

Final Report

Collision

**Between BW Seine and barge SOL 2315 towed
by tug SOL 1009**

at Singapore Strait TSS

on 5 February 2023

TIB/MAI/CAS.138

Transport Safety Investigation Bureau
Ministry of Transport
Singapore

20 May 2024

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

ASD	Able Seafarer Deck
AIS	Automatic Identification System ¹
ARPA	Automatic Radar Plotting Aid
BCR	Bow Crossing Range
BCT	Bow Crossing Range Time
BKI	Biro Klasifikasi Indonesia ² (Indonesia Classification Bureau)
BRM	Bridge Resource Management
COG	Course Over Ground ³
COLREGs	Convention on the International Regulations for Preventing Collisions at Sea, 1972
CPA	Closest Point of Approach
DGST	Directorate General of Sea Transportation, Indonesia ⁴
ETA	Estimated Time of Arrival
GPS	Global Positioning System
H	Hour
IMO	International Maritime Organization
ISM	The International Management Code for the Safe Operation of Ships and for Pollution Prevention
knot	Nautical mile per hour
m	Metre
MARINA	Maritime Industry Authority, Philippines

¹ SOLAS V/19.2.4.5 AIS shall: 1) provide automatically to appropriately equipped shore stations, other ships and aircraft information, including the ship's identity, type, position, course, speed, navigational status and other safety-related information; 2) receive automatically such information from similarly fitted ships; 3) monitor and track ships; and 4) exchange data with shore-based facilities.

² Bahasa Indonesia language.

³ The course made good by the vessel after the effects of the current and/or wind.

⁴ Maritime Administration, Republic of Indonesia.

min	Minute
mm	Millimetre
MPA	Maritime and Port Authority of Singapore
MT / T	Metric tonne / Tonne
nm	Nautical mile
OOW	Officer Of the Watch
PEBGC	Pilot Eastern Boarding Ground 'C'
PPAT	Pulau Punggol Aggregate Terminal
RPM / rpm	revolution per minute
SOG	Speed Over Ground ⁵
STW	Speed Through Water
STCW	Seafarers Training, Certification and Watchkeeping
TCPA	Time to Closest Point of Approach
TSS	Traffic Separation Scheme ⁶
UKC	Under Keel Clearance
UTC ⁷	Universal Coordinated Time
VDR	Voyage Data Recorder
VHF	Very High Frequency radio communication
VTIS	Vessel Traffic Information Service

⁵ The speed of the vessel after the effects of the current and/or wind.

⁶ A routing measure aimed at the separation of opposing streams of traffic by appropriate means by the establishment of traffic lanes – IMO Ships' Routing.

⁷ Coordinated Universal Time (UTC) is the primary time standard to which the world regulates clocks and time.

SYNOPSIS

On 5 February 2023, at about 1613H, there was a collision between a Singapore registered oil tanker BW Seine (SE) and an Indonesia registered barge SOL 2315 (SOL2) towed by an Indonesia registered tug SOL 1009 (SOL1) in the precautionary area of the Singapore Strait Traffic Separation Scheme⁸.

SE in ballast condition and SOL2 in loaded condition arrived in Singapore with SE transiting westbound to the Pilot Eastern Boarding Ground 'C' (PEBGC) and the tug and tow transiting northbound towards Eastern Buoy.

The collision caused SOL2's hull to rupture and deform with sea water ingress into its breached compartments, while SE water ballast tank was ruptured, causing ballast water to flow out from the tank and into the sea.

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

The investigation found that both SE and SOL1 did not follow the COLREGs rules and both vessels did not make continuous assessments using visual compass bearing to determine the risk of collision.

The crew of SOL1 had mistaken the response of VTIS as the permission to cross the TSS and did not take appropriate collision avoidance actions.

There was inadequate manning level for the SE's bridge team, a deviation from its Safety Management System. The SE's bridge team also did not apply the principles of BRM effectively.

⁸ A mandatory routeing system adopted by the IMO, in accordance with the requirements of regulation V/10 of the International Convention for the Safety of Life at Sea 1974 (SOLAS). Routeing system is any system of one or more routes or routeing measures aimed at reducing the risk of casualties; it includes traffic separation schemes (TSS), two-way routes, recommended tracks, areas to be avoided, no anchoring areas, inshore traffic zones, roundabouts, precautionary areas and deep-water routes – IMO Ships' Routeing.

VIEW OF VESSEL 1



Figure 1 – (Source: the Company)

DETAILS OF VESSEL 1

Name	BW Seine ⁹ (SE)
IMO Number	9342217
Classification society ¹⁰	American Bureau of Shipping (ABS)
Ship type	Oil Tanker
Year Built	2007
Flag	Singapore
Company	BW Fleet Management Pte Ltd ¹¹
Gross tonnage	43797
Length overall	221.21m
Breadth	21.20m
Moulded Draught	14.70m
Summer Freeboard	6515mm
Main engine(s)	Dalian Marine Diesel Works 6S60MC MK 6 (1 x 12240kW)

⁹ At the time of the incident the vessel's registered name was 'BW Seine'. It has since been renamed 'Hafnia Seine' from 14 February 2023.

¹⁰ Recognised Organisation (RO) approved by the Flag Administration for issuance of statutory certificates.

¹¹ From here onwards referred to as the Company in the report.

Propeller(s)	1 x fixed pitch
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VIEW OF VESSEL 2

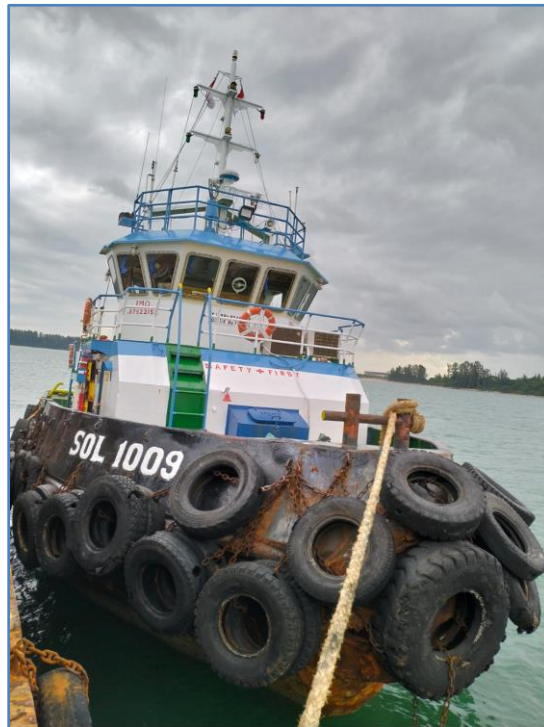


Figure 2 – (Source: SOL 1009)

DETAILS OF VESSEL 2

Name	SOL 1009 (SOL1)
IMO Number	8782159
Classification society	Biro Klasifikasi Indonesia ¹² (BKI)
Ship type	Tug
Year Built	2015
Flag	Indonesia
Operator and Owner	PT. Pelayaran Nasional Bahtera Armada Jaya ¹³
Gross tonnage	149

¹² For issuance of Load Line, Hull Classification and Machinery Classification certificates. Issuance of other statutory certificates is by DGST.

¹³ Vessel owner as stated in the Certificate of Nationality issued by DGST. From here onwards would be referred to as the Operator in the report.

Length overall	24.00m
Breadth	7.00m
Designed Draft	2.792m
Summer Freeboard	608mm
Main engine(s)	Mitsubishi S6A3-MPTK (2 x 600 horsepower)
Propeller(s)	2 x fixed pitch

VIEW OF VESSEL 3

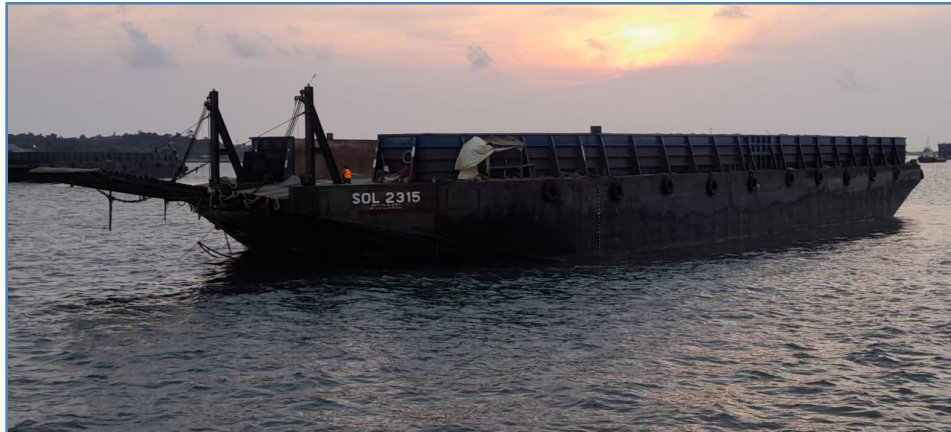


Figure 3 – (Source: the Operator)

DETAILS OF VESSEL 3

Name	SOL 2315 (SOL2)
Classification society	Biro Klasifikasi Indonesia ¹⁴ (BKI)
Ship type	Barge
Year Built	2013
Flag	Indonesia
Operator	PT. Pelayaran Nasional Bahtera Armada Jaya
Owner	PT. Sandico Ocean Lines
Gross tonnage	1833
Length overall	73.15m
Breadth	21.34m
Designed Draft	3.66m
Summer Freeboard	991mm

¹⁴ For issuance of Load Line and Hull Classification certificates. Issuance of other statutory certificates is by DGST.

1 FACTUAL INFORMATION

All times used in this report are Singapore Local Time (LT) unless otherwise stated. Singapore Local Time is eight hours ahead of UTC.

In the conduct of marine safety investigation into the circumstances surrounding the collision, the investigation team reviewed information obtained from the Master and crew of SE and SOL1, the Company of SE, the Operator of SOL1 and SOL2, and the Singapore VTIS.

1.1 Sequence of events

- 1.1.1 On 5 February 2023, in the precautionary area¹⁵ at the eastern part of the Singapore Strait TSS (see **figure 4**, hereinafter referred as Precautionary Area), the westbound tanker SE was proceeding to PEBGC¹⁶ and a northbound tug towing a barge (SOL1 and SOL2 respectively) was proceeding to PPAT. Both destinations were within the port of Singapore.

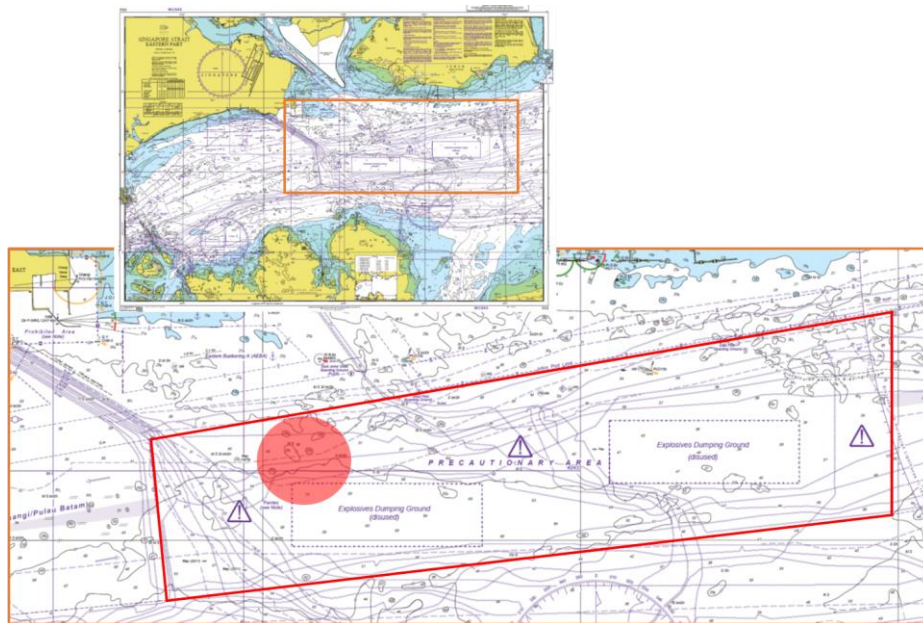


Figure 4 – Precautionary area annotation in red border (with translucent red circle indicating the area of incident) at the eastern part of the Singapore Strait TSS marked on Singapore Chart 502 (*Source: TSIB*)

¹⁵ A routing measure comprising an area within defined limits where ships must navigate with particular caution and within which the direction of traffic flow may be recommended (*Source: IMO Ships' Routing*).

¹⁶ SE was the third of four vessels in VTIS sequence, expected to arrive at PEBGC at 1715H for picking up a pilot.

- 1.1.2 At about 1548H VTIS East¹⁷ called SE, informing¹⁸ them that they were third and Frosso K (FK)¹⁹ fourth in the sequence of arrival at PEBGC to pick up pilot²⁰. At this time, SE was about 11.44nm²¹ from PEBGC, proceeding on COG 261° with SOG of 10.3 knots. VTIS East then queried SE whether they were going to overtake FK. The Second Officer (2O), who was the Officer of the Watch, responded that SE intended to overtake FK on its starboard side and confirmed that they would be ready to pick up pilot at PEBGC as vessel number three²².
- 1.1.3 At about 1550H the Chief Officer (CO) of SOL1²³, which was in the Precautionary Area²⁴, requested permission from VTIS East to transit northbound towards Eastern Buoy²⁵ after passing astern of the westbound vessel Atlantic Falcon (AF)²⁶ which was on their starboard bow (AF was ahead of FK and SE, see **figure 5**). VTIS East responded with 'received, thank you²⁷'. At this position SOL1 and SOL2²⁸ was proceeding on COG 045° with SOG 3.2 knots and was at about 4.86nm and bearing 250.8° from SE's port bow.

¹⁷ Operating on VHF channel 10, at sector 9 of the Malacca and Singapore Strait Ship Reporting System (STRAITREP) and vessels in this sector report to the Singapore VTIS (*Source: Chart 5527 – Mariners' Routing Guide Singapore Strait Eastern Part*).

¹⁸ Key responsibilities of VTIS East - Communicate with vessels, monitor, and update their movements, provide traffic information, and warn vessels on risk of collision, grounding, or any other risks to safety of navigation. Advise vessels to observe COLREGs, good seamanship and safe practices. The investigation team noted that the information exchanged between VTIS East and SE was to minimise the probability of congregation of three or more vessels at PEBGC.

¹⁹ At this time, FK was ahead of SE by about 2.2nm and was on COG 261° with SOG 10.3 knots.

²⁰ The Master of SE had earlier received information regarding vessels arriving at the same boarding ground (PEBGC) from PSA Marine's Pilotage Services (PSAM) by email at 1515H.

