°03.496'E.

1.5.3 Prior to the occurrence, at about 2119H, with AN and several other vessels at anchor within the anchorage, a West bound tanker²⁷ with a speed of about 9 knots was passing at about 0.55 nautical mile to the south of AN (See **figure 14**).

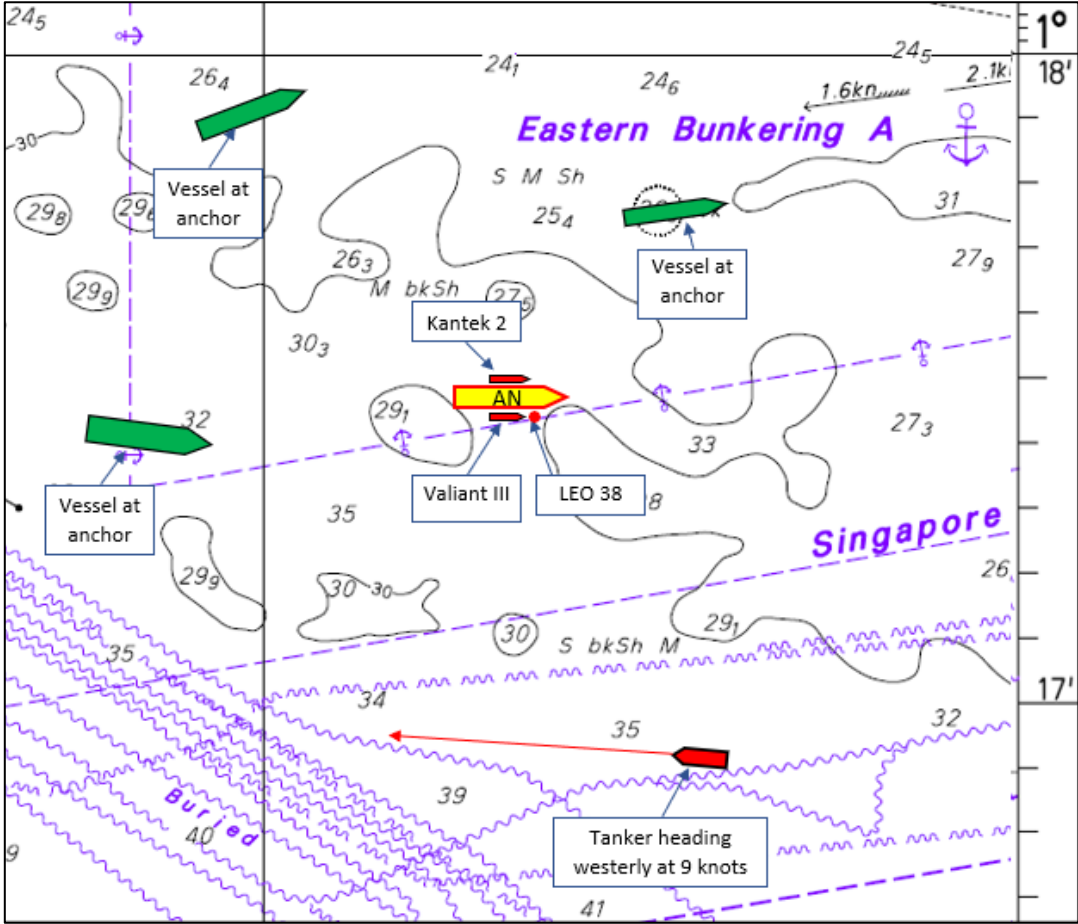


Figure 14 – AN at anchor while a west bound tanker (in red) was passing south at about 0.55 nautical miles (not to scale).

- 1.6 Alliance Automation Services (AAS)
 - 1.6.1 AAS provides calibration services for gas meters, temperature sensors and other calibration equipment onboard ships. On the day of the occurrence TECH-1, TECH-2 and TECH-3 boarded AN on 17 May 2022 at about 1500H to carry out equipment calibration services and completed the task and

²⁷ A 92m length tanker with draught of about 5m, passed south of AN and LEO 38.

paperwork at about 2030H.

