

Final Report

COLLISION

**TANKER SHUN SHENG
AND
BARGE KOI 5 (TOWED BY TUG KOI 3)**

**AT SINGAPORE
TRAFFIC SEPARATION SCHEME
SOUTH OF SUDONG ANCHORAGE**

7 FEBRUARY 2019

MIB/MAI/CAS.060

Transport Safety Investigation Bureau
Ministry of Transport
Singapore

24 May 2021

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.

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Table of Contents

SYNOPSIS	1
1 FACTUAL INFORMATION	7
1.1 Narrative	7
1.2 Inspection of Koi 3 and Koi 5	25
1.3 Search and Rescue Operation	28
1.4 Crew information of Koi 3 and Koi 5	29
1.5 Crew information of SS	31
1.6 Bridge Resource Management and SMS Procedures	32
1.7 The tug and tow light arrangement	33
1.8 Additional information	34
1.9 Location of occurrence	35
1.10 Environmental Factors	36
2 ANALYSIS	37
2.1 Conduct of navigation and passage planning by the tug and tow	37
2.2 Identification of the tug and tow	39
2.3 Conduct of navigation by SS	39
2.4 Loss of situational awareness by the crew of SS	40
2.5 Plotting SS' position	41
2.6 Maintenance and use of shipboard equipment	41
2.7 Capsize of the tug	42
2.8 Incidental observations	42
3 FINDINGS	43
4 SAFETY ACTIONS	45
5 SAFETY RECOMMENDATIONS	46

SYNOPSIS

On 7 February 2019 at about 0454H, the Hong Kong¹ registered chemical tanker “Shun Sheng” and the Sierra Leone registered barge “Koi 5” which was under tow by the Sierra Leone registered tug “Koi 3” were involved in a collision, about 0.78 nautical mile (nm) south of Raffles buoy, within Singapore territorial waters, in the westbound lane of the Traffic Separation Scheme (TSS). At the time of the collision, the weather was fine, and the visibility was between 3nm to 5nm.

Before the collision, the tanker in loaded condition² was enroute to Lumut, Malaysia, and was heading in the westbound lane of the TSS in Singapore territorial waters and doing about 12 knots (kt)³.

The tug towing the barge in loaded⁴ condition, was on northerly heading⁵ at 1.5kt, towards Raffles buoy. The tug was planning to exit the TSS and was bound for Sudong Special Purpose Anchorage⁶.

The collision between the tanker and the barge caused material damage⁷ and water ingress into the barge and girting of the tug which then capsized and sank. The tanker did not sustain material damage and remained fit to continue passage. Two of the six crew members from the tug were reported missing, while four were rescued from the sea.

The Maritime and Port Authority of Singapore (MPA) issued a safety broadcast, initiated surface Search and Rescue (SAR) operations, including diving operations to search for the two missing crew members inside the capsized tug. The bodies of the two missing crew members were later discovered inside the capsized tug.

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

The investigation revealed that the barge being towed was inadequately lit and not visible to the bridge team of the tanker and posed a danger to the safety of navigation. The investigation also revealed that the tug’s passage within the TSS was altered

¹ Hong Kong-Special Administration Region of the People’s Republic of China.

² Carrying about 3282.294 metric tonnes (mt) of Nitric Acid in bulk.

³ 1kt is a unit of speed equal to one nautical mile (1852m) per hour.

⁴ Carrying about 5000mt of cargo.

⁵ Koi 3 was attempting to move out of the TSS at various headings and was affected by the strong prevailing current.

⁶ Situated within Singapore Port Limit.

⁷ Material damage in relation to a marine casualty as determined by Casualty Investigation Code para 2.16, means:

- Significantly affects the structural integrity, performance or operational characteristics of marine infrastructure or of a ship; and
- Requires major repair or replacement of a major component or components; or
- Destruction of the marine infrastructure or ship.

prematurely and the tug was not fitted with a gob rope that would have avoided girting and minimised the chances of the tug to capsize. The doors, windows and other openings of the tug were in open position which resulted in rapid flooding of the tug giving very little reaction time to the crew.