²¹ Approximate position Latitude 01°17.16'N and Longitude 104°09.05'E.

²² In his interaction with the investigation team, the Master of SE clarified that based on SE's ETA and his assumption that FK would slow down, SE would arrive at PEBGC ahead of FK.

²³ At this period until prior to the collision, the CO and an Oiler were on SOL1's bridge. The Oiler was on the helm taking helm orders from the CO. The investigation team gathered that the Oiler did not possess any certification for performing the functions of a rating forming a part of a navigation watch (STCW II/4), and that he had been instructed by the Operator to perform that role. The Oiler reportedly had one year of deck crew experience in Indonesia's inland trade on small craft.

²⁴ Approximate position Latitude 01°15.55'N and Longitude 104°04.32'E, from this position the CO of SOL1 was aware that SOL1 and SOL2 would be crossing the general direction of vessels transiting the Precautionary Area.

²⁵ The port hand lateral mark off the East Johor Strait Boarding Ground (PJSB) in the Singapore's port.

²⁶ AF was about 2.2nm from SOL1's starboard bow.

²⁷ The CO had assumed the response from VTIS East as a permission for SOL1 and SOL2 to cross the Precautionary Area.

²⁸ The length of tow was estimated by SOL1's CO to be about 128m measured from SOL1's stern to the stern of SOL2.

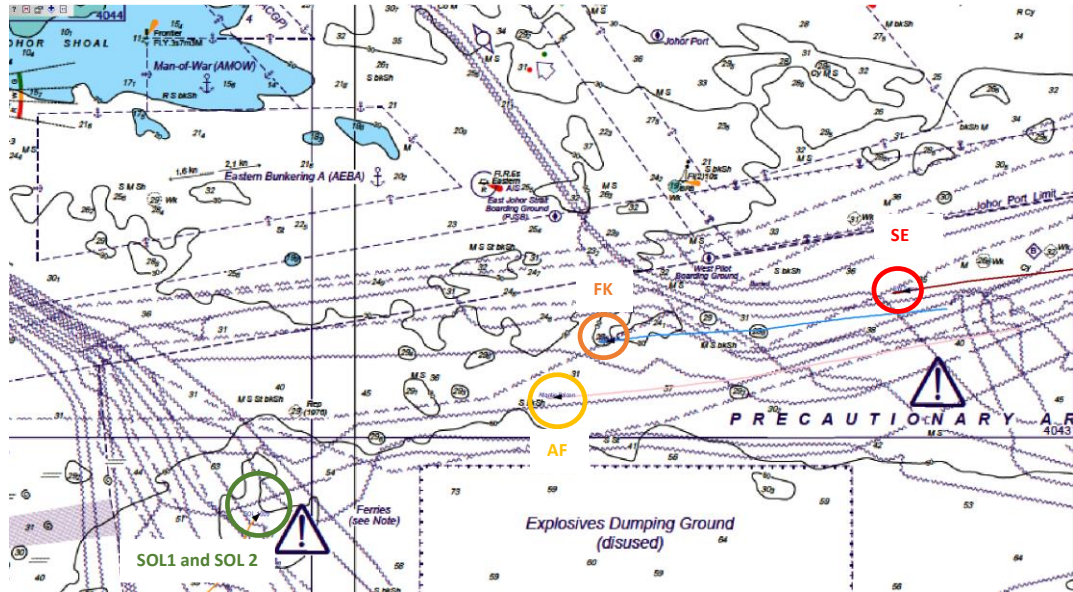


Figure 5 – Positions of SOL1 towing SOL2 (green circle), AF (yellow circle), FK (orange circle), and SE (red circle) on the chart (Source: TSIB) – *Not to scale*

1.1.4 **Figure 6** indicates the position of the persons on the bridge of SOL1 at about 1550H.

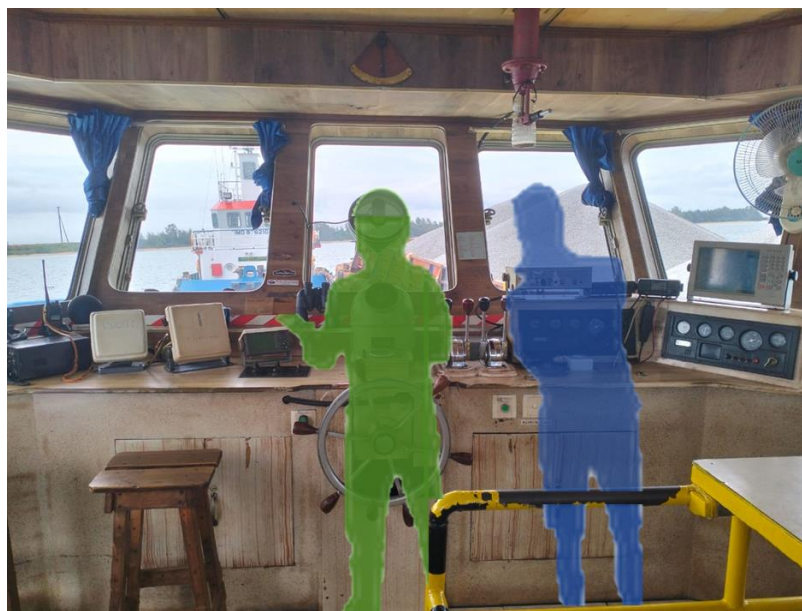


Figure 6 – SOL1's bridge view, looking forward, with position of Oiler (green) and CO (blue) (Source: TSIB)

1.1.5 When SE was about 11.28nm from PEBGC (at approximate position 01°17.13'N and 104°08.85'E), proceeding at a SOG of 10.2 knots (STW 11.6 knots), the Master informed the 2O²⁹ (see **figure 7**, showing the location of persons on SE's bridge at the time) that SE was still on schedule³⁰ to arrive at PEBGC (see **figure 8**, ECDIS indicating ETA at 1656H).



Figure 7 – SE's bridge view, looking forward (as viewed from the port side), with the positions of Master (black), ASD (green, performing the role of a lookout) and 2O (blue) (Source: the Company – annotations by TSIB)

²⁹ At this period until the collision, the Master, 2O and an ASD lookout were on SE's bridge. The Master was at the conn of SE. [Conn - To have the navigational control of the vessel, i.e., the actual control of the ship's speed and direction, including giving helm and engine orders (Source: SE's Navigational Safety Manual)].

³⁰ SE's pilot boarding time at PEBGC was scheduled at 1715H (Source: PSAM).

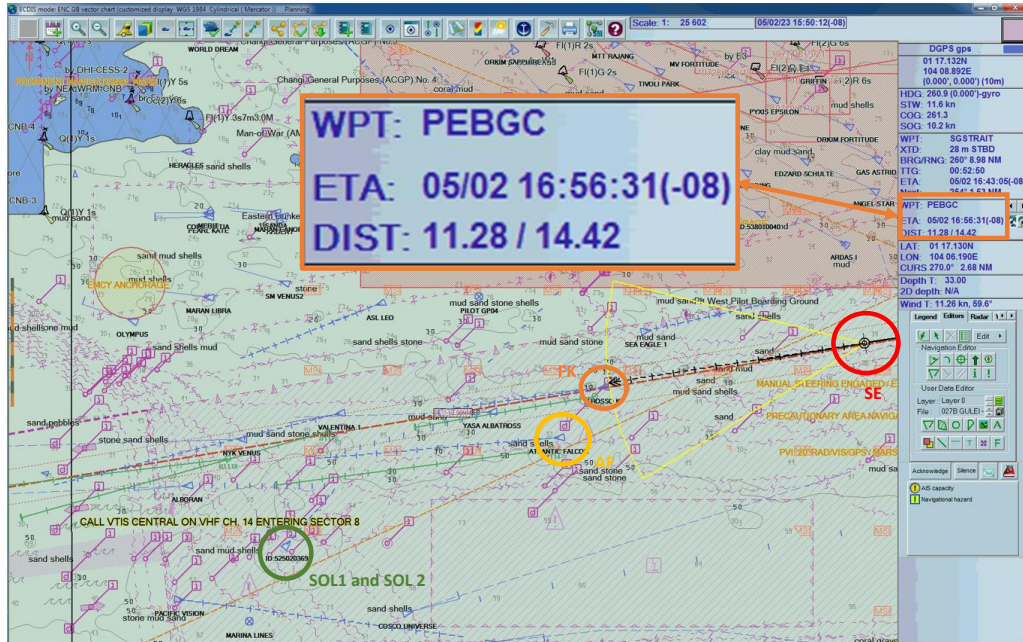


Figure 8 – SE’s ECDIS screen at 1550H indicating ETA PEBGC at 1656H with positions of SOL1 towing SOL2 (green circle), AF (yellow circle), FK (orange circle), and SE (red circle) (Source: the Company – annotations by TSIB)

1.1.6 At about 1556H the CO of SOL1 was manoeuvring to pass clear of AF which was on SOL1’s starboard side. Meanwhile, onboard SE, the Master acquired the target signature of SOL2 on the X-band ARPA³¹. SOL1 and SOL2 were seen as two separate targets in close proximity (see **figure 9**).

³¹ A marine radar with automatic radar plotting aid (ARPA) capability which can create tracks using radar target signature, calculate the tracked object's course, speed, closest point of approach (CPA) and the time to closest point of approach (TCPA). Radar is an acronym for radio detection and ranging. Marine radars on ships, are used to detect other ships and land obstacles, to provide bearing and distance for collision avoidance and navigation at sea.

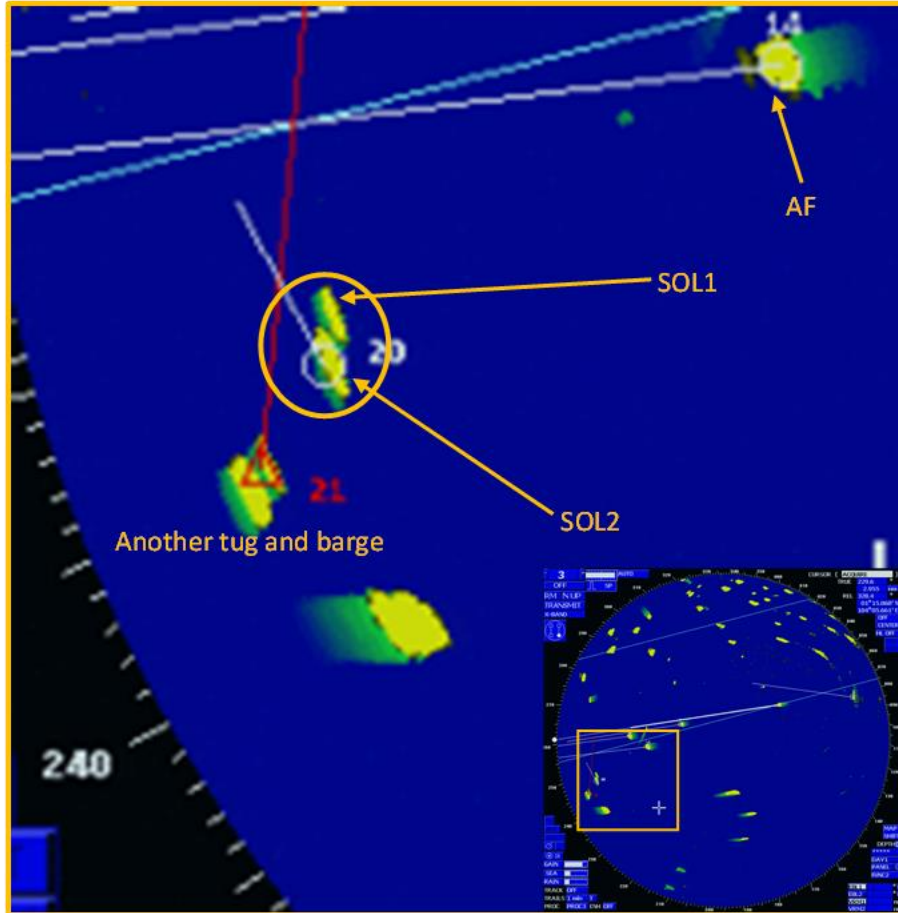


Figure 9 – SOL2’s target signature (no. 20) acquired (Source: VDR of SE – annotation by TSIB)

- 1.1.7 At about 1601H, SE’s 20 informed the Master that a tug under tow (referring to SOL1 and SOL2 which were also in visual sight, with SOL1 bearing 249.9° ahead of SE’s port bow and at a distance of 2.64nm) was ‘crossing’, which was acknowledged as ‘OK’ by the Master.
- 1.1.8 At about this time, SOL1 was towing SOL2 at an approximate speed SOG 3.7 knots. SE’s X-band ARPA indicated SOL2 was at a distance of about 2.7nm and bearing 246.5° ahead of SE’s port bow with a CPA at 0.12nm (222.24m) in about 13.2mins.
- 1.1.9 At about 1602H, as AF passed clear of SOL1’s bow, the CO of SOL1 called VTIS East but VTIS East was communicating with another vessel.

1.1.10 At about 1603H³², SOL1's CO called VTIS East to inform their intention to pass astern of FK³³ which was about 0.7nm on SOL1's starboard side and about 1.46nm ahead of SE (see **figure 10**). SOL1 was towing SOL2 at an approximate speed SOG 3.5 knots on COG 024.5°.