- 1.6.2 The three technicians were provided with PPE by AAS, which included safety helmet, shoes, gloves, and goggles.
- 1.6.3 The investigation team gathered that other than the one donned by TECH-2, there were four other inflatable lifejackets of different make and model available at AAS' workshop for use when performing jobs at the anchorage. (See **figure 15**). technicians reportedly would collect them before boarding the vessel at anchorage.



Figure 15 – The different types of lifejackets in AAS' inventory

- 1.6.4 AAS clarified the reason for the different types of lifejackets, i.e. they catered to the individual's preference for the size and weight of the lifejackets and that they were procured at different times. The investigation team further gathered that AAS was not aware of the difference in activation method of the lifejackets in their inventory.
- 1.6.5 On the day of the occurrence, TECH-1 and TECH-3 did not take any lifejackets with them from the workshop. All three technicians were carrying a backpack

²⁸ Marine Equipment Directive (MED) 96/98/EC, Weighed 1.5Kg (Actual). During the investigation this was confirmed to be automatic (with manual inflation capability) type.

²⁹ Referred to as performance level 275 in ISO12402-3.

³⁰ ISO 12402-3, weighed 1.4Kg (Based on the product specification sheet). During the investigation this was confirmed to be automatic (with manual inflation capability) type.

containing walkie-talkie, calibration equipment/ meters and general hand tools such as spanner, screwdriver, Allen-key, plier etc. Each backpack weighed around 8 to 10 kg.

1.6.6 The investigation team noted that AAS had some procedures³¹ typically for their work, which included requiring all staff to comply with safety requirements contained within. There was no specific procedure for safe transfer of personnel when performing work at the anchorage.

1.6.7 The investigation team sighted a Risk Assessment (RA) on transfer of personnel at sea³² which had been approved by TECH-3 and participated by TECH-1 and TECH-2. The RA identified the following relevant hazards and the control measures –

Hazard	Risk Control	Additional Control
Trip / Fall resulting in drowning	Maintain three-point contact. Regular checks on wave momentum, good judgement and execution	Use of lifejacket. Not to rush.

1.6.8 According to TECH-3 and TECH-1, before the MOB occurrence, TECH-2 appeared to be in normal condition and did not report of any medical condition prior to commencement, during the work or prior to disembarkation. AAS confirmed that prior to this embarkation, TECH-3 carried out a work-related briefing as per the job scope. There was no discussion on the need to carry a lifejacket amongst the technicians prior to leaving the workshop.

1.7 Safe transfer requirements

1.7.1 Under the Ministry of Manpower (MOM) Workplace Safety and Health (WSH) (General Provisions) Regulation 23 – Measures to be taken to prevent falls:

It shall be the duty of the employer of a person who is exposed to the risk of falling into water and of drowning to provide –

(i) Equipment and means of rescuing and resuscitating drowning persons;

³¹ The investigation team noted that these procedures had been adapted from other organisations.

³² Dated 14 January 2021 and to be reviewed three years later, 14 January 2024.

and

(ii) Suitable lifejackets or other equipment

1.7.2 The Port Marine Circular (PMC) no. 34 of 2020³³ issued on 7 August 2020 provides guidelines for safe transfers of persons between vessels at anchorages in the Port of Singapore. Among others, the Circular highlights that all parties involved in the transfer should keep good situational awareness, exercise extreme caution and be made aware of a risk assessment of the impending transfer operation when conducting the transfer. The PMC included information on appropriate PPE to be worn, such as a working SOLAS type-approved lifejacket or a lifejacket meeting ISO 12402 - performance level 100³⁴, or higher.

1.8 Additional information

1.8.1 Type of lifejacket

1.8.1.1 ISO 12402 (all parts):2020³⁵ deals with personal floatation devices (PFDs) for persons engaged in activities, whether in relation to their work or their leisure, in or near water. PFDs manufactured, selected, and maintained to this International Standard give a reasonable assurance of safety to a person who is immersed in water.

1.8.1.2 According to ISO 12402, there are two classes of PFD, one that do not require intervention by the user (automatically inflated lifejacket), and are suited for activities where persons are likely to enter the water unexpectedly (such as a fall); and PFD that require intervention (e.g. manually inflated lifejacket) which are deemed suitable for use if the user believes there would be sufficient time to produce full buoyancy, and if help is close at hand. Regardless, the user should ensure that the operation of the PFD is suited to the specific application.