The tanker was navigated at lower bridge watchkeeping level than what had been prescribed within the SMS and did not have a dedicated lookout. As a result, the situational awareness on the tanker was compromised and weak and the bridge team had not utilised all available means for making an informed decision. There were also indications of an ineffective implementation of the SMS.

VIEW OF THE VESSELS



Figure 1 - Image of the tug Koi 3 at repair yard after salvaged (Source: TSIB)



Figure 2 – Image of Barge Koi 5 viewed from the port quarter (Source: TSIB)



Figure 3 – Image of tanker Shun Sheng (*Source: TSIB*)

DETAILS OF VESSELS

Name	Tug - Koi 3	Barge - Koi 5	Shun Sheng (SS)
IMO No. / Official No.	SLR10301	SLR 10302	9279692
Flag	Sierra Leone	Sierra Leone	Hong Kong, China
Classification Society ⁸	SING-LLOYD	SING-LLOYD	Nippon Kaiji Kyokai (Class NK)
ISM RO ⁹	N.A. ¹⁰	N.A.	Class NK
Ship Type	Tugboat	Non-propelled, steel flat top deck cargo barge	Oil & Chemical Tanker
Builder	Kiong Nguong Shipbuilding Contractor Co., Ltd., Malaysia	P.T. Marco Polo Shipyard, Indonesia	Shin Kurushima Dockyard Co., Ltd, Japan
Year	January 1995	2008	June 2002
Owner	King Ong Trading Pte. Ltd	King Ong Trading Pte. Ltd	Xiangyuan International Shipping
ISM Manager ¹¹	N.A.	N.A.	Shang Hai Rainbow International Ship Management Co. Ltd.
Gross tonnage	98	1807	5376
Length overall	20.51m	73.15m	113.98m
Breadth moulded	6.10m	21.34m	18.20m
Depth moulded	3.05m	4.57m	9.65m
Draught (Mean)	2.073m	3.7m	7.478m
IMO line of sight	N.A.	N.A.	112m (forward blind distance)
Summer Freeboard	0.977m	0.7m	2.216m

⁸ Classification Society also referred to as a Recognised Organisation (RO), which means an organisation that has been assessed by a flag State and has the delegation of authority to perform statutory certification and services on behalf of the flag State.

⁹ RO conducting survey and certification for International Safety Management (ISM) Code for the Safe Operation of Ships and for Pollution Prevention.

¹⁰ ISM applies to "...other cargo ships and mobile offshore drilling units of 500 gross tonnage and upwards...".

¹¹ Responsible for the operation of the ship to carry out all duties and responsibilities imposed by the ISM Code.

Main Engine(s)	Twin diesel engines MCR 474Kw	N.A.	B&W 6L35MC (MARCK 6) MCR 3900kW x 210 kW x 120rpm
Propeller	Twin propeller	N.A.	1 x Right-Hand propeller
Voyage Data Recorder	N.A.	N.A.	Simplified (S-VDR) ¹²
AIS ¹³	Fitted	Not fitted	Fitted

Table 1

¹² In accordance with requirements for a vessel of its size. S-VDR is not required to record radar images.

¹³ Automatic Identification System. An AIS transponder is of two types (A and B). Transponder A-type provides information – including ship's identity, type, position, course, speed, closest point of approach (CPA), time to CPA (TCPA), navigational status and other safety related information – automatically to appropriately equipped shore stations, other ships and aircraft. AIS transponder B-type fitted on Koi 3 is typically meant for non-SOLAS vessels and has limited information to be transmitted, which includes, identity of the vessel, position, course, speed. There is no requirement for a non-propelled barge to be fitted with AIS transponder. Refer SOLAS V/19- Carriage Requirement for AIS.

1 FACTUAL INFORMATION

All times (H) used in this report are in Singapore local time, which is eight hours ahead of Coordinated Universal Time (H=UTC¹⁴ + 8H).

The investigation team utilised the Marine Accident Data Analysis Suite (MADAS¹⁵) to obtain a holistic picture of movements of relevant vessels and developments prior to the occurrence.