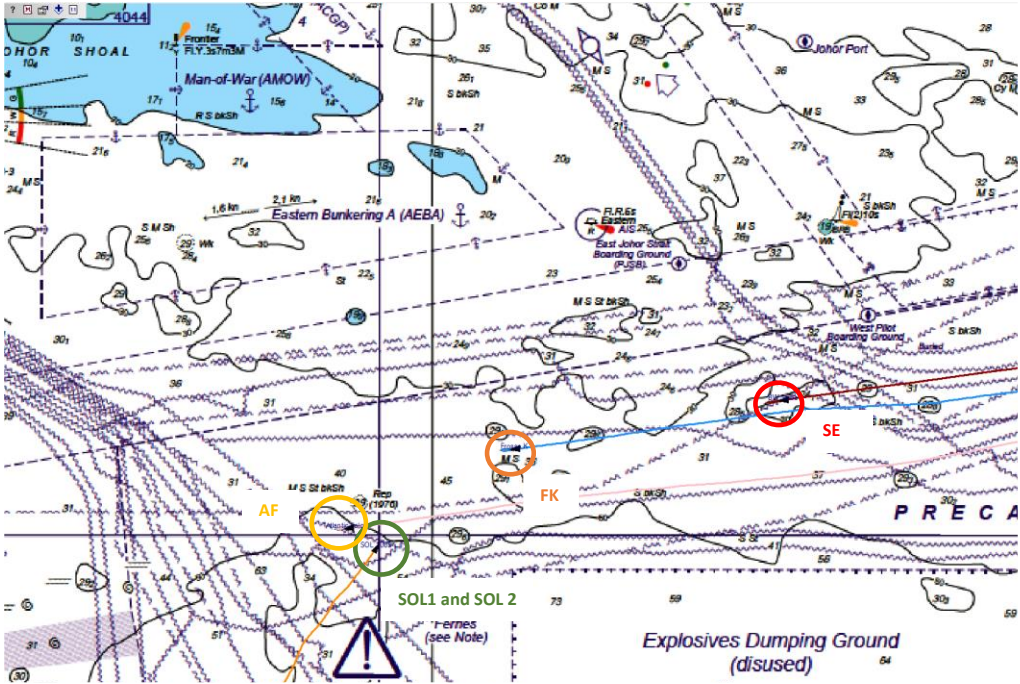


Figure 10 – Positions of SOL1 towing SOL2 (green circle), AF (yellow circle), FK (orange circle), and SE (red circle) on the chart (Source: TSIB) – Not to scale

1.1.11 At this time³⁴, SE was proceeding on COG 261.9° with SOG 9.5 knots (heading was 261° with STW at 11.0 knots). SE's X-band ARPA radar indicated SOL2 was at about 2.49nm and bearing 246.6° ahead of SE's port bow with a CPA of 0.04nm (74.08m) in about 12mins.

1.1.12 At about 1604H VTIS East informed SE that SOL1 which was towing SOL2, intended to cross ahead of SE and advised SE to keep a lookout. The 2O of SE acknowledged the information. After acknowledging VTIS East's advice, the 2O queried the Master if there was a need to alter to port, and the Master said, 'no

³² SOL1 was at position Latitude 01°16.13'N and Longitude 104°04.73'E, and at an approximate distance of 2.11nm from SE's port bow.

³³ FK was at position 01°16.57'N and 104°05.34'E on a COG 262.8° with SOG 6.7 knots.

³⁴ SE's position at this time was Latitude 01°16.83'N and Longitude 104°06.69'E.

need, it's OK' and that he would slow down SE instead.

- 1.1.13 In his interaction with the investigation team, the Master of SE clarified that in his understanding of the COLREGs³⁵, he determined SE as the stand-on³⁶ vessel. The Master further explained that in his understanding, the message from VTIS East was for information only and he did not have any intention³⁷ to slow down.
- 1.1.14 The Master added, based on his monitoring of information obtained from the X-band ARPA³⁸ radar (CPA and observing the relative vector line) as per **figure 11**, he assessed that both SOL1 and SOL2 would pass clear of SE's bow, where the vector line of SOL2 would not intersect SE on the radar screen³⁹.

³⁵ International Regulations for Preventing Collisions at Sea 1972.

³⁶ COLREG Rule 17 Action by Stand-on Vessel.

- (a) (i) Where one of two vessels is to keep out of the way the other shall keep her course and speed.
(ii) The latter vessel may however take action to avoid collision by her manoeuvre alone, as soon as it becomes apparent to her that the vessel required to keep out of the way is not taking appropriate action in compliance with these Rules.
- (b) When, from any cause, the vessel required to keep her course and speed finds herself so close that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action as will best aid to avoid collision.
- (c) A power-driven vessel which takes action in a crossing situation in accordance with subparagraph (a)(ii) to avoid collision with another power-driven vessel shall, if the circumstances of the case admit, not alter course to port for a vessel on her own port side.
- (d) This Rule does not relieve the give-way vessel of her obligation to keep out of the way.

³⁷ The Master did not make known to the other members of the bridge team of the intention of not slowing down.

³⁸ SOL2 was at a distance of 2.07nm, bearing 246.5° ahead of SE's port bow with a CPA of 0.01nm (18.52m) in 9.8mins.

³⁹ ARPA information indicated SOL2's BCR of 0.14nm to 0.23nm between 1605H and 1611H, but the BCR was reduced from 0.13nm at 1612H to 0.03nm at 1613H when SOL1 began turning to starboard (See **table 2**).

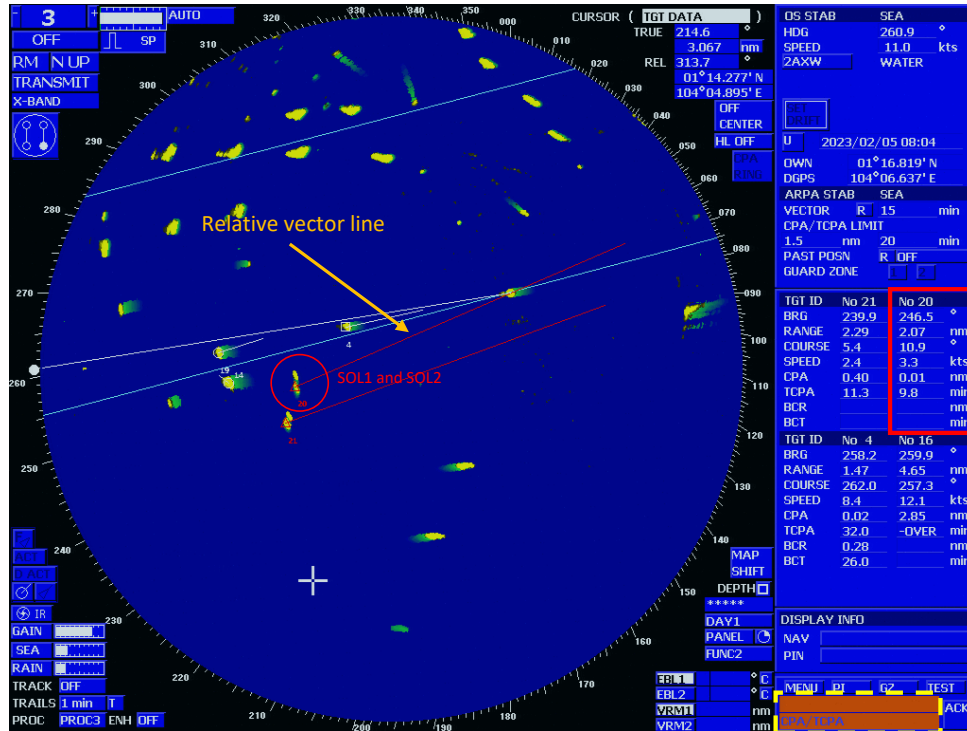


Figure 11 – SE’s X-band ARPA radar screen⁴⁰ at 1604H showing target information of SOL2 (in red box on the right column) (Source: the Company – annotation by TSIB)

- 1.1.15 At about 1605H, the Master of SE, noting two sets of tug and tow visually on SE’s port bow, asked the 2O which of the two would be crossing SE’s bow. Soon after, the Master realised that the first set (SOL1 and SOL2) was the tug and tow that would cross SE’s bow (referring to the BCR) while the other set would pass on SE’s port side. SE’s X-band ARPA radar indicated SOL2 to be at about 1.87nm and bearing 246.7° ahead of SE’s port bow with a CPA of 0.04nm (74.08m) in 9mins and a BCR of 0.15nm (277.8m) in about 8.3mins (see **figure 12**).

⁴⁰ The relative vector line will turn from white to red if the targets are in close proximity, based on the CPA and TCPA, with visual alert at the bottom right of the radar screen.

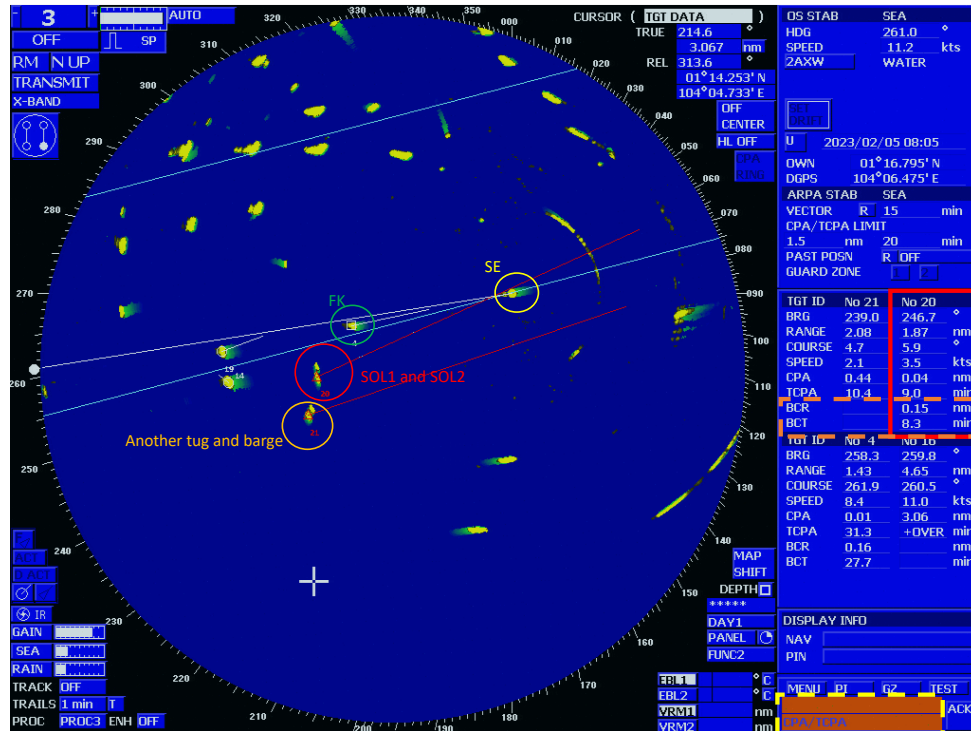


Figure 12 – SE's X-band ARPA radar screen at 1605H showing target information of SOL2 (in red box on the right column) with its BCR (*Source: the Company – annotation by TSIB*)

- 1.1.16 At about 1606H SE was on COG 261.2° with SOG 9.4 knots (heading was 260.7° with STW at 11.2 knots). The Master of SE informed the 2O of his intention to go in between the two sets of tug and tow, i.e., ahead of the tug and tow that was behind SOL1 and SOL2. In his interaction with the investigation team, the Master of SE clarified that at this stage, he intended⁴¹ to maintain SE's course and speed.
- 1.1.17 By about 1608H SOL1 had cleared FK (the latter was on the port side of SOL1 at a distance of about 0.1nm) and SOL1⁴² continued its northerly passage towards Eastern Buoy (see **figure 13**).

⁴¹ The Master assessed that SOL1 and SOL2 would pass clear of SE's bow with maintaining the course and speed.

⁴² SE was at about 1.25nm and bearing 074° from SOL1's starboard bow.

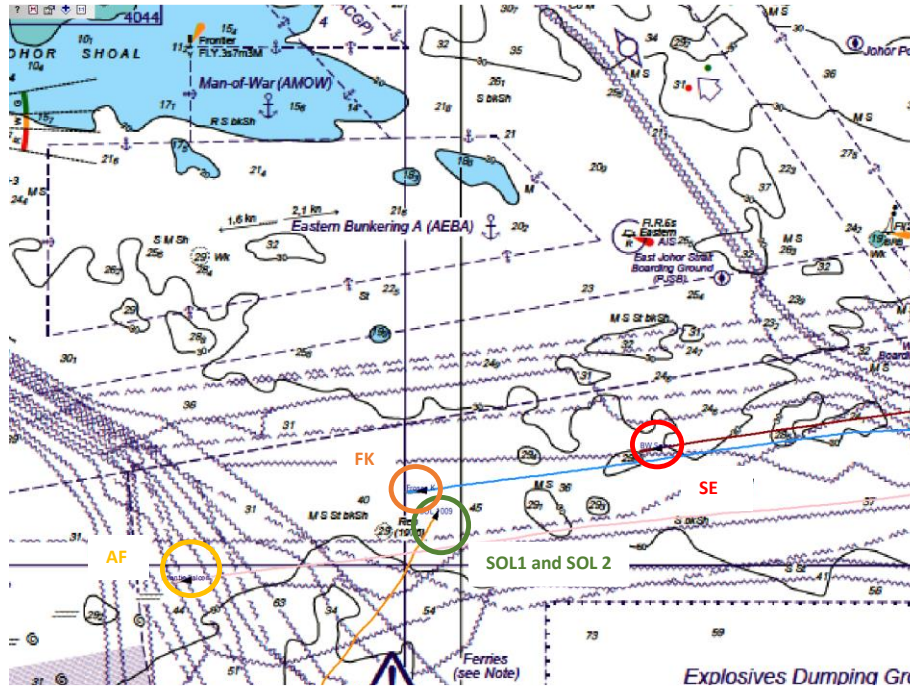


Figure 13 – Positions of SOL1 towing SOL2 (green circle), AF (yellow circle), FK (orange circle), and SE (red circle) on the chart (Source: TSIB) – Not to scale

- 1.1.18 At about 1609H, the CO of SOL1⁴³ reportedly calling SE three times⁴⁴ on VHF channel 10 but did not receive any response. Thereafter SOL1's CO reportedly calling VTIS East but did not get a response⁴⁵.
- 1.1.19 During this time, the Master of SOL1 came on the bridge after hearing radio calls by the CO⁴⁶. The CO advised the Master of SOL1 that VTIS East had granted permission for SOL1 to proceed to Eastern Buoy and that they would be passing ahead of SE which was about 1nm away⁴⁷. The Master then took over conn and the helm to navigate towards Eastern Buoy⁴⁸.

⁴³ SOL1 was at position 01°16.43'N and 104°04.90'E on COG 038.4° with SOG 4.2 knots.

⁴⁴ SE's VDR recording indicated one call from SOL1 to SE but was not responded by SE. Between 1609H and 1610H the SE's Master and 2O were conversing about a unique power supply ship (which was anchored at Eastern Bunkering Alpha Anchorage (AEBA) at about 1.1nm from SE's starboard beam). At 1610H SE asked VTIS East whether VTIS East had called them. VTIS East responded with 'I am calling 3B Destiny'.

⁴⁵ The investigation team gathered that at the time there were multiple routine communications taking place between VTIS East and other users of the TSS.

⁴⁶ The Master of SOL1 was below the bridge, there was no doors between the bridge and the deck below which was accessible by a stairway.

⁴⁷ The investigation team understood that the CO's assessment was based the distance obtained from the AIS.

⁴⁸ At this period until prior to the collision, the Master, Chief Officer, and an Oiler were at SOL1's bridge. The Master had taken over the helm.