1.8.1.3 Within the two classes, certain attributes make some PFDs better suited to

³³ This Circular was issued by the Regulator of the Port to the harbour craft community and shipping community. A set of draft Port Regulations to mandate the wearing of lifejackets at sea is being worked on by the Regulator of the Port, which aims to place the responsibility on each individual (i.e. crew, shore-based personnel), Master and person-in-charge of a ship to take ownership of their safety. User shall determine the suitability of the lifejacket to be worn by considering factors such as condition of the work environment, manufacturer's donning instructions, weather conditions, size and weight of the user etc.

³⁴ This level is intended for use in sheltered or calm water, where users may have to wait for rescue.

³⁵ Does not include lifejackets under the SOLAS Convention or throwable devices / flotation cushions.

various circumstances. These are as follows:

- (i) higher levels of support provided by PFDs (levels 100, 150 or 275) that generally float the user with greater water clearance, when required for increasingly severe conditions;
- (ii) to provide lifejackets with automatic means of operation (inherently buoyant or automatically inflated) that float users without any intervention on their part, except in initial donning of the lifejacket or to provide lifejackets with manual means of operation, that is, the users inflate the lifejackets by manual or oral operation.

1.8.2 The lifejacket worn by TECH-2

1.8.2.1 The inflatable lifejacket retrieved from TECH-2's body was sent by PCG to HSA for testing (see **figure 16**).

1.8.2.2 A visual inspection³⁶ performed by HSA on the lifejacket documented the following:

- (i) On the exterior section of the lifejacket, a label titled "Instructions for Use" indicated the following:
 - a. the lifejacket was to be used with a 33g CO₂ cylinder;
 - b. for manual inflation, pull the toggle at the base of the lifejacket; and
 - c. for automatic inflation, inflation would begin automatically after immersion in water for 5s.
- (ii) On the interior section, the inflation device was connected to a manual activating lever. The following was found on the inflation device and gas cartridge:
 - a. A gas cartridge was found screwed onto the inflation device. The cartridge was found to be intact and weighed 145g.
 - b. A green tamper clip was found secured onto the inflation device and the manual activating lever in a "up" position, indicating that the device had not been used.

³⁶ Conducted on 30 August 2022.