1.1 Narrative¹⁶

According to the crew of Koi 3

1.1.1 In the early morning of 6 February 2019, the tug, Koi 3, towing¹⁷ the barge, Koi 5¹⁸, (hereinafter referred to as the tug and tow) were on passage from the Eastern Seaboard (SEAE) to Sudong Special Purpose Anchorage (ASSPU¹⁹) with an expected time of arrival (ETA) of 7 February at about 0800H²⁰.

1.1.2 On 7 February at about 0001H, the Master handed over the conn²¹ of the tug and tow to the Chief Officer (CO) reminding²² that the tug and tow were to arrive ASSPU at about 0800H. The bridge team comprised the CO, who had the conn of the vessel, steering the tug and an Able Seafarer Deck (ASD-A) on lookout duties²³. The weather was fine with the visibility of about 3nm to 5nm. The wind was light with slight seas and swell.

1.1.3 The crew of Koi 3 informed the investigation team that Koi 3's GPS stored a pre-loaded passage plan that took the vessel westbound, hugging outside the northern edge of the Singapore Strait TSS towards ASSPU. For the last few legs of the passage, the tug and tow would round-off south of Raffles Lighthouse at WP 2 before altering course to steer 304°T, passing between

¹⁴ UTC – Coordinated Universal Time, is the primary time standard by which the world regulates clocks and time.

¹⁵ MADAS was conceived by Avenca in conjunction with the UK MAIB and NTSB to meet the specific requirements of accident investigators. MADAS enables investigators to fuse digital data from all available sources (e.g. VDR, ECDIS, AIS, VTS, GPS, etc.).

¹⁶ Combination of statements of the personnel involved and information obtained from the respective Company.

¹⁷ According to the crew of Koi 3 the barge was being towed using a towing rope of about 70m in length which was connected to the towing hook on Koi 3. The AIS status of the tug was 'Underway using engine'.

¹⁸ Loaded with 5000 metric tons of cargo.

¹⁹ According to the longest serving crew on board (about 12 months) this was the tug and tow second passage from SEAE to ASSPU. Previously, Koi 3 was towing Koi 5 to Punggol.

²⁰ 7 February 2019 Sunrise 0716H.

²¹ Conn of the vessel means having command of the vessel's movement at sea.

²² According to the CO, the Master did not leave any instructions (written or verbal) on a specific passage plan to follow for an ETA of 0800H, only a reminder to call him if in doubt.

²³ According to the ASD-A, it was a usual practice during lookout duties to maintain visual lookout forward of the beam on either side of the tug, in addition to periodical sighting of the condition of the barge towed astern.

south of Sudong anchorages and the northern limit of the TSS. This passage would then take the tug and tow to pass portside to Raffles buoy²⁴ and thereafter, at WP 3 altering to starboard towards north on a heading of about 347°T towards ASSPU (see **figure 5** showing Koi 3's estimated²⁵ pre-loaded passage²⁶ in blue dashed line and Raffles buoy circled red).



Figure 4 – Sample of Koi 3 towing Koi 5 last few legs of the planned passage towards ASSPU

1.1.4 The CO informed the investigation team that Koi 3 had been displaying its navigation lights (for vessel making way through the water) as per Rule 22²⁷ and 24a²⁸ of the International Regulations for Preventing Collision at Sea (COLREGs) for vessel engaged in towing²⁹ operation, throughout its passage. In addition, the forward section of Koi 5, was fitted with a battery-operated red light on top of the frame structure of the ramp door and was also illuminated

²⁴ Raffles buoy characteristic – Yellow conical FI (6) Y.15s, circled red in figure 4.

²⁵ Based on interviews.

²⁶ According to the Master, the CO was at a liberty to follow a different passage plan for making the ETA and was to call him when in doubt.

²⁷ COLREGs Rule 22 for vessel of 12m or more in length but less than 50m in length, the visibility of masthead light 5nm, side light 2nm, towing light 2nm, a white, red, green or yellow all-round light 2nm.

²⁸ COLREGs Rule 24 – Towing and pushing

- a. A power-driven vessel when towing shall exhibit:
 - Two masthead lights in a vertical line (when the length of the tow measured from the stern of the towing vessel to the aft end of the tow exceeds 200m, three such lights in a vertical line)
 - Side lights
 - Stern light
 - towing light in a vertical line above the stern light
 - When the length of tow exceeds 200m a diamond shape where it can best be seen
- b. A vessel of object being towed...shall exhibit:
 - Side lights
 - Stern light

²⁹ The length of the tow at the material time, according to the crew was about 150m.

by Koi 3's stern light³⁰ and towing light³¹ (*sic*)³².