- 1.1.20 The investigation team noted that between 1608H and 1610H VTIS East channel was busy with attending to calls from a regional ferry which was attempting to make a routine report of crossing the TSS and the VTIS East operator was trying to call a merchant ship⁴⁹ to provide navigational information.
- 1.1.21 At about 1611H the Master of SE informed the 2O that after the tug and tow (SOL1 and SOL2) had passed, the ship's engine should be brought down to 77 rpm from the current 81 rpm and, thereafter the 2O was to bring the ship's engine speed up to 80 rpm. At this time SOL1 was about 0.44nm and bearing 262.6° ahead, fine on the starboard bow of SE⁵⁰ (see **figure 14**).

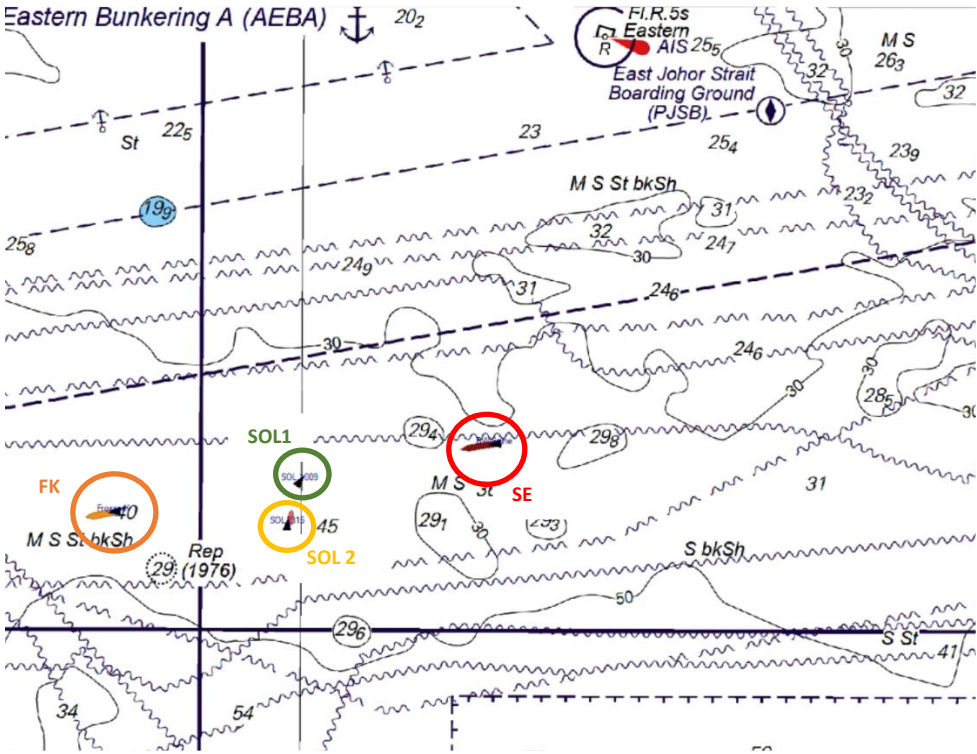


Figure 14 – Positions of SOL1 (green circle) towing SOL2 (yellow circle), FK (orange circle), and SE (red circle) on the chart (Source: TSIB) – Not to scale

- 1.1.22 The Master of SOL1 noting no change in SE's heading, increased the speed of

⁴⁹ Six calls in quick succession were heard being made by the regional ferry before VTIS East operator acknowledged the report. During this period, five calls were made by VTIS East to another vessel which would benefit from navigational information.

⁵⁰ SE's position at this time was 01°16.65'N and 104°05.56'E, proceeding on COG 261.1° with SOG 9.4 knots. SE's heading was 261° with STW of 11.0 knots. SOL1 was proceeding on COG 035.2° with SOG 4 knots.

SOL1 and altered towards starboard⁵¹ (to keep the barge away from the path of SE). When asked by the investigation team both the Master and CO confirmed that SOL1 had already crossed SE's bow but SOL2 was still in SE's path.

- 1.1.23 When SOL2 was at about 0.62nm and bearing 249.3° ahead of SE's port bow with CPA at 0.04nm (74.08m) in 2.9mins and BCR at 0.16nm (296.32m) in 2.2mins (see **figure 15**), the SE's Master began the adjustment on the ship's engine telegraph reduce engine rpm to 77⁵².

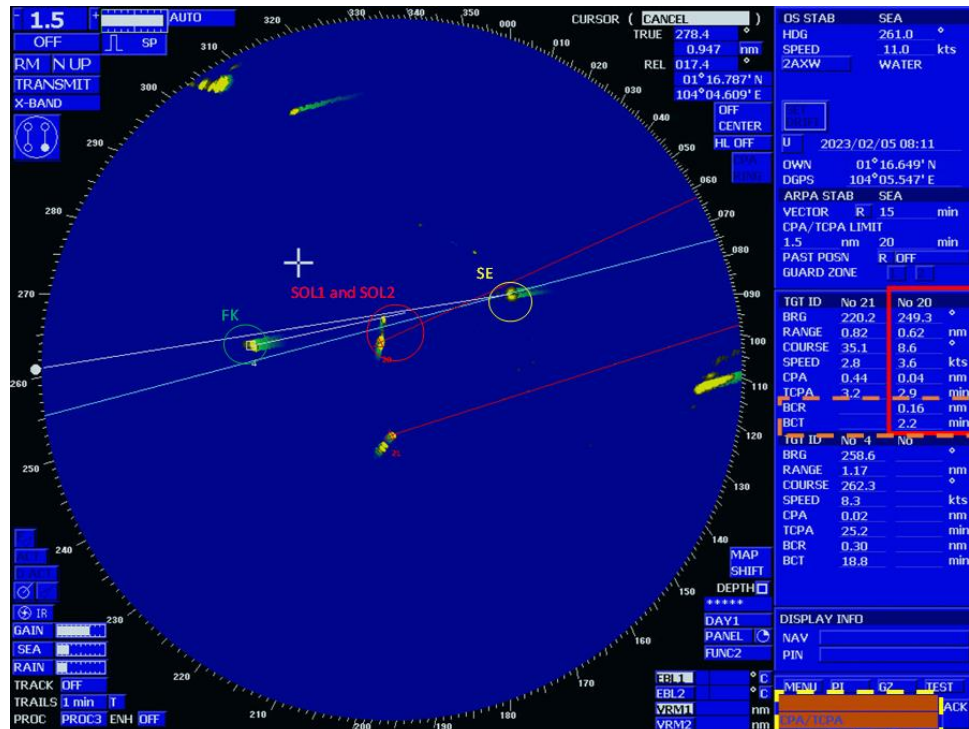


Figure 15 – SE's X-band ARPA radar screen at 1611H showing the position of vessels (two minutes before the collision) (Source: the Company – annotations by the TSIB)

- 1.1.24 At about 1612H, the SE Master instructed the ASD⁵³ to begin hand steering. Helm orders (as tabulated in **table 1**) were given at the instructions of the Master. At around 35 seconds after 1613H, SOL2's starboard quarter came into

⁵¹ From 1611H 49s to 1613H 41s the following were SOL1 course (COG) alterations - 024.2° → 032.2° → 035.9° → 039.2° → 041.8° → 047.4° → 050.8° → 050.7° → 053° → 055.3° → 054.7° → 072.9° (Source: VDR of SE).

⁵² In his interaction with the investigation team, the Master of SE clarified that it takes one minute for every one rpm reduction. The engine would then be in a condition for manoeuvring readiness once the rpm reduction was completed.

⁵³ The ASD was instructed by the Master to change his role from a lookout to hand steer the helm prior to the occurrence.

contact with SE’s bow, causing the barge to pivot. The bow ramp door fitted on SOL2 then came into contact with the starboard hull of the SE resulting in a breach above the waterline, causing ballast water to flow out into the sea.

Time (hhmmss)	Helm orders	Remarks
161236	Port 5	-
161312	Midship	-
161335	-	Collision

Table 1 – Helm orders from VDR before the collision (*Source: the Company*)

1.1.25 The Master of SOL1 confirmed that prior to the collision, he manoeuvred the tug more to starboard and increased the speed (see **figure 16**, in red circle). The Master further clarified that this action was taken for the safety of the tug and his crew, to avoid the tug being pull by the towing rope if SE were to be in between the tug and the barge, as such an event would lead to the tug to capsize due to girting⁵⁴.

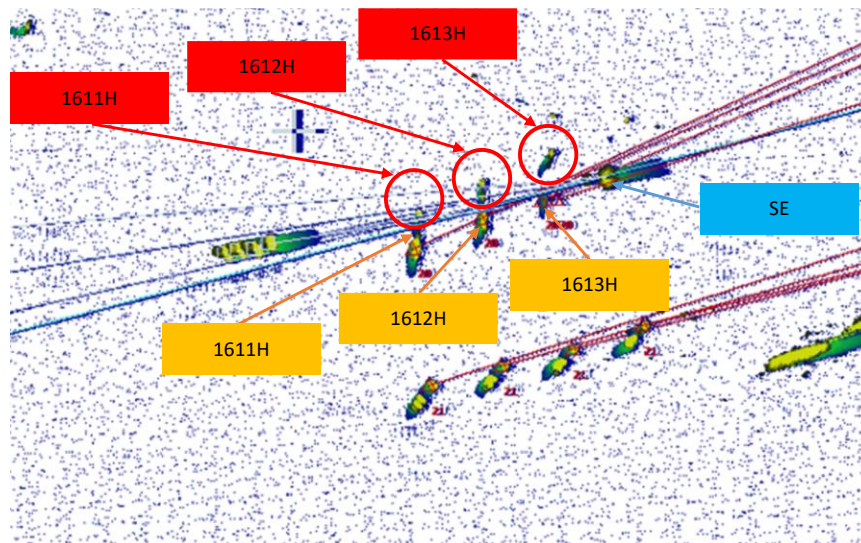


Figure 16 – Overlay of the radar signature of the targets SOL1 (red label), SOL2 (orange label), and SE (blue label) as seen on SE’s X-band ARPA radar from 1611H to 1613H (*Source: the Company – annotations by TSIB*)

⁵⁴ Girting may also be referred to as girthing, tripping or girding. A towline under tension will exert a heeling moment on the tug if the line is secured around amidships and is leading off towards the beam. If the force in the towline is sufficiently powerful, it may overcome the tug’s righting lever and cause the tug to capsize or “girt”. (*Source: West of England - Loss Prevention Bulletin*)

- 1.1.26 SOL1 called VTIS East at about 1614H to report the collision noting that there was no change in the SE's course, and that water was coming out of its hull. SOL1 at this time was about 0.21nm from SE's starboard beam. VTIS East communicated with SE at 1615H to verify the collision, which was acknowledged by the Master SE confirming a hull breach on the starboard side.
- 1.1.27 In response to the investigation team's queries whether the risk of collision had been established in the period leading up to the collision, the Master of SE confirmed that since the period of the 20's communication regarding alteration of course, there were no visual compass bearings taken and the bridge team members did not update him on the status of the tug and tow (SOL1 and SOL2) or any other vessels in the vicinity.
- 1.1.28 The Master of SE also recalled that prior to the collision at about 1612H, SOL1 had already passed SE's bow, but SOL2, which was under tow, was likely right ahead and not visible from SE's bridge.
- 1.1.29 As a result of the collision, the towline and split rope⁵⁵ of the tow parted. SOL2 as a result of the collision, had its hull at the starboard quarter breached and with sea water ingress, causing the barge to list to starboard.
- 1.1.30 In his interaction with the investigation team, the CO of SOL1 took the response of VTIS East to be a permission to cross the Precautionary Area after clearing AF.
- 1.2 Consolidated ARPA information onboard SE
- 1.2.1 The investigation team consolidated the ARPA information of SOL2 (target no. 20) onboard SE from 1601H to 1613H (collision at 35 seconds after 1613H) (see **figure 17**).

⁵⁵ Elaborated in paragraphs 1.5.4.

1601H	1602H	1603H	1604H																																																																																																																																																
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Figure 17 – Consolidated information of SOL2 (target no. 20) from SE's ARPA radar (*Source: VDR of SE*)

1.2.2 The chronological of events leading to the collision with SE's heading and the distance / bearing of SOL1 and SOL2 as well as the CPA / BCR and TCPA / BCT of SOL2 between 1601H and 1612H is tabulated in **table 2**.

Time	SE's heading	SOL1 range (nm) / bearing	SOL2 range (nm) / bearing	SOL2 CPA / BCR (nm)	SOL2 TCPA / BCT (mins)	Remarks
1550	261°	4.86 / 250.8°	-	-	-	-
1601	261°	2.64 / 249.9°	2.7 / 246.5°	0.12	13.2	The 2O of SE informed the Master of a tug under tow (SOL1 and SOL 2) 'crossing' and SOL2 acquired on ARPA
1602	261°	2.11 / 250.2°	2.49 / 246.6°	0.04	12	-
1604	260.9°	1.9 / 250.7°	2.07 / 246.5°	0.01	9.8	VTIS East informed SE that SOL1 which was towing SOL2 would be crossing ahead of SE
1605	261°	1.75 / 250.8°	1.87 / 246.7°	0.04 / 0.15	9 / 8.3	The Master of SE realised that the first set (SOL1 and SOL2) was the tug and tow that would cross SE's bow (referring to the BCR) while the other set would pass on SE's port side
1606	260.7°	1.62 / 251.6°	1.67 / 247°	0.05 / 0.19	8.3 / 7.4	The Master of SE informed the 2O of his intention to pass ahead of the tug and barge that was behind SOL1 and SOL2

Time	SE's heading	SOL1 range (nm) / bearing	SOL2 range (nm) / bearing	SOL2 CPA / BCR (nm)	SOL2 TCPA / BCT (mins)	Remarks
1607	260.5°	1.42 / 252.4°	1.46 / 247.1°	0.03 / 0.14	7.2 / 6.5	-
1609	261°	0.98 / 254.4°	1.04 / 248.2°	0.06 / 0.23	5 / 3.9	SOL1 called SE on VHF channel 10 but no response was received
1610	261.2°	0.74 / 256.9°	0.83 / 248.7°	0.07 / 0.22	3.9 / 2.9	-
1611	261°	0.44 / 262.6°	0.62 / 249.3°	0.04 / 0.16	2.9 / 2.2	SOL1 crossed SE's bow (from port to starboard side) but SOL2 being towed was in SE's path
1612	261°	0.36 / 267.2°	0.4 / 251.3°	0.03 (55.5m) / 0.13 (240.76 m)	1.9 / 1.3	The Master of SE noted SOL2 was not visible from the bridge
1613	257.3°	0.16 / 291.1°	0.2 / 248.9°	0.01 (18.5m) / 0.03 (55.56m)	0.9 / 0.8	Collision at 35 seconds after 1613H

Table 2 – Consolidated SOL1 and SOL2 range (distance) and bearing from SE's VDR (*Source: the Company*)

1.3 Crew's qualifications and roster

SE

1.3.1 SE was manned by 24 officers and crew from India, Malaysia, Myanmar, the Philippines and Sri Lanka. Details of relevant persons are listed in **table 3**.