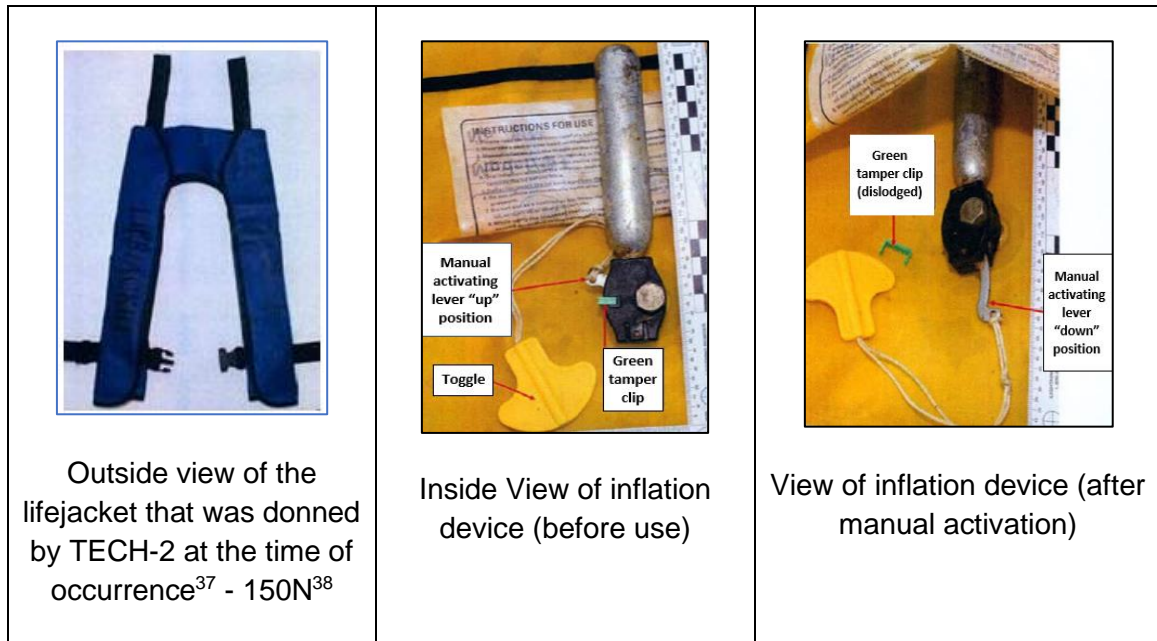


Figure 16 – Lifejacket donned by TECH-2 and its inflation device.

1.8.2.3 A test was conducted on the lifejacket as follows:

- (i) The lifejacket was inflated using the oral inflation tube. Air was retained and the lifejacket remained inflated for at least 24 hours.
- (ii) The lifejacket was immersed in water to test if there was automatic inflation capability. There was no inflation after immersion of 30s.
- (iii) The lifejacket was inflated using manual activation. It inflated almost immediately when the toggle was pulled and remained inflated for at least 24 hours. The tamper clip dislodged from the inflation device and the manual activating lever was in a "down" position.
- (iv) The gas cartridge was removed and examined. It was found to be pierced and weighed 112g, indicating that 33g of compressed gas was discharged from the cartridge (corresponds with what was stated on the label titled "Instructions for use". See 1.8.3.i.a.)

³⁷ Standards of manufacture – Unknown. Weighed about 1.1Kg (Based on the product specification sheet). Upon confirmation by HSA, this was confirmed to be a manual inflation type.

³⁸ Open-source research suggests that the 10Kg could equate to approximately 100 Newtons (N). A 100N is a basic lifejacket that keeps a person afloat in sheltered / calm waters. Referred to as performance level 150 in ISO12402-3, having the ability to maintain the position of a fully clothed person with the mouth and nose clear of the water.

1.8.3 Identifying the type of lifejacket

1.8.3.1 In order to have a better understanding about the lifejacket worn by TECH-2, the investigation team attempted to determine the manufacturer based on the model number affixed to the lifejacket.

1.8.3.2 The investigation team then obtained details of the vendor³⁹ from where the lifejacket worn by the TECH-2 was procured by AAS (TECH-3), and gathered the following:

- (i) The local seller kept only manual lifejackets (see **figure 17**), and the method of inflation would be made known to the buyer at the point of sale.



Figure 17 – Lifejacket⁴⁰ sold by the local vendor (current stock)

- (ii) The label (user guide) accompanying the lifejacket (see **figure 18**) advised the user to pull the toggle to inflate when there is a danger of falling is imminent or when in the water; and that pulling of toggle is not needed for automatic-inflation type. There was no indication on the lifejacket or in the user guide on the type of lifejacket (that is, manual or automatic).

³⁹ Vendor located in Singapore is a shop dealing with sporting and outdoor goods and did not have a fixed supplier for the lifejackets.

⁴⁰ This lifejacket was approved by China Classification Society (CCS). It was manufactured in accordance with Chinese Standard JT 346-2004 which specifies the marine inflatable lifejacket product classification, marking, structure, technical requirements, test methods, inspection rules and signs, packaging and storage. The standard applies to inflatable lifejackets for lifesaving for watersports. According to CCS, this lifejacket was manufactured in 2017 for recreational purpose such as fishing.