- 1.1.5 At about 0200H, the tug and tow, about 1.2nm east of Raffles Lighthouse and heading about south-westerly at 2.8kt, were moving along outside of the northern edge of the TSS westbound lane. See **figure 5** showing the tug and tow transiting an area between north of the TSS and Singapore port limit.

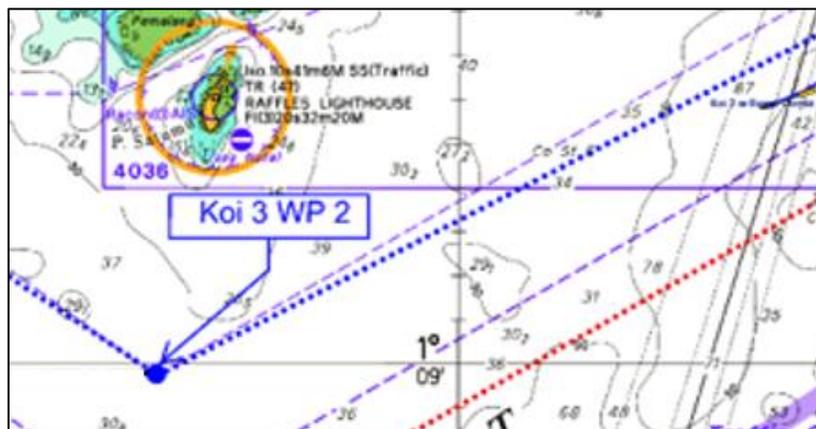


Figure 5 – Koi 3 and Koi 5 position at 0200H (*not to scale*)

- 1.1.6 According to the CO, during the passage, the engine was continuously throttled (increased/decreased) between 'Full Ahead' and 'Half Ahead' to make a daylight³³ arrival at ASSPU.
- 1.1.7 By about 0240H, when the tug and tow were about 1.1nm southwest of Raffles Lighthouse and approaching WP 2 for its course alteration position, the CO recalled observing a vessel at about 0.8nm, identified by the AIS as the "Pan Africa", which was anchored within Sudong Petroleum Holding Anchorage (ASPH), and was positioned³⁴ near the path of the planned course of the tug and tow.
- 1.1.8 Noting that the tug and tow's position was less than 4nm from ASSPU and with the ETA of 0800H i.e. about five hours of passage steaming, the CO assessed

³⁰ A *stern light* means a white light placed as nearly as practicable at the stern showing an unbroken arc over an arc of horizon of 135° and so fixed as to show the light 67.5° from right aft on each side of the vessel.

³¹ A *towing light* means a yellow light having the same characteristics as the stern light.

³² The stern light and towing light are not designed for illuminating a tow.

³³ Tug and tow are prohibited from movements within Singapore port in hours of darkness for navigational safety – Source: {Port Marine Circular No.4 of 2000 – Prohibition of line-towed at night in the Western Sector}

³⁴ Due to change of tide, it is normal for vessels to swing around their anchor cable. The distance between the edge of the anchorage (Singapore port limit) and the northern limit of the TSS was about 0.2nm (about 370m). The length of Pan Africa was about 290m. MPA confirmed that Pan Africa was anchored on 6 February 2019 at about 1515H within the designated anchorage but had swung out of the ASPH during the change of tide. The Pan Africa remained at anchor throughout and the position at the time was not a danger to safety of navigation within the strait. The Pan Africa was scheduled for a departure pilot on 10 February 2019.

the need to reduce the tug and tow's speed to less than 1kt. The CO further informed the investigation team that, at such a low speed, the tug and tow would be influenced by the tidal stream setting them towards the anchored Pan Africa, if the CO were to follow the planned passage.

1.1.9 The CO thus decided to steer the tug and tow as per the revised passage plan³⁵ (see **table 2** and **figure 6** showing the revised passage plan in black and yellow course line).