Rank	Master	2O	ASD
Age	41	34	34
Certificate held Issued by	STCW Regulation II/2 ⁵⁶ Marine Department, Malaysia	STCW Regulation II/2 MARINA	STCW Regulation II/5 ⁵⁷ MARINA
Daily Work hours ⁵⁸	Non-watchkeeping duties ⁵⁹	2400H to 0400H 1200H to 1600H	2400H to 0400H 1200H to 1600H
Experience in rank (years)	5.1	4.9	7
Experience on similar type ship (years)	11.6	6	10
Service with company (years)	0.5	1	12
Service onboard (months)	4.2	7.6	8

Table 3 – Experience matrix of SE

1.3.2 The Master and 2O had attended the BRM training course as required under the STCW Code. Under the STCW Code there is no requirement⁶⁰ for the ASD to attend a BRM training course. The Master had sailed in the Singapore Strait thrice in the past in this rank. This was the first trip calling the port of Singapore under the Master’s command, after the vessel had performed voyages in the coast of West Africa.

1.3.3 Prior to the collision, the rest hour records maintained onboard for the Master, 2O and the ASD indicated that, in the past 24-hour and in the last 7-day period, their rest hours were in compliance with the STCW⁶¹ and MLC⁶² Convention, as

⁵⁶ Seafarers Training, Certification and Watchkeeping (STCW) Code - A-II/2 Mandatory minimum requirements for certification of masters and chief mates on ships of 500 gross tonnage or more.

⁵⁷ Seafarers Training, Certification and Watchkeeping (STCW) Code - A-II/5 Mandatory minimum requirements for certification of ratings as able seafarer deck.

⁵⁸ Scheduled daily work hours at sea as recorded in the vessel’s table of shipboard working arrangements.

⁵⁹ 0730H to 1200H, 1300H to 1800H and 2000H to 2100H.

⁶⁰ According to the flag Administration.

⁶¹ STCW Code - A-VIII/1 Fitness for duty.

⁶² Maritime Labour Convention, 2006 - Regulation 2.3 – Hours of work and hours of rest.

documented (tabulated in **table 4**).

Rest hours	24-hour	7-day
Master	11.5	92.5
2O	13.5	93
ASD	13.5	93

Table 4 – Rest hour of the Master, 2O, and the ASD.

SOL1

- 1.3.4 SOL1 was manned by eight officers and crew from Indonesia. Details of relevant persons are listed in **table 5**. SOL2 was unmanned during the towing voyage. As such there were no persons onboard SOL2 at the time of the incident.

Rank	Master	Chief Officer	Oiler
Age	54	51	29
Certificate held Issued by	STCW Regulation II/3 ⁶³ DGST	National certification ⁶⁴ DGST	STCW Regulation III/4 ⁶⁵ DGST
Daily Work hours ⁶⁶	0600H to 1200H 1800H to 2400H	0000H to 0600H 1200H to 1800H	0000H to 0400H 1200H to 1600H
Experience in rank (years)	15	9	0.25
Experience on similar type ship (years)	8	8	0.25
Service with company (years)	1	5	0.25

⁶³ STCW Code - A-II/3 Mandatory minimum requirements for certification of officers in charge of a navigational watch and of masters on ships of less than 500 gross tonnage, engaged on near-coastal voyages.

⁶⁴ National Certificate of Competency Deck Officer Class V Management – Chief Mate (Local Voyages – Below GT 500)

⁶⁵ STCW Code - A-III/4 Mandatory minimum requirements for certification of ratings forming part of a watch in a manned engine-room or designated to perform duties in a periodically unmanned engine-room.

⁶⁶ Duties during watchkeeping at sea as recorded in the vessel's deck logbook.

Rank	Master	Chief Officer	Oiler
Service onboard (months)	3	3	3

Table 5 – Experience matrix of SOL1

- 1.3.5 The Master of SOL1 had attended the BRM training course as required under the STCW Code. Although not a requirement under the national certification, the CO too attended the BRM training course. The Oiler who was a part of the engine room team (and was not trained for navigational watchkeeping duties) was placed on bridge duty and as recalled by the Master, in accordance with the Operator’s instruction. The role of the Oiler could not be established.
- 1.3.6 There were no records of rest or work hour maintained onboard. The investigation team noted from the vessel movements⁶⁷ and the accounts of the crew that the crew reportedly had sufficient rest prior to the commencement of the voyage towards Singapore.
- 1.3.7 The Master had sailed into the port of Singapore with SOL1 and SOL2 for about nine times since early November 2022 and at numerous occasions with the previous company. The Master was familiar with the crossing of the Precautionary Area (which had been done at the same location) and the reporting requirements to the VTIS.
- 1.4 Damage and additional information on SE
- 1.4.1 SE’s no. 6 starboard water ballast tank was ruptured⁶⁸ (sheared and distorted) as indicated in **figure 18**, causing ballast water to flow out from the tank and into the sea. SE’s bow was also damaged as a result of the collision.

⁶⁷ The loading of cargo onboard SOL2 at Karimun, Indonesia took about 6 hours (from 1000H to 1545H) on 3 February, thereafter no activity until 4 February at 1940H when they departed Karimun for Singapore. The collision took place when SOL1 and SOL2 were transiting northbound in the Precautionary Area upon arriving in Singapore.

⁶⁸ A report from the Classification Society stated that the extent of damage extended to an area of approximately 5m x 2.5m.



Figure 18 – Hull damage on SE (*Source: the Company and SOL1 (inset) – annotation by TSIB*)

- 1.4.2 SE has a valid Safety Management Certificate (SMC) with an approved safety management system⁶⁹ (SMS) onboard. All other statutory certificates of SE were valid at the time of the incident.
- 1.4.3 At the time of the collision, SE was on her ballast passage to Singapore, with draughts 6.3m (forward) and 8.3m (aft) with a 2m trim by the stern, for taking bunkers and change of crew. SE's visibility plan indicated, from the conning position (bridge) the minimum visibility⁷⁰ range as 188.771m in full loaded condition and 335.091m in ballast condition (see **figure 19**).

⁶⁹ SE has a valid SMC which signifies that the shipboard management operates in accordance with the approved safety management system as per the requirement of the International Safety Management (ISM) Code.

⁷⁰ SOLAS V/22 - Navigational bridge visibility - Ships of not less than 55m in length, shall meet the following requirements: 1) The view of the sea surface from the conning position shall not be obscured by more than two ship lengths, or 500m, whichever is the less, forward of the bow to 10° on either side under all conditions of draught, trim and deck cargo.

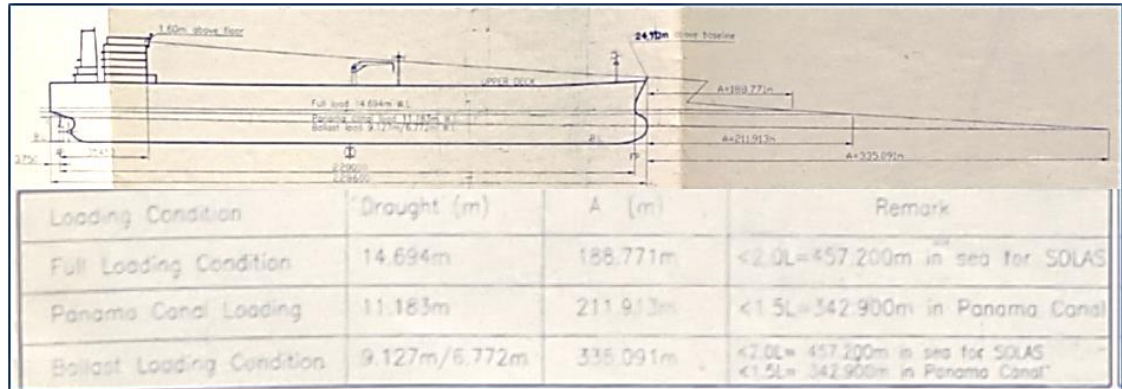


Figure 19 – SE's visibility plan table (Source: the Company)

1.4.4 On 5 February 2023 at 0659H, the Master of SE sent a request by email to Singapore pilots⁷¹ for SE's arrival at PEBGC to be 1800H. At 1122H the Master sent an amended arrival time of 1700H (based on a recalculated ETA). At about 1510H, Singapore pilots informed SE on VHF channel 20 for SE to arrive PEBGC at 1715H to avoid bunching⁷² at PEBGC.

1.5 Damage and additional information on SOL1 and SOL2

1.5.1 There was no damage to SOL1 as a result of the collision. SOL2's starboard quarter was damaged on the side wall and the hull in way of void tanks no. 7 and 8 starboards were ruptured and deformed with sea water ingress into the breached compartments. SOL2's bow ramp door also suffered damages, where the forward starboard end was sheared when it came into contact with SE's hull (see **figure 20**).

⁷¹ PSA Marine's Pilotage Services, Singapore's port pilotage service provider.

⁷² When too many vessels arrive at the same time.



Figure 20 – Hull damage on the barge SOL2 and damage bow ramp door (inset) (Source: SOL1)

- 1.5.2 SOL1 was a twin-screw coastal tugboat with bollard pull certified at 15.62T issued by BKI, installed with a towing hook for connection to the towline. All statutory certificates of SOL1 were valid at the time of the incident.
- 1.5.3 SOL2 was a non-propelled flat-top barge with side wall and bow ramp door for the carriage of cargo. The hull was divided by two longitudinal and seven transverse watertight bulkheads forming twenty-four spaces with a swim bow and stern. Skegs were fitted at the stern to improve tracking whilst under tow. Towing brackets were fitted at the bow of the barge to facilitate towing. All statutory certificates of SOL2 were valid at the time of the incident.
- 1.5.4 According to SOL1's Master and typical with tug and tow on cross-straits⁷³ towing voyages, SOL2 was rigged with towing equipment provided by the Operator. The main towing arrangement comprised stud link chains connected

⁷³ Tug and barge movement crossing the Singapore Strait.

by shackles to the ends of the split rope (bridle) spliced to the towing rope (towline), forming a 'Y' configuration (see **figure 21**).

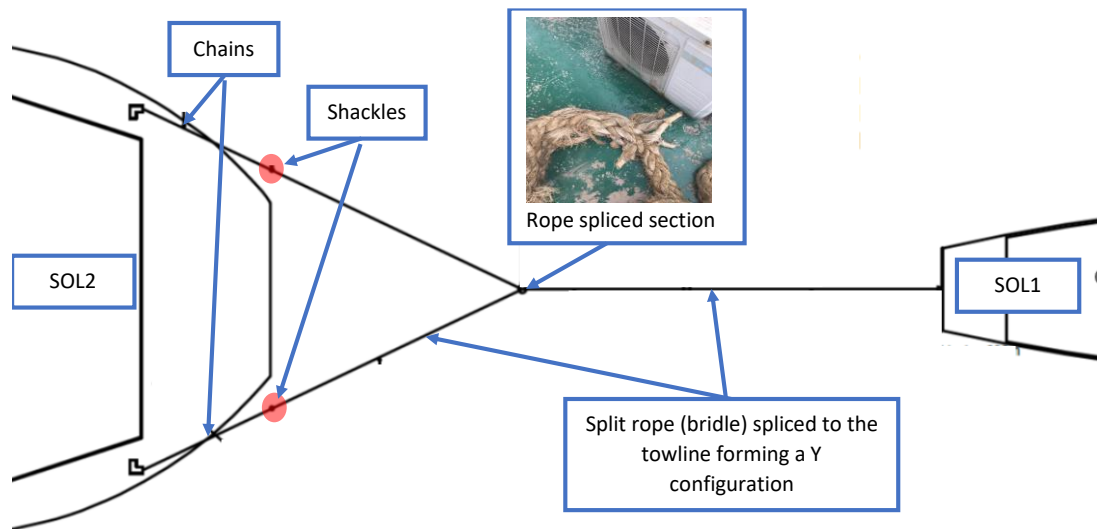


Figure 21 – Towing arrangement (not to scale) (*Source: the Operator and SOL1's Master – annotation by TSIB*)

- 1.5.5 SOL2's minimum required static bollard pull was 12T as certified by BKI. SOL2 had loaded 4390 tons of cargo with draughts 3.4m (forward) and 4.4m (aft) and towed by SOL1. The purpose of the bow ramp door at the forward is to facilitate the loading and discharge of cargo (see **figure 22**) which is lowered when the barge is beached or berthed. At sea the bow ramp door is lifted and secured at about 45° incline (which was the condition at the time of the collision).



Figure 22 – Bow ramp door lowered at berth, sample photo for reference
(Source: TSIB)

1.6 Navigation procedures and requirements

1.6.1 SE's passage plan as per SMS

- 1.6.1.1 A passage plan for SE was prepared by the 2O and approved by the Master on 28 January 2023 for SE's voyage from Gulei, China to Singapore. The plan included among others, information about the departure and arrival ports, nautical charts and publications to be used during the voyage, the waypoint list, and an information sheet (see **figure 23**) for various legs of the passage.
- 1.6.1.2 The information sheet provides the true course, leg distance, estimated speed, position verification, UKC⁷⁴, and remarks e.g., Master on conn and vessel on manual steering etc. The manning level for transiting 'SG Strait'⁷⁵ (Singapore Strait) is indicated as 4MH (red box in **figure 23**).

⁷⁴ Under keel clearance.

⁷⁵ 'SG Strait' is the waypoint name in the approved passage plan, it was the 14th of a 17 legs passage from Gulei, China to Singapore.

Voyage No : 027B Passage From : Gulei Passage To : Singapore Total DTG : 1637.9'										Position Verification V - Visual Bearing R - Radar Fix G - GPS C - Celestial Obs			Bridge watch M - ER Manned U - UMS H - Hand Steering A - Auto steering				
Way Pt	Way Point Co-ordinates		Location Area / Landmark (WP Name)	True Co.	Leg Dist.	Est. Spd.	Est time to next W.P Hrs	Position Verification		UKC Min ⁿ	Parallel Indexing / Leg reference			Bridge watch Level	Security Level	D T G	
	Nos	Latitude						Longitude	Method Primary/Secondary		Interval Max ⁿ (Mins)	Object	Brg				Dist
014	01	15.63 N	103 59.95 E	SG Strait	261	20	11.0	01.83	V/R	20	29.2	Tanah Merah	343	3.21'	4MH	1	05.4
Master on conn // Vessel on manual steering, Vessel approaching to pilot station // Continue monitoring traffic and VTIS for traffic updates // CATZOC A1																	

Figure 23 – ‘SG Strait’ leg of the passage plan with bridge watch level highlighted in red (Source: the Company)

1.6.1.3 The passage plan was part of the Navigational Safety⁷⁶ Manual chapter 3 - Planning and Execution, section 3.1 Passage Planning. It detailed among others the requirement that the passage plan –

- MUST be appropriately concise so that critical information is not lost in excessive details.
- MUST be approved by Master and understanding to be acknowledged by all OOW.
- MUST be prepared and approved prior to departure.
- MUST be prepared berth to berth.
- MUST be prepared on the company-approved format.
- MUST refer to the guidelines for any Hazardous Navigational Transits (Section 3.4). Risk assessment to be completed.