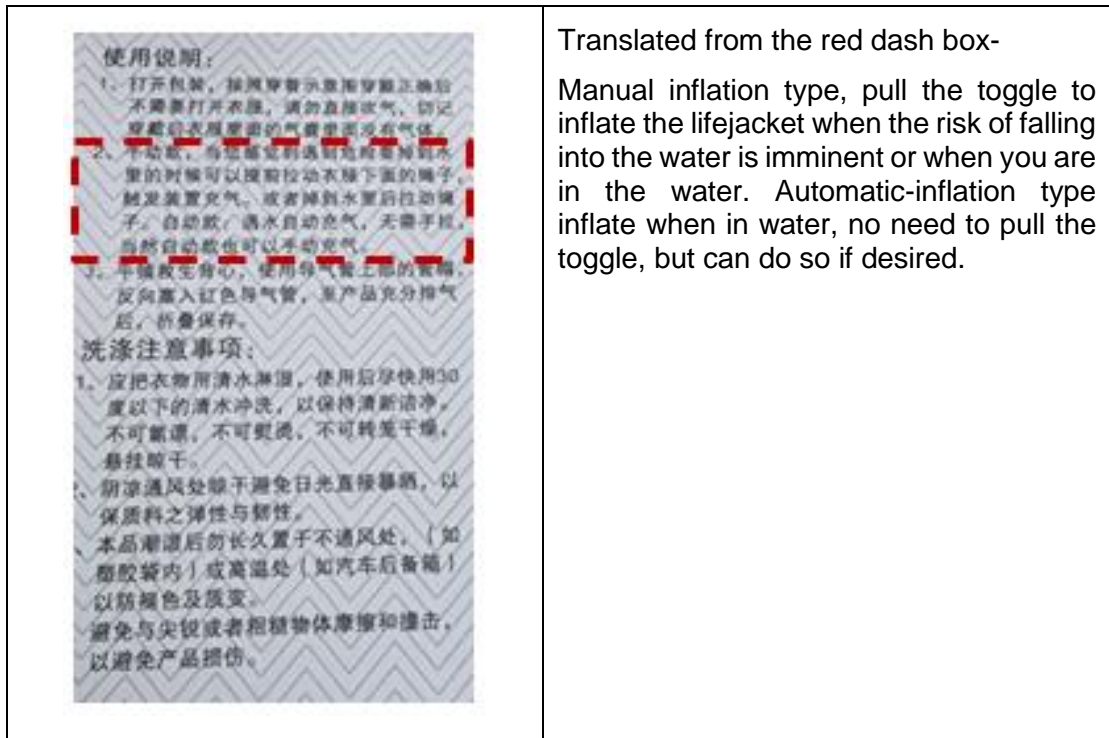


Figure 18 - Label (user guide) accompanying the lifejacket (Annotated and translated by TSIB)

(iii) The label also had a pictorial depiction of the lifejacket's donning and operation once the user falls into the water (see **figure 19**).



Figure 19 – Pictorial depiction of lifejacket's donning and operation.

1.8.3.3 A company, based in China, initially responded⁴¹ to the following queries from the investigation team -

- (i) The certificate accompanying the lifejacket does not indicate the inflation type⁴² of the lifejacket; and
- (ii) The “Instruction for use” label on the exterior section of the lifejacket is the same regardless of the mode of inflation of the lifejacket, i.e. common for both, the automatic lifejacket vs manual lifejacket (no separate label to indicate different instructions to inflate the different types of lifejackets).

1.8.3.4 To the investigation team’s query that a “common instruction for use” label for the two different types of inflation for the lifejacket could be misleading to the user, the company responded that they were only a trading company (reseller) who would procure lifejacket (online) for their customers and had no control over the “Instruction for use” labels on the lifejackets.

1.8.3.5 In its interaction with CCS, the investigation team noted that the Standards JT 346-2004⁴³ did not specify the lifejacket to be marked with the type of inflating mechanism. As a result of the investigation team’s discussion with CCS, a check carried out by CCS revealed that the “Instruction for use” labels for lifejackets manufactured after 2018 (meant for domestic use and recreational purpose) were also ambiguous. CCS further advised that the manufacturer had made improvements to the lifejackets as follows –

- Printed the performance level (e.g.150) and the inflation means on the front of the lifejacket (see **figure 20**),
- Labels on “Instruction for use”, with clearer guidance, are sewed on the back of the lifejacket (see **figure 21**).

⁴¹ They reportedly supplied lifejackets which were approved by China Classification Society (CCS). According to the company, the sales record shown that there were no inflatable lifejackets supplied to Singapore in the past three years.

⁴² The two types are automatic inflation or manual inflation.

⁴³ The Standard in accordance with which the lifejacket donned by TECH-2 was manufactured.