Revised passage plan	Course and distance	Remarks
WP2 to WP3a	270°T x 3nm	Crossing the TSS
WP3a to WP4a	308°T x 1.3nm	Outside the TSS
WP4a to ASSPU	038°T x 2nm	Southeast of Nipa beacon

Table 2



Figure 6 – The revised passage plan for the tug and tow annotated with black and yellow dashed line (*not to scale*)

1.1.10 The revised passage plan was to take the tug and tow away³⁶ from Sudong anchorages towards Nipa Island (south of the TSS) at WP 3a. On exiting the TSS, the tug and tow was to be steered on a heading of about 308°T (orientation of the TSS) for about 1.3nm towards WP 4a. At WP 4a, the tug and tow, maintaining about 0.7nm southeast of Nipa beacon, would then wait

³⁵ Revised passage plan was also pre-loaded inside Koi 3's GPS.

³⁶ The CO informed the investigation team that it was also a common practice for the tug and tow to wait outside of the southern limit of the TSS and thereafter to cross the TSS and arrive Singapore during daylight hours.

for daybreak before crossing³⁷ the TSS towards ASSPU for an ETA³⁸ of 0800H.

1.1.11 At about 0300H, the CO confirming that the westbound lane of the TSS was clear of traffic, altered the tug and tow’s heading westerly to cross the TSS westbound lane (see **figure 7**). The CO reported to Singapore Vessel Traffic Information System (VTIS)³⁹ West on VHF Channel 73 as a routine reporting required under STRAITREP⁴⁰.

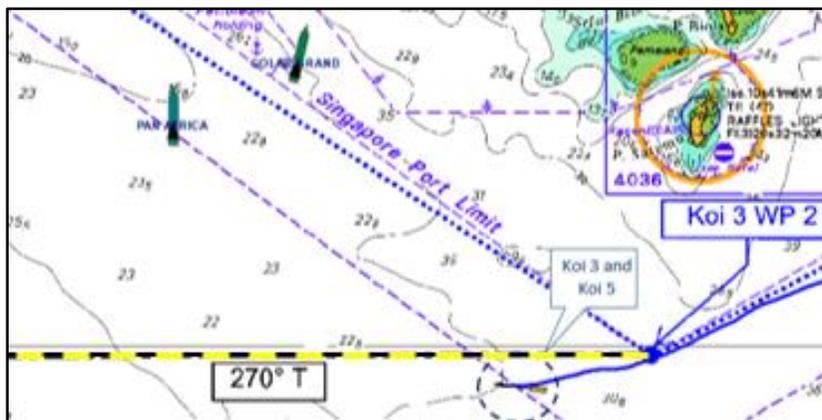


Figure 7 - The tug and tow’s position at about 0300H annotated by TSIB (*not to scale*)

1.1.12 By about 0310H, when the tug and tow were in the middle of the traffic lane following the revised passage plan, the CO again assessed the tug and tow’s position relative to ASSPU. Fearing that the tug and tow might be late for making the 0800H ETA at ASSPU, the CO decided to improvise the passage plan by shortening the distance to be travelled in the TSS (see **table 3** and **figure 8** showing the improvised passage plan in black dotted line).

Improvised passage plan	Course and Distance	Remarks
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³⁷ COLREGs Rule 10(c) – A vessel shall, so far as practicable, avoid crossing traffic lanes but if obliged to do so shall cross on a heading as nearly as practicable at right angles to the general direction of traffic flow. (This would require a heading of about 038°).

³⁸ At daybreak of about 0716H, the tug and tow would require a speed of about 2.5kt to 3kt to cross the TSS for 0800H ETA at ASSPU.

³⁹ MPA operates the VTIS, which integrates data from various sources including radars, the AIS, Closed Circuit Television System, Very High Frequency Communications System and vessel databases, to provide an accurate and comprehensive understanding of the traffic in the Singapore Strait and Singapore port waters.

⁴⁰ Reference Singapore Port Information – *Vessels approaching...VTIS operational area call the appropriate VTIS operator...West* and provide the vessel’s position by bearing and distance from Raffles Lt (01°09.606’N, 103°44.450’E).