1.6.1.4 The Straits / Channels & Rivers section of the SMS for any Hazardous Navigational Transits denotes Singapore Strait as one of the areas where a risk assessment is to be carried out and submitted to the Company’s Office / Marine Team for their review and discussion.

1.6.1.5 The Master as the responsible person, together with the Chief Officer, OOWs⁷⁷ and Chief Engineer as team members are also responsible for making the risk assessment. The risk assessment detailed among others the work steps, hazards, control measures and remarks on briefing – stop work conditions. ‘Coastal navigation – Singapore Strait’ was the activity assessed on the risk assessment.

⁷⁶ The SMS Fleet Procedure’s Navigational Safety Manual comprised of 9 chapters.

⁷⁷ Second and Third Officers.

- 1.6.1.6 Amongst others, the hazard on change in position of object or personnel was identified and the control measure were (a) all actions must be substantial and made in good time, (b) use only log speed for collision avoidance calculations in ARPA, (c) efficient visual lookout posted and (d) actions required by the COLREGs and company procedures to be complied with.
- 1.6.1.7 According to the passage plan, SE's bridge watch composition⁷⁸ or bridge watch level was stated as 4MH⁷⁹. Noting that during the occurrence the composition was 3MA, the investigation team sought clarification from the Master, who further confirmed that based on his understanding of the SMS the minimum bridge watch level (see **figure 24**) for coastal waters was 3UA and that the correct bridge watch level for Singapore Strait TSS should have been 4SH⁸⁰ (as indicated in the SMS).

⁷⁸ SE's Navigational Safety Manual chapter 1 – Policy section 1.1 Watch composition.

⁷⁹ 4MH read with reference to **figure 24** would indicate; 4 - the number of personnel on the bridge to be four, M - the machinery space team composition in engine room manned with one duty engineer and one duty watchkeeping rating, and H - indicating hand steering.

⁸⁰ The bridge watch composition 4SH would indicate vessel in 'Confined Waters - In port / Harbours, Port approaches, Channels & Fairways' conditions as defined in the Navigational Safety Manual chapter 2 – Resource Management, section 2.1 Definitions / Abbreviations. SE was in Singapore's Port approaches at the 'SG Strait' leg of the passage.

Conditions			Master	OOW	Look - Out	Pilot	Steer	Engine Room	*Watch Level
Pilotage	All	All						S	5
Confined Waters	All	Clear weather						S	4
		Restricted Visibility						S	4
Coastal Waters	All	Clear weather	Option				A	U	2 or 3
		Restricted Visibility						M	3 or 4
Open Seas	Daylight	Clear weather			Option		A	U	1 or 2
		Restricted Visibility	Option				A	U	2 or 3
	Darkness	Clear weather					A	U	2
		Restricted Visibility	Option				A	U	2 or 3
At Anchor	Daylight	All			Option		-	U	1 or 2
	Darkness	All					-	U	2
STS operation	Underway	All			Option			S / M	2 or 3
	At Anchor	All	Anchor Watch Composition – If Mother Vessel						

*Watch Level indicates the number of bridge team members that are required to be present on the bridge.

- Legends
 - Mandatory
 - Option – Based on risk assessment (Optional members shall be readily available)
 - Steering – Hand steering (H) / Auto Pilot (A)
 - Change of Conn **MUST** be clearly communicated & recorded in the logbook.
 - Additional lookouts over and above the requirement may be posted upon the master’s discretion.
- Machinery Space Team Composition ER (Engine Room)
 - U - Unmanned – UMS watchkeeping
 - M - Manned – 1 xDuty Engineer + 1 xDuty watchkeeping (Rating)
 - S - Stand by for Manoeuvring – Chief Engineer or Second Engineer + 1 xDuty Engineer + 1 x Watchkeeping Rating

Figure 24 – Bridge watch composition (Source: the Company)

1.6.1.8 The Master was not able to provide any explanations or reasons for the mismatch of the requirements of the Company’s SMS with what was being practised at the time of occurrence.

1.6.2 Singapore Strait TSS routing system

1.6.2.1 Singapore Strait TSS is a ships’ routing system adopted by the IMO. Rules for vessels navigating through the Singapore Strait are provided in the publication IMO Ships’ Routing and in a circular⁸¹ reminding shipmaster on the safety of navigation in the Singapore Strait. Rules 8 states ‘All vessels navigating in the routing system of the Straits of Malacca and Singapore shall maintain at all times a safe speed consistent with safe navigation, shall proceed with caution,

⁸¹ Port Marine Circular no. 20 of 2006 - Safety of navigation in the Singapore Strait (MPA).

and shall be in a maximum state of manoeuvring readiness’.

1.6.2.2 The Master of SE in his interaction with the investigation team confirmed that he was aware of the circular and of the rules for vessels navigating through the Straits of Malacca and Singapore. Under the approved passage plan of 4MH manning level, a senior engineer was not required to standby the engines in a condition for manoeuvring readiness. The Master of SE clarified that the Chief Engineer was in the engine room during the SG Strait leg of the passage, but the engine was not in a condition for manoeuvring readiness until the Master began the adjustment on the engine telegraph to reduce engine rpm to 77 at 1611H (See para 1.1.23).

1.7 SOL1’s procedures and system

1.7.1 Procedures and order

1.7.1.1 According to the Master of SOL1, the Operator’s ship operating procedures were briefed to the Master before joining the ship and the Master in turn would disseminate the ship operating procedures to the ship’s crew. The Operator’s ship operating procedures⁸² includes the following:

- To ensure valid tug and barge certificates and port clearance are onboard.
- To ensure the tug and barge are seaworthy.
- To ensure navigation and safety equipment are available.
- To ensure all crew are properly certified.
- To ensure all crew adhere to company procedure.
- Master to report to company daily.

1.7.1.2 Along with the Operator’s ship operating procedures, the Master of SOL1 made a Master’s standing order⁸³ for all crew. The order is divided into three sections, ‘before sailing’, ‘during sailing’ and ‘in port’. The standing order includes the following:

Before sailing

⁸² As interpreted from Bahasa Indonesia.

⁸³ As interpreted from Bahasa Indonesia.

- To receive tug and barge certificates and port clearance from agent or Port Master.
- To ensure the tug and barge are seaworthy.
- To ensure good weather conditions for the transit.
- To ensure navigation and safety equipment are in operational condition.
- To ensure cargo is secured.
- To start the main engine one hour before departure and all crew are onboard.

During sailing

- Watchkeeper to maintain bridge watch.
- To check navigation equipment status at regular interval.
- To make logbook entry.
- To check vessel's position at regular interval.
- To report to VTIS.
- To observe COLREGs.
- To report to company daily.

In port

- To maintain cargo watch during load or discharge operation.
- To ensure the cargo is in good condition when cargo is onboard the barge.
- Do not throw garbage or oil into the port.
- To report to company daily.

1.7.1.3 The Operator's ship operating procedures and the Master's standing order were posted onboard SOL1 for all crew to read.

1.7.2 Bridge equipment

1.7.2.1 SOL1's bridge was equipped with a magnetic compass, GPS⁸⁴, X-band radar,

⁸⁴ Receiver for a global navigational satellite system.

AIS, VHF radio, and an echo sounder. The equipment were reported to be operational at the time of the incident. On the bridge were also the steering wheel and the main engine control throttles (see **figure 25**).

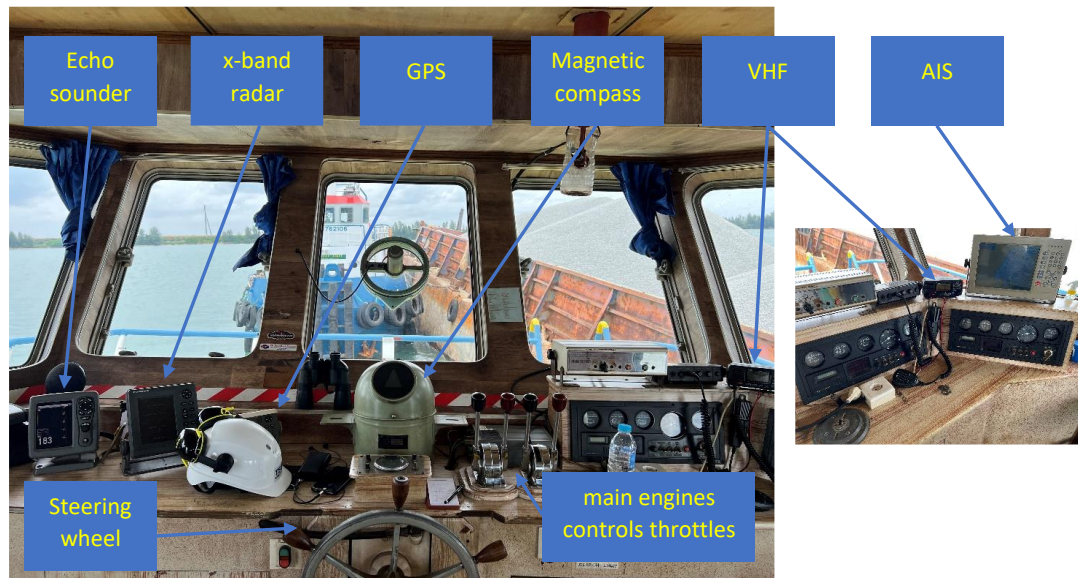


Figure 25 – SOL1's bridge equipment (*Source: TSIB*)

1.8 Meteorological and tidal information

- 1.8.1 On 5 February 2023 at 1800H, the weather recorded in SE's deck logbook indicated BF 3⁸⁵ with northerly winds and overcast sky. The tidal stream at 1600H was setting⁸⁶ on a direction of 057° at 2 knots⁸⁷.
- 1.8.2 The actual tidal stream experienced by the vessels at the collision location at 1600H were setting on a direction of 082° at 1.3 knots, calculated based on available data from SE's VDR.
- 1.8.3 According to VTIS East communication and the information received⁸⁸ from a merchant ship transiting STRAITREP Sector 9 of the Singapore Strait TSS (see

⁸⁵ Beaufort Scale – e.g., BF 3: 7-10 knots. Gentle Breeze. Large wavelets on sea., BF 4: 11-16 knots. Moderate Breeze. Small waves, fairly frequent white horses., BF 5: 17-21 knots. Fresh Breeze. Many white horses (Source: NP 100 The Mariner's Handbook).

⁸⁶ Set or setting is when a vessel is affected by a tidal stream, its movement over the bottom will be the resultant of two vectors, the course and speed through the water of the vessel and the direction and rate of the tidal stream (Source: D.A. Moore's Marine Chartwork – Adlard Coles Nautical publication).

⁸⁷ Singapore Tide Tables 2023, published by MPA.

⁸⁸ As heard from SE's VDR.

figure 26), the range of visibility at the time of the incident was about 7nm to 8nm.

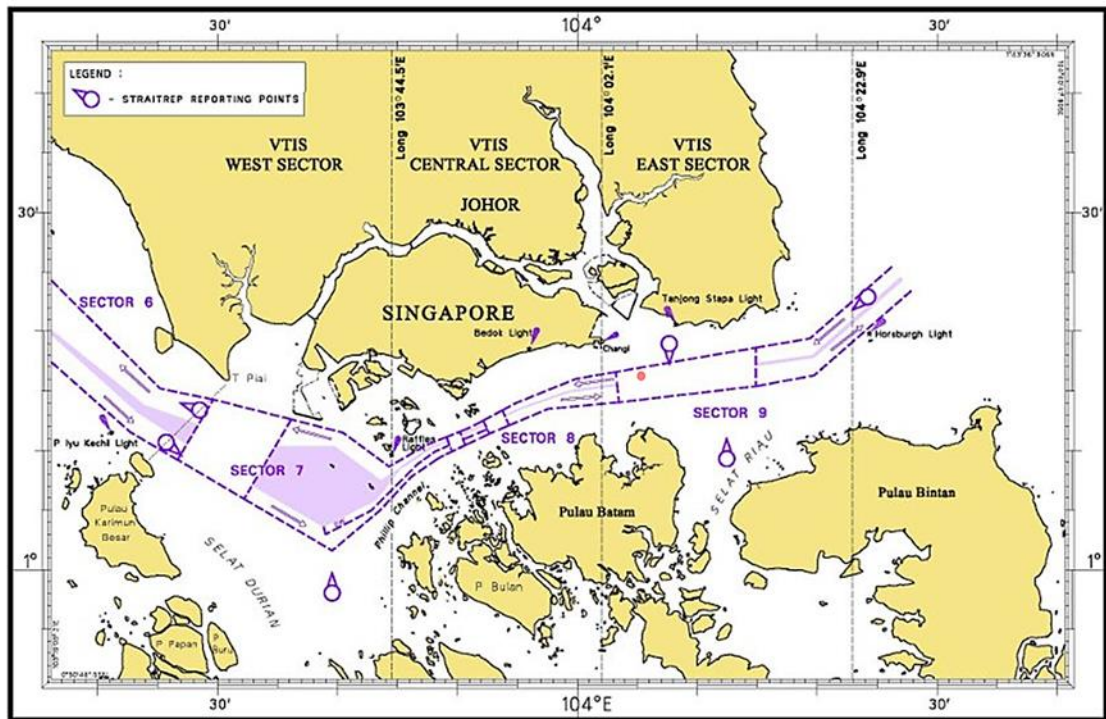


Figure 26 – VTIS East coverage area at STRAITREP Sector 9, red dot indicating collision location (Source: MPA – annotation by TSIB)

1.9 VTIS operations

1.9.1 MPA operates the VTIS from the Port Operations Control Centre (POCC), which integrates data from various sources including radars, the AIS, Closed Circuit Television System, VHF Communications System and vessel databases, to provide accurate and comprehensive understanding of the traffic in the Singapore Strait. The VTIS provides traffic advisories and information, based on vessels' reporting of their intentions (e.g. crossing of traffic lanes), and Masters are expected exercise their own professional judgement before actions are taken, the VTIS does not give traffic instructions nor grant permission. A Watch Manager (WM) is the overall in-charge of the centre and oversees the operators under its shift.