Figure 20 – Marking on the front of the lifejacket (translated by TSIB)

<p style="text-align: center;">使用须知</p> <ol style="list-style-type: none"> 1. 使用前检查救生衣，确保救生衣包装完好。请仔细阅读说明，确认本产品是手动款还是自动款产品。 2. 只有充气之后救生衣才具有浮力，未充气状态下不可漂浮。 3. 如果有使用痕迹，请检查气瓶是否已经使用，充气装置拉手是否自然闭合。 4. 适合35kg以上人群穿着。 5. 使用且仅使用33g CO₂气瓶。 6. 避免尖锐物及高温物接触，防止损坏救生衣 	<p>Instructions for use</p> <ol style="list-style-type: none"> 1 Check the lifejacket before use to ensure that the lifejacket is packed in good condition. Read the instructions carefully to confirm whether the product is manual or automatic inflation. 2 The lifejacket has buoyancy only after inflated, does not have buoyancy if not inflated. 3 If there are traces of use, check whether the gas cylinder has been used and whether the handle of the inflation device is closed. 4 Suitable for person weigh over 35Kg. 5 Use only 33g CO₂ cylinder.
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	6 Avoid contact with sharp and high temperature object to prevent damage to the lifejacket.
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Figure 21 – Label sewed on the lifejacket (Translated by TSIB)

1.8.3.6 The lifejacket instruction text was also amended to reflect the following text (see **figure 22**)

<p>四、充气说明</p> <p>1、自动充气落水后自动充气装置在5秒钟内将自动充气，变成一件救生衣。</p> <p>2、手动充气用右手迅速有力的拉动充气装置的拉子，充气装置在5秒钟内充气变成一件救生衣。如果是先充气再入水，务必用手交叉压在胸口的气囊，不使其滑出或伤害使用者。</p> <p>3、嘴吹充气通过吹气管进行充气，一般只用于经过使用后，气囊气体损失后作为补气之用，严禁先进行嘴充气，再进行自动或手动充气。两次充气可能导致气囊内压力过大爆裂。</p>	<p>1. Automatic inflation. After entering the water, the inflation device will automatically inflate the lifejacket within 5s.</p> <p>2. Manual inflation. Pull the toggle quickly and forcefully to inflate the lifejacket. The inflation device inflates the lifejacket within 5s. If the lifejacket is inflated before entering the water, pressed the inflated lifejacket against the chest with both hands crossing each other to prevent the lifejacket from slipping out or injuring the user.</p> <p>3. After being used for a while, the air in the lifejacket can be replenished by blowing through the oral tube. The lifejacket shall always be inflated initially by either automatic inflation or manual inflation. It is strictly forbidden to inflate the lifejacket orally first then follow by either the automatic inflation or manual inflation. Inflating the lifejacket twice may cause the lifejacket to burst due to excessive pressure.</p>
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Figure 22 – Accompanying instruction text (Translated by TSIB)

2 ANALYSIS

The investigation looked into the following:

- 2.1 The likely cause of the fall into the water
 - 2.1.1 There was no autopsy report available to determine the cause of death of TECH-2 or if TECH-2 suffered injuries during the fall.
 - 2.1.2 In determining the factors that could have resulted in TECH-2's fall into the water, the investigation team considered TECH-2's experience, his health condition, and the possibility of him losing balance during the transfer.
 - 2.1.3 From the investigation team's interaction with TECH-2's colleagues who were with him on AN, there was no evidence to suggest that TECH-2 was unwell before disembarking AN.
 - 2.1.4 Prior to the occurrence, the AM had safely transferred to AN and the Skipper confirmed the boat was in a near-stationary condition when waiting for the three technicians to transfer. As the boat's deck was painted with anti-slip paint, it is unlikely that TECH-2 had slipped and fallen into the water.
 - 2.1.5 The transfer operation was carried out on the windward side owing to a larger vessel being moored to AN on its leeward side. The Skipper had made an assessment for the safe conduct of the transfer by assessing the prevailing conditions. Witness accounts indicated that when TECH-2's feet were on the deck of LEO 38, the boat's motion⁴⁴ changed. Soon after this TECH-2 with a backpack weighing about 10Kg, was seen to squat down, possibly to balance himself.
 - 2.1.6 The swaying and rolling of LEO 38 was due to the sudden swells which were likely caused by a passing vessel. Notwithstanding, the investigation team held the view that, as far as practicable, efforts must be made to carry out transfers on the leeward side.
 - 2.1.7 The transfer operation was also carried out in the hours of darkness, which had lessened the chance for the Skipper to see the oncoming swells to abort the transfer operation or to provide warning to TECH-2 or to take actions to minimise the effect of the swells on the boat.