0310H to WP 3b	270°T x 1nm	Heading towards WP3b
WP 3b to WP 4b	308°T x 1nm	Nil
WP 4b to ASSPU	000°T x 1.7nm	Nil

Table 3

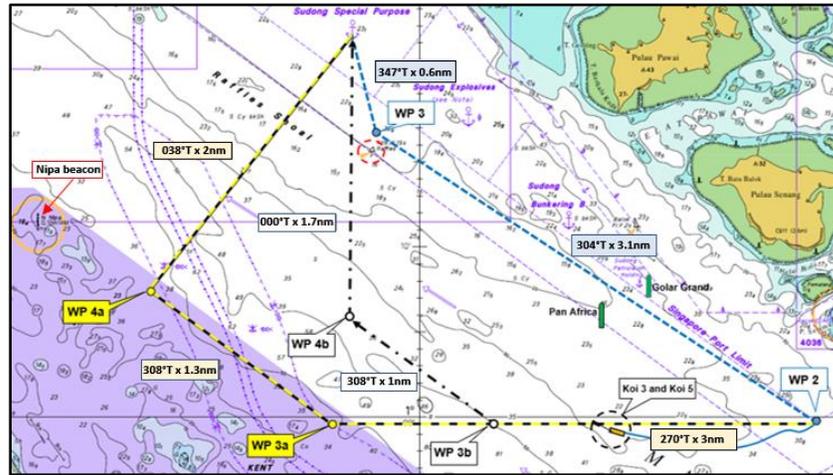


Figure 8 - The tug and tow's position at about 0310H showing the improvised passage plan (black dashed line) annotated by TSIB with WP 3b and WP 4b for easy reference (*not to scale*)

1.1.13 By about 0400H, the tug and tow were on a north westerly heading at about 1.4kt in the westbound lane of the TSS, at a distance of about 1nm from Pan Africa and the CO began to alter Koi 3's heading to starboard, as per the improvised passage plan (see **figure 9**).

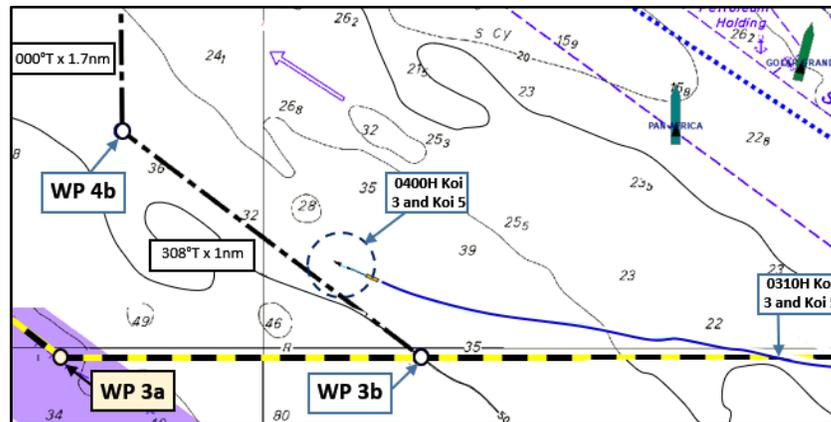


Figure 9 - Showing the tug and tow's position at 0400H following the improvised passage plan (black dashed line) annotated by TSIB with WP 3b and 4b for easy reference (*not to scale*)

- 1.1.14 At about 0435H, when Koi 3 was about 1.7nm south of ASSPU, the CO checked the surrounding area for traffic in the TSS and noting no traffic of significant concern at that time, altered Koi 3's heading further starboard towards north i.e. from 308°T to 000°T, with the intention to take the tug and tow to pass the Raffles buoy (circled red in figures 4, 6, 8 and 10) on its starboard side.