- 1.9.2 VTIS East was manned by an operator who had relevant training⁸⁹ as per model courses approved by the International Association of Marine Aids and Lighthouse Authorities (IALA). The operator who manned the station before 1600H had been performing this role in VTIS for more than 15 years, while the operator who manned the station after 1600H had been performing this role in VTIS for more than 5 years.
- 1.9.3 The VTIS has the ability, amongst others, to provide the operator with visual alerts⁹⁰ (colour coded vector line) at the operator's screen. Depending on the colour of the vector line, the operator is then required to provide relevant traffic advisories for vessel awareness of the risk of collision and take corrective actions accordingly (using the following message markers), Red – Warning, Amber – Advice, and Green – Information.
- 1.9.4 Records from VTIS indicated that an amber visual alert was triggered at 35s after 1608H which persisted until 46s after 1609H when a red visual alert was triggered between SE and SOL2. The VTIS operator clarified that the necessary traffic information and advisory on the intention of SOL1 and SOL2 crossing had been provided to SE at 1604H. Thereafter the VTIS operator attended to other traffic conditions which were also developing at that time. He did not give further traffic advisory when the visual alerts were triggered relating to SE and SOL2.

⁸⁹ IALA Model Course V-103/1 VTIS Operator's Certification.

⁹⁰ When vessels vector line meets, the colour of the vector line (default colour is white) will change indicating the approximate time before a collision, with Red – triggered 5 minutes before a collision, Amber – triggered 7 minutes before a collision, and Green – triggered 10 minutes before collision.

2 ANALYSIS

2.1 SE, in ballast condition, and the tug and tow (SOL1 and SOL2) with SOL2 in loaded condition, were in the Precautionary Area with SE westbound proceeding to PEBGC and the tug and tow northbound heading towards Eastern Buoy. The visibility was good in daylight condition and the tidal stream was setting on a direction of 082° at 1.3 knots prior to the collision. The investigation team analysed the following areas that led to the collision:

- (i) actions of the bridge team of SE
- (ii) bridge watch composition and passage plan of SE
- (iii) actions of the bridge team of SOL1
- (iv) bridge manning level of SOL1
- (v) actions of VTIS East

2.2 Actions of the bridge team of SE

2.2.1 The Master of SE was aware of the other vessels and their arrival time at PEBGC from the email sent by PSAM at 1515H on the day of occurrence and at 1548H VTIS East provided SE with information of other vessels ahead of SE arriving at PEBGC. The Master of SE evaluated the information and determined that SE would arrive at PEBGC ahead of FK and intended to overtake FK on its starboard side.

2.2.2 The 2O of SE reported the crossing of SOL1 and SOL2 to the Master at about 1601H. Thereafter at about 1604H VTIS East informed SE that SOL1 and SOL2 would be crossing ahead of SE which was acknowledged by the bridge team of SE. There was no further active reporting by the 2O or the lookout ASD regarding the crossing of SOL1 and SOL2 to the Master until the collision.

2.2.3 After acknowledging VTIS East information regarding the crossing of SOL1 and SOL2, the 2O of SE proposed to the Master to make alteration to port to give way to SOL1 and SOL2, of which the Master replied, 'no need, it's OK' and indicated to the bridge team of his intention to slow down but did not do so to slow down. The Master of SE instead plan to slow down SE at the end of the 'SG Strait'⁹¹ leg of the passage, a plan which was not shared with the bridge

⁹¹ On the 'SG Strait' leg of the voyage, SE had maintained a steady COG of about 261° (Heading of about 261°) and an average SOG of about 10 knots (STW of about 11 knots) up until the moment of the collision.

team. The investigation team opined that after the 20's proposal, the Master of SE should reassess if risk of collision with SOL1 and SOL2 existed and to slow down SE if needed, to allow more time to assess the situation.

2.2.4 The Master of SE determined that SE as the 'stand on' vessel whereas SOL1 which was towing SOL2, as the 'give way' vessel according to COLREGs and hence determined to keep SE's course and speed. The Master, in keeping SE's course and speed, failed to assess that SOL1, which was the give way vessel, was not giving way to SE and did not take the appropriate action to alter the course of, or slow down, SE.

2.2.5 The Master of SE had relied mainly the ARPA radar information (relative vector line⁹² of SE) for his appraisal of the situation and the risk of collision. The Master had determined that SOL2 would pass clear of SE. While the assessment at that moment could indicate that SOL2 would clear SE's bow, the investigation team opined that had the bridge team made continuous observation of SOL2 using visual compass bearing⁹³, they would have determined the risk of collision existed when the compass bearing of SOL2 did not appreciably change (see **figure 27**). There seems to be a lack of BRM for an effective communication, teamwork, and decision making on the bridge, on the part of SE's bridge team members.

⁹² The Master of SE's interpretations of the ARPA radar information and observations of SOL2's relative vector line indicated that SOL2, which was being towed by SOL1, would pass SE on the starboard side after crossing SE's bow.

⁹³ COLREG Rule 7 Risk of Collision –

- (d) In determining if risk of collision exists the following considerations shall be among those taken into account:
- (i) such risk shall be deemed to exist if the compass bearing of an approaching vessel does not appreciably change; and
 - (ii) such risk may sometimes exist even when an appreciable bearing change is evident, particularly when approaching a very large vessel or a tow or when approaching a vessel at close range.

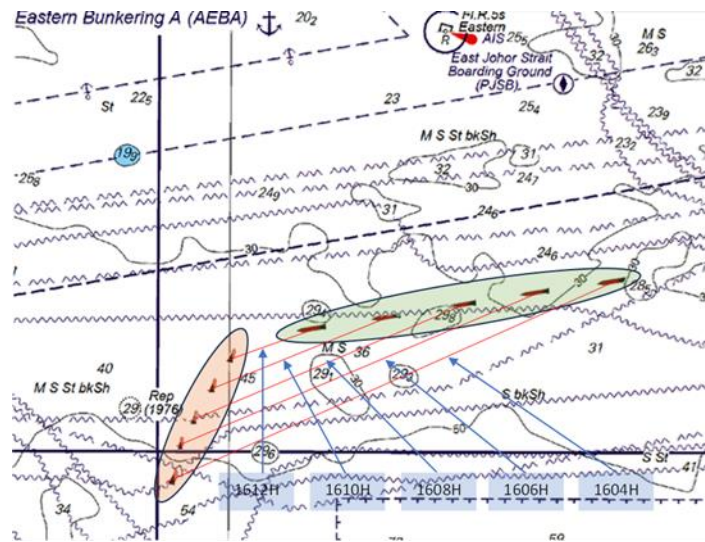


Figure 27 – Positions of SE shaded green and SOL2 shaded orange with bearing line in red which did not appreciably change, from 1604H to 1612H (Source: TSIB)

- 2.2.6 The Master and 2O of SE were engaged in a conversation regarding a vessel at anchor moments before the collision. It would be desirable that the Master and 2O observed⁹⁴ the attention necessary when navigating in the Precautionary Area. Their focus of attention to the developing close quarter situation was diminished and valuable time for the assessment of the risk of collision was wasted. This may have contributed to the delay in taking collision avoidance action at about 1612H.
- 2.2.7 The Master of SE took collision avoidance action at 1612H when he instructed the ASD lookout to commence hand steering. At this time SOL2 was not visible from SE's conning position (bridge) as SOL2 was below the minimum visibility range. The occurrence demonstrated the importance of giving full attention to the surrounding when navigating the Precautionary Area in order to have full appraisal of the situation.
- 2.2.8 The Master of SE probably did not account for the tidal stream effect on SOL1 and SOL2. When SOL1 and SOL2 was transiting northbound, the easterly tidal stream had set both SOL1 and SOL2 towards the path of SE. Additionally, the investigation team noted that the bridge team of SE, in their watchkeeping and lookout duties, was passive and did not continue to apprise the Master on the

⁹⁴ STCW Code Chapter VIII / Section A-VIII/2 – Part 4-1 – Principles to be observed in keeping a navigational watch.

crossing of SOL1 and SOL2.

2.2.9 As SE's heading was reciprocal to the direction of the tidal stream, there was minimal or no change to SE's heading, but SE's speed was effectively reduced by the easterly tidal stream. The effect of the easterly tidal stream had likely affected the Master of SE's decision of not to slow down before the 'SG Strait' leg of the passage in order not to delay the pilot pick up time of 1715H.

2.3 Bridge watch composition and passage plan of SE

2.3.1 The bridge watch composition for the 'SG Strait' leg of the passage was 3MA which differs from the approved passage plan of 4MH, which is also different from the SMS requirement of 4SH. SE was on auto-pilot mode at the 'SG Strait' leg, instead of the hand steering mode listed in the approved passage plan, which also required another ASD to be on the bridge.

2.3.2 The 2O of SE who had prepared the passage plan was aware that the bridge watch composition for the 'SG Strait' leg of the passage did not meet the requirements of the bridge watch composition in the approved passage plan. The 2O did not raise this concern to the Master. The 2O who prepared the passage plan was probably uncertain on the definition of confined waters (in port / harbours, port approaches, channels and fairways) of the SMS and did not consider the requirements of confined waters when preparing the passage plan.

2.3.3 The Master of SE was aware that the bridge watch composition for the passage was different from the approved passage plan and did not meet the requirement of the SMS for the passage in the Singapore Strait TSS. The Master had deviated from the requirement of the SMS on the bridge manning level and did not ensure watchkeeping arrangements were adequate for maintaining a safe navigational watch while transiting the 'SG Strait' leg. The Master did not give an explanation for deviating the SMS requirement.

2.3.4 Under 4MH (approved passage plan), a senior engineer is not required to be in the engine room to standby the engines for manoeuvring and thus the engines may not be in a condition readily for manoeuvring, this did not meet the Singapore Strait TSS's routing system rule to maintain maximum state of manoeuvring readiness. Although the Master clarified that the Chief Engineer was in the engine room during the 'SG Strait' leg of the passage, it is unclear

whether Chief Engineer knew that his responsibilities was to ensure that the engine was in a condition for manoeuvring readiness.

2.3.5 The investigation team also noted from the approved passage plan of SE that the bridge watch composition of SE on the 'AEPA'⁹⁵ leg (in Singapore port / Pilotage) should have been 5SH as indicated in the SMS (see **figure 24**), instead of 5MH (see **figure 28**).

Way Pt		Way Point Co-ordinates		Location Area / Landmark (WP Name)	True Co. Deg	Leg Dist. NM	Est. Spd. Kts	Est time to next W.P. Hrs	Position Verification Method Primary/ Secondary	Interval (Mins)	UKC (Mtrs)	Parallel Indexing / Leg reference			Bridge watch Level	Security Level (Marsec)	D T G (NM)
Nos	Latitude	Longitude	Object									Brg	Dist				
017	01	15.44 N	103 54.93 E	AEPA	261	3	03.0	00.96	V/R	20	12.4				5MH	1	00.0

Voyage No : 027B
 Passage From : Gulet
 Passage To : Singapore
 Total DTG : 1637.9'

Position Verification: V - Visual Bearing, R - Radar Fix, G - GPS, C - Celestial Obs
 Bridge watch: M - ER Manned, U - UMS, H - Hand Steering, Auto steering

Arrival at AEPA anchorage // Additional security measures in place reports of unauthorized boarding while ship at anchor stay vigilant // Send AMVER FR // Continue to report in IFC Reporting // FEV // Echo sounder printer off // Master off conn // CATZOC A1

Figure 28 – Passage plan of SE (Source: the Company)

2.4 Actions of the bridge team of SOL1

2.4.1 The CO and the Oiler was on the bridge of SOL1 during the crossing of the Precautionary Area towards Eastern Buoy. The CO had reported the crossing to VTIS East and had assumed that SOL1 had been given permission by VTIS East to cross. The CO began the crossing by steering SOL1 and SOL2 in the direction of the Eastern Buoy (see **figure 29**).

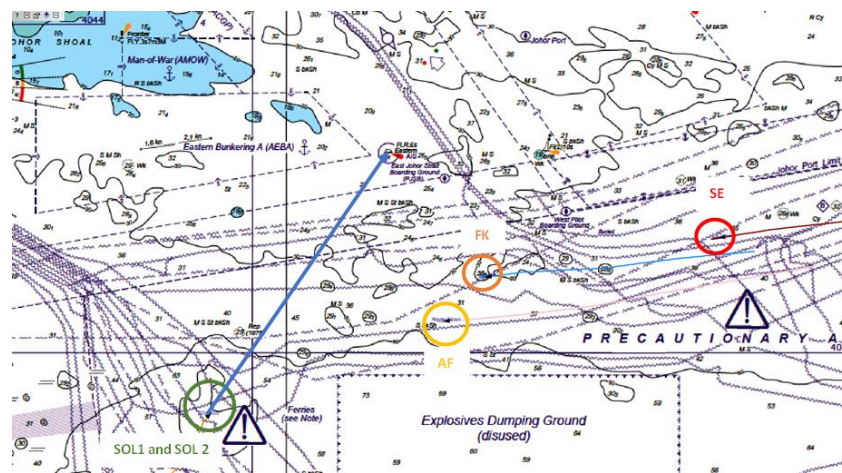


Figure 29 – SOL1 and SOL2 circled green with heading in blue arrow line towards Eastern Buoy (Source: TSIB)

⁹⁵ Eastern Petroleum 'A' Anchorage, an anchorage in the Singapore port where movement requires pilot.

2.4.2 The CO observed three vessels (AF, FK, and SE) proceeding westbound when commencing the crossing of the Precautionary Area towards Eastern Buoy. The CO manoeuvred SOL1 and SOL2 to pass astern of AF (see **figure 30**) and thereafter pass astern of FK (see **figure 31**).