⁴⁴ The six motions that would affect the boat are 1 - Sway, 2 - Roll, 3 - Heave, 4 - Purge, 5 - Pitch, 6 - Yaw.

- 2.2 TECH-2's lifejacket
- 2.2.1 The inspection and test confirmed that the lifejacket donned by TECH-2 was in a working condition, and of a manual inflation type i.e. requiring manual activation by the user.
- 2.2.2 The investigation team could not establish the reason why TECH-2 did not inflate the lifejacket when he was in the water.
- 2.2.3 The following possibilities were thus considered by the investigation team:
- The sudden fall into the water could have shocked TECH-2 and caused him to not activate the toggle to manually inflating the lifejacket, in a state of panic; or
 - TECH-2 was not familiar with the inflation method of the lifejacket.
- 2.2.4 The lifejacket worn by TECH-2 was a manual inflated lifejacket. However, the label on this lifejacket had instructions and a depiction which were common for both automatic and manual activated lifejacket, which can be misleading. It is unclear if TECH-2 had been influenced by the unclear depiction on the label of the lifejacket.
- 2.2.5 Falling into water can disorientate a person and may impair their decision-making ability. This occurrence highlights the importance of ensuring that appropriate lifejacket is used and to be thoroughly familiar with its operation.
- 2.2.6 It is unfortunate that TECH-2 did not manage to grab on to the lifebuoys that were thrown to him earlier by the TECH-1, as well as the crew of VALIANT III and AN. By the time he grabbed on to the lifebuoy deployed by TECH-1, it is likely that he had been overcome by exhaustion (being in the water for about 10 minutes with a backpack of about 10Kg) and released his grip of the lifebuoy.
- 2.3 AAS' SOP on transfer of personnel at sea
- 2.3.1 There was no SOP in place at AAS to ensure that lifejackets are donned for carrying out tasks at the anchorage. A RA conducted in the year prior identified the control measures to mitigate the risk of falling into the water and drowning which included ensuring a three-point contact, regular checks on wave momentum and wearing of a lifejacket. It is evident that the RA was not discussed prior to the task as TECH-1 and TECH-3 were not wearing a

lifejacket and the TECH-2 was caught off-guard when LEO 38 suddenly swayed and rolled.

2.3.2 It is probable that TECH-2 was aware of the importance of wearing a lifejacket (influenced by his seagoing experience) but did not maintain a three-point contact after transferring to the deck of LEO 38.

2.3.3 Considering the risks involved in the transfer of persons at sea, it is important to conduct a RA and discuss the contents, prior to each transfer operation, regardless of how experienced an individual can be. Doing so would serve as a reminder on the risk control measures such as the need to don a lifejacket and the importance of maintaining three-point contact during the transfer.

2.4 Transfer of persons at sea

2.4.1 It is important to note that backpack or bag, which may cause a person to lose balance, prevent or affect a person's ability to stay afloat or even obstruct the proper inflation of the lifejacket, should be transferred across by a messenger rope, instead of being carried, when transferring between vessels.

2.4.2 Risks associated with boat transfers should never be underestimated as the situations can be dynamic especially the effect of prevailing weather, sea conditions and the various external factors when the anchored vessel's location was adjacent to the port limit and TSS. The occurrence demonstrated that regardless of the experience, transfer of persons between vessels poses a high risk of falling into the sea.

2.4.3 The presence of an additional deckhand would help to avert such a situation, help persons transferring to maintain their balance and guide them during the transfer.

2.4.4 At the time of occurrence, LEO 38 was manned solely by the Skipper. It would be desirable for a review of the one-man operation for boats which conduct transfer of personnel to be revisited by the Regulator of the Port in consultation with the shipping community.

2.5 Importance of an appropriate lifejacket & be familiar with its operation

2.5.1 Although, the lifejacket for TECH-2 was procured by TECH-3, TECH-3 was not aware of the means of inflating the lifejacket or even the design differences of

the lifejackets.

- 2.5.2 Despite its efforts in tracing the manufacturer of the lifejacket worn by TECH-2 with the intention to improve the instructions on the label (which can be misleading), the investigation team was not able to identify the lifejacket manufacturer.
- 2.5.3 Lifejackets are manufactured according to various performance standards and be used in different situations or locations. A lifejacket can save a life in time of need. It is important that the user knows the appropriate type of lifejacket to be used and is thoroughly familiar with its operation. It is thus important for lifejacket procured to come with proper and correct instructions for use and is fit for purpose.

3 CONCLUSIONS

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

- 3.1 TECH-2 lost his balance and fell into water during the transfer from AN to LEO 38 when LEO 38 swayed and rolled due to the sudden swells caused by a passing vessel and TECH-2 was carrying a backpack which weighed about 10Kg.
- 3.2 When TECH-2 fell into the water, the lifejacket did not inflate. The lifejacket was found to be a manual inflation type which required intervention by the user to inflate by pulling the toggle. It is unclear if TECH-2 was disoriented in a state of panic or unfamiliar with how to manually inflate the lifejacket or was influenced by the misleading label which included instructions for both manual and automatic inflation lifejacket.
- 3.3 Lifebuoys were immediately deployed by TECH-1 and the crew of the vessels involved, but TECH-2 did not manage to grab them except the last one. TECH-2 was likely exhausted having been in the water for about 10 minutes attempting to stay afloat with a backpack of about 10Kg. As a result TECH-2 was unable to hold on to the lifebuoy deployed.
- 3.4 Although AAS conducted RA and indicated control measures to mitigate the risk of falling into water and drowning, there was no process in place to discuss the RA prior to the deployment of the team to AN, including the donning of lifejacket and maintaining three-point contact at all times.
- 3.5 It is deemed that an additional deck-hand to assist in the transfer should be considered to mitigate the risk associated with transfer of persons at sea.
- 3.6 It is important for the user to know the appropriate type of lifejacket being used and to be thoroughly familiar with its operation considering the possibility of labels to be misleading.

4 SAFETY ACTIONS

Arising from discussions with the investigation team, the organisation(s) has/have taken the following safety action.

- 4.1 The Company for the service technician, AAS, took the following safety actions:
- i. Developed Guidelines for Safe Transfer of Persons Between Vessels at Anchorages (with reference to MPA's Port Marine Circular No.34 of 2020), which include the carrying out safety briefing at the office before proceeding on-site. The safety briefing includes, among others, personnel to be aware of the risk assessment and be alert and maintain good situation awareness of the weather and sea state before proceeding with the transfer, supervisor to check the donning of lifejacket by the personnel, all hand carry bags to be transferred by messenger rope to/from service boat, etc.
 - ii. Maintain and issue only automatic inflation type lifejackets that meet the requirement of SOLAS type-approved lifejacket or a lifejacket meeting ISO 12402 – performance level 150 or higher; and the lifejackets would be sent for regular servicing as per manufacturer's instructions.
- 4.2 The Company for LEO 38 had taken the following safety actions.
- i. Skipper to always maintain good situational awareness and exercise extreme caution when conducting the transfer operation;
 - ii. Skipper to remind and ensure all persons involved in transfer operation wear appropriate Personal Protective Equipment (PPE), including a suitable lifejackets or other equipment for keeping such persons afloat in the event that they fall into the water; and
 - iii. The above guidelines to be displayed prominently on board for the Skipper and passengers of the service boat.

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 The following safety recommendations are issued to the Regulator of the Port of Singapore:

5.1.1 To consider in its review of the existing PMC 34 of 2020, recommending users to use a working SOLAS type-approved lifejacket or a lifejacket meeting international ISO 12402 of at least performance level 150 with automatic inflation capability. **[TSIB-RM-2023-01]**

5.1.2 To consider a review of the existing licensing framework of one-man operation for the launch boats to ensure safe transfers of personnel at the anchorage. **[TSIB-RM-2023-02]**