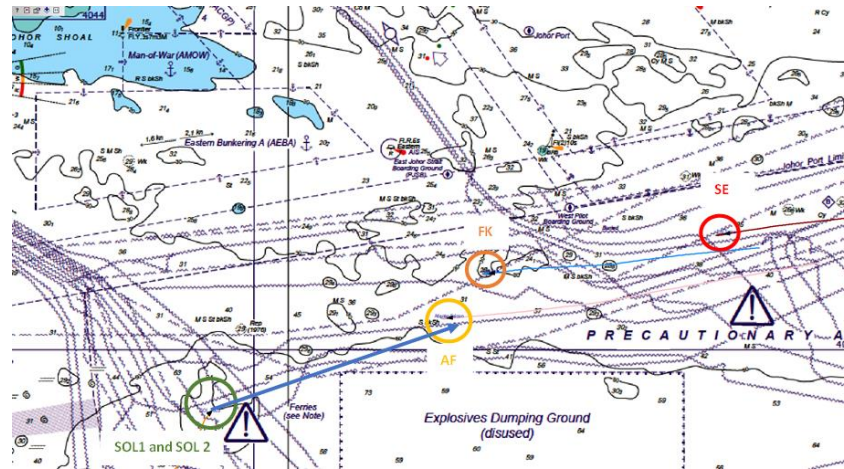


Figure 30 – SOL1 and SOL2 circled green with heading in blue arrow line to pass astern of AF circled yellow (Source: TSIB)

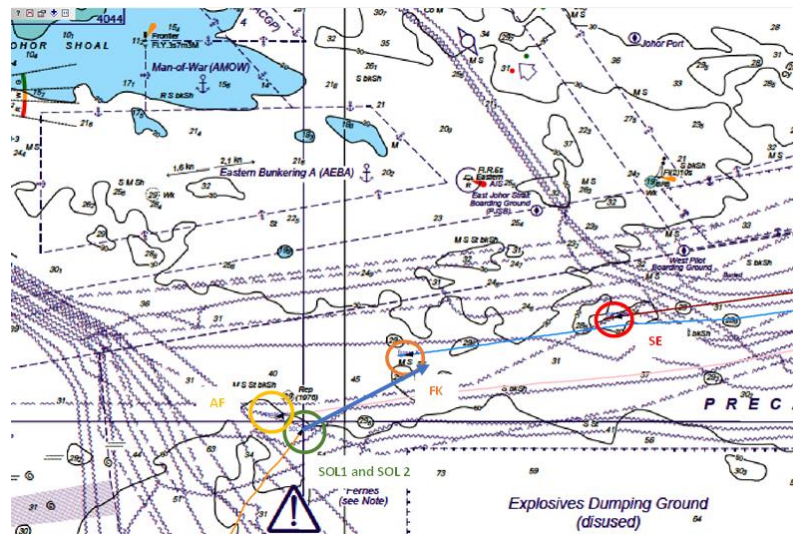


Figure 31 – SOL1 and SOL2 circled green with heading in blue arrow line to pass astern of FK circled orange (Source: TSIB)

2.4.3 At about 1609H, from the AIS information, the CO observed that SE was about 1nm away and decided to continue heading towards Eastern Buoy, instead of passing the astern of SE (see **figure 32**).

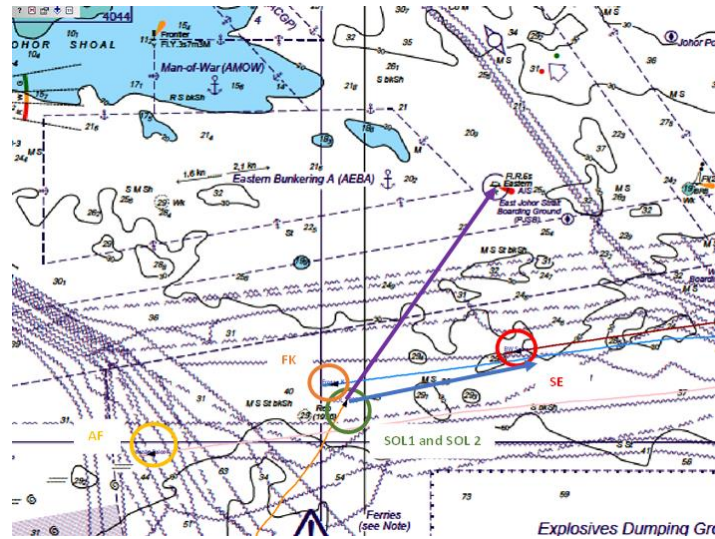


Figure 32 – SOL1 and SOL2 circled green with heading in purple arrow line towards Eastern Buoy and with blue arrow line indicating the possible route to pass astern of SE circled red (*Source: TSIB*)

- 2.4.4 The CO had assessed the distance of 1nm was sufficient for SOL1 and SOL2 to pass clear ahead of SE without using radar and compass to determine if the risk of collision exists. Although the CO called SE on the VHF channel 10 (VTIS East working channel), he received no response.
- 2.4.5 The CO’s assessment of the risk of collision was based on the distance obtained from the AIS and the assumption that SE was aware that SOL1 and SOL2 had been granted permission by VTIS East to cross the Precautionary Area. The CO did not make continuous assessment of SE using visual compass bearings which would have determined that risk of collision existed when the compass bearing of SE, an approaching vessel did not appreciably change (see **figure 27**) and take action to avoid the collision.
- 2.4.6 The CO also did not make assessment of SE on the radar, instead tried to call SE on the VFH channel 10 (VTIS East working channel) at 1609H to raise SE’s attention on SOL1 and SOL2 locations. After failing to get a response from SE, the CO continued SOL1’s course towards Eastern Buoy. The CO was unaware that a close quarter situation was developing, and risk of collision existed.
- 2.4.7 The CO should have taken collision avoidance action according to COLREGs instead of trying to contact SE on VHF which resulted in valuable time wasted. In determining risk of collision, the CO had relied on the AIS and VHF. As SOL1

which was towing SOL2 was the 'give way' vessel in the crossing situation, if risk of collision existed, the CO should have observed COLREGs⁹⁶ and taken collision avoiding action that would allow passing SE at a safe distance.

2.4.8 The Master upon hearing the VHF calls made by the CO had decided to take over the conn of SOL1. The CO informed the Master that VTIS East had granted permission for SOL1 and SOL2 to cross the Precautionary Area and SE was about 1nm away from SOL1 and SOL2.

2.4.9 The Master of SOL1 continued to steer SOL1 and SOL2 towards Eastern Buoy and at 1611H observed the heading of SE unchanged (see **figure 33**) and from the perspective of the Master, SOL1 had just crossed SE's bow from port to starboard. The Master was aware that SOL2 was still on the port side of SE's bow, altered SOL1 course to starboard⁹⁷.

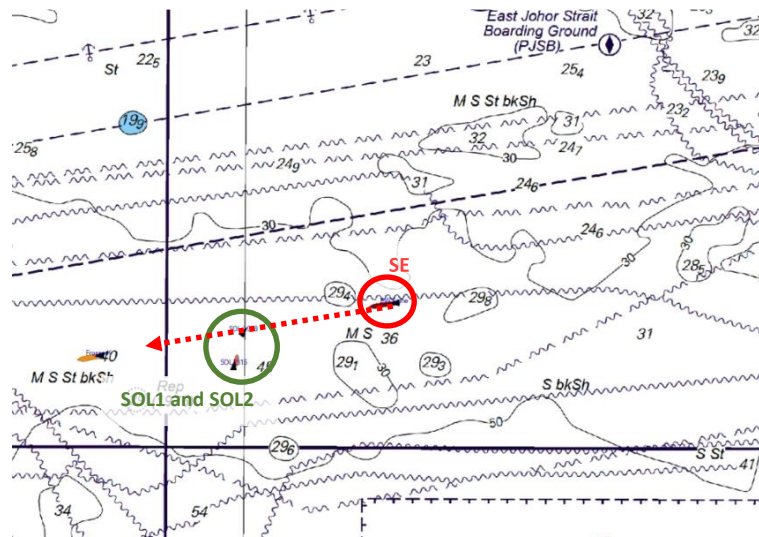


Figure 33 – SE's (circled red) heading at 261° in dashed red line with SOL1 and SOL2 (circled green) ahead of SE. (*Source: the Company and TSIB*)

2.4.10 The course changed by the Master had probably caused the pulling tension of the towline to decrease which resulted in the reduction of SOL2's ahead movement, albeit residual ahead momentum. The reduction of SOL2's ahead movement, coupled with the effect of the easterly tidal stream, had placed SOL2 in the path of SE and had consequently resulted in a collision.

⁹⁶ COLREG Rule 16 Action by Give-way Vessel -Every vessel which is directed to keep out of the way of another vessel shall, so far as possible, take early and substantial action to keep well clear.

⁹⁷ It was recorded SOL1 made about 49° course change to starboard from COG 024.2° to 072.9° until the collision.

2.4.11 It is desirable for the Master to make full appraisal of the situation to determine risk of collision when he took over conn from the CO. The Master should have taken immediate collision avoidance action after taking over conn from the CO and avoid crossing ahead of SE.

2.5 Bridge manning level of SOL1

2.5.1 Prior to the Master of SOL1's arrival on the bridge, the bridge composition of SOL1 comprised the CO and Oiler. The Oiler was placed on helm duty and was not certified⁹⁸ as a rating forming part of a navigational watch.

2.5.2 The Master of SOL1 did not ensure that the watchkeeping arrangements⁹⁹ were adequate for maintaining a safe navigation watch by placing the Oiler on helm duty. There were available deck ratings certified for navigational watch onboard whom the Master could use for the helm duty. The CO also did not raise the issue of using a non-certified rating for navigational watch to the Master.

2.5.3 Master of SOL1 had followed the Operator's instructions for the Oiler to be placed on helm duty. The Operator did not ensure that SOL1 was manned in compliance with the safe manning requirements¹⁰⁰ in its instructions to place a non-certified rating performing navigational watch on helm duty.

2.6 Actions of VTIS East

2.6.1 The CO of SOL1 had wrongly interpreted the response of VTIS East as a permission to cross the Precautionary Area. In any case, the bridge team of SOL1 should maintain vigilant, comply with COLREGs and at all times make full appraisal of the situation using all available means appropriate in the prevailing circumstances.

2.6.2 VTIS East had provided SE with information regarding the crossing of SOL1 and SOL2, which was acknowledged by SE. The VTIS East operator, which was monitoring and managing other traffic conditions at the time, did not give further traffic advisory when the visual alerts were triggered. The dynamics of the traffic situation and the VHF calls handled during that period had probably contributed

⁹⁸ STCW Code - A-II/4 Mandatory minimum requirements for certification of ratings forming part of a navigational watch.

⁹⁹ STCW Chapter VIII – Watchkeeping / Regulation VIII/2 – Watchkeeping arrangements and principles to be observed and STCW Code - A-VIII/2 Watchkeeping arrangements and principles to be observed.

¹⁰⁰ STCW Chapter I – General provisions / Regulation I/14 – Responsibilities of companies and STCW Code - A-I/14 Responsibilities of companies.

to the VTIS East operator not providing further reminders to SE and SOL1 on the risk of collision. It would be desirable for the VTIS East operator to request assistance on the developing situation before attending to other traffic conditions.

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 SE and SOL2 (towed by SOL1) collided in the Precautionary Area of the Singapore Strait TSS under clear weather conditions and good visibility.
- 3.2 The bridge team of SE did not make a full appraisal of the situation when advised by VTIS East of the crossing of SOL1 and SOL2. The bridge team of SE also did not apply principles of effective BRM and did not make continuous assessments using visual compass bearing to determine the risk of collision.
- 3.3 The Master of SE did not account for the tidal stream effect which had brought SOL1 and SOL2 towards the path of SE.
- 3.4 The Master and 2O of SE had not made proper applications of the SMS procedures with regards to the bridge watch composition and the watch level mentioned in the passage plan was made without following the Navigational Safety Manual.
- 3.5 The CO of SOL1 had misinterpreted the response of VTIS East of SOL1 and SOL2's intention to cross the Precautionary Area as a permission granted and the other vessels would keep clear to the tug and tow.
- 3.6 The CO of SOL1 was relying on AIS and VHF communication for collision avoidance and did not comply with the crossing situation rule in accordance with COLREGs.
- 3.7 The Master of SOL1 did not make full appraisal of the situation to determine risk of collision after taking over the conn from the CO.
- 3.8 The Master of SOL1 had followed the Operator's instruction and did not comply with the safe manning requirements by deploying a rating who was a non-certified rating to be on helm duty.
- 3.9 The Operator of SOL1 and SOL2 did not ensure that SOL1 was manned in compliance with the safe manning requirements, in ensuring qualified and certified person is deployed for navigational duty.

3.10 At about 10 mins prior to the collision the VTIS East operator provided traffic advisory to SE on SOL1 and SOL2 movements and their intention to cross ahead of SE. The VTIS East operator attended to other developing traffic conditions and did not give further traffic advisory when the visual alerts between SE and SOL2 were triggered at about 5 mins prior to the collision.

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 Changes made to the Straits / Channels & Rivers section of the Navigational Safety Manual, which provided clarity for the need of compliance to the watch composition level of “Confined waters”, and “Pilot” conditions.
- 4.1.2 Dynamic navigation audit in Singapore Strait included into the Company’s navigation audit criteria, with the objective of a comprehensive review through observation¹⁰¹ of navigational practices during a voyage in the Singapore Strait by an auditor¹⁰² onboard a vessel¹⁰³.
- 4.1.3 Reflective learning¹⁰⁴ developed after the incident and shared with the ship’s crew during annual onboard training sessions by the onboard trainers of which officers and ratings were reiterated to challenge / seek clarification from senior officers when in doubt.
- 4.1.4 Changes made to the Company’s Competence Management Matrix:
 - Requiring Master to attend the Continuous Learning for Master¹⁰⁵ (CLM) course prior to joining a vessel.
 - Requiring OOWs to attend a Bridge Team Management¹⁰⁶ (BTM) course prior to joining a vessel.

¹⁰¹ The following are amongst the items observed: i) Implementation of BRM principles by bridge team, ii) COLREGs compliance, iii) Interaction with VTIS, and iv) Utilisation of all available means to determine risk of collision including visual compass bearings.

¹⁰² The audit by the Fleet Training Superintendents focuses on the effectiveness of the Bridge Team Management (BTM) during arrival departure ports and in areas of high-density traffic and the bridge composition levels during the passages.

¹⁰³ As of 29 November 2023, 25% of the Company operated vessels has completed the dynamic navigation audit in Singapore Strait.

¹⁰⁴ As of 29 November 2023, 69% of the Company operated vessels has completed the Reflective learning.

¹⁰⁵ Amongst the topics covered were simulator training, ECDIS, incident case study, vessel anchoring, vessel departing Singapore and vessel at Suez Canal. Training was conducted by an external training providers either in India or the Philippines.

¹⁰⁶ The course is based on guidelines from IMO Model Course 1.22 - Bridge Resource Management. Training was conducted by an external training providers either in India or the Philippines.

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.

It is recommended that:

5.1 For the Operator of SOL1 and SOL2

5.1.1 To ensure qualified and certified personnel are assigned for navigational duty. [TSIB Recommendation RM-2024-009]

5.1.2 To ensure the Master and Officers adhere to COLREGs rules. [TSIB Recommendation RM-2024-010]

5.2 For Singapore VTIS

5.2.1 To encourage VTIS operator to request assistance when needed. [TSIB Recommendation RM-2024-011]