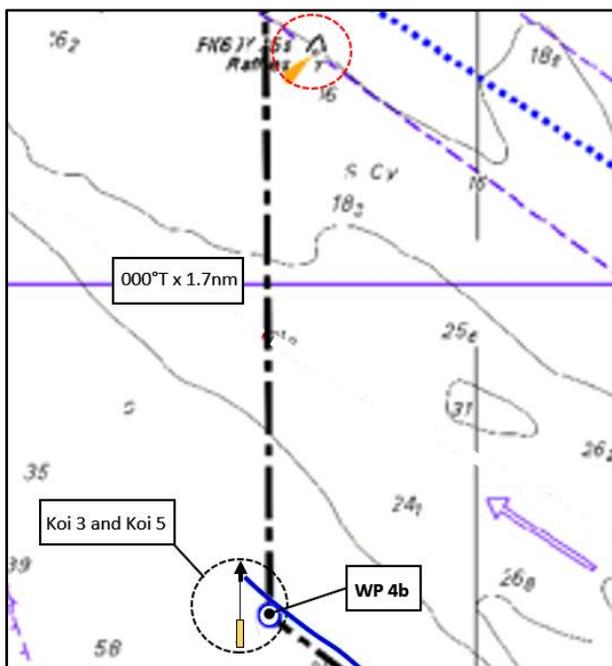


Figure 10 - The tug and tow on the last leg of the improvised passage plan (black dashed) towards ASSPU at about 0435H (*not to scale*)

- 1.1.15 Soon after, Koi 3 was on the new course of about 000°T, when the CO noted that the tug and tow's prevailing speed and assessed that it was still early for the tug and tow to arrive⁴¹ ASSPU. Accordingly, the CO⁴² reduced Koi 3's speed to a minimum, in order to maintain the northerly heading, towards ASSPU.
- 1.1.16 At about 0447H, when the tug and tow were maintaining a northerly heading and proceeding at about 0.5kt, the CO received an advice from VTIS West on

⁴¹ From this position at 0435H, to make 0800H ETA at ASSPU would require a speed of about 0.5kt.

⁴² The CO could not explain why the tug and tow were not waiting outside the TSS during this voyage considering that to make an ETA of 0800H from daybreak at 0716H would still allow for the ETA to be achieved at 2.5kt to 3kt.

VHF Channel 73, to “not stop or drift in the middle of the westbound lane”. The advice further stated that “if waiting to Singapore go to the side...wait at Nipa...do not stop in the middle dangerous many ships...”. The CO acknowledged the call and increased Koi 3’s speed to about 2kt.

1.1.17 After the CO had increased Koi 3’s speed, the look-out (ASD-A) reported the presence of two vessels abaft the starboard beam to the CO (see **table 4** and **figure 11**).

S/N	Name of vessel	Position from Koi 3	Remarks
1	Shun Sheng (SS)	About two points ⁴³ abaft the starboard beam at about 1.5nm	Displaying two masthead lights and red sidelight
2	Tiger Liaoning (TL)	About four points abaft the starboard beam at about 0.9nm	Displaying two masthead lights and green sidelight.

Table 4

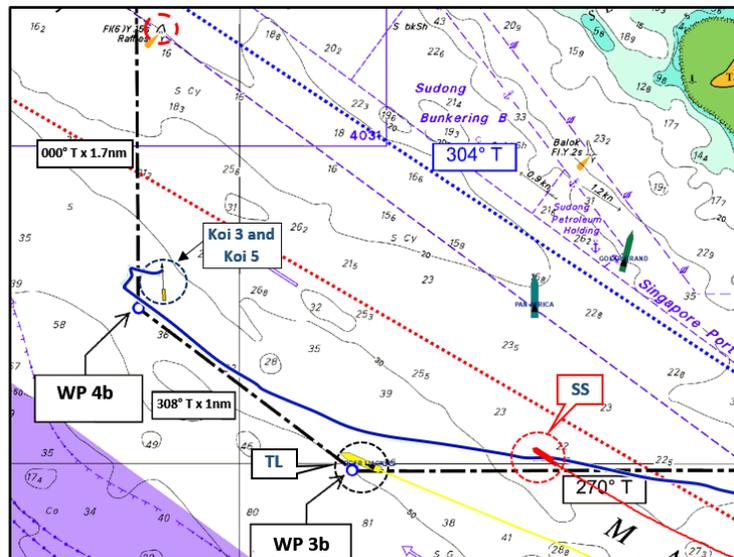


Figure 11 - Positions of SS, TL and the tug and tow at about 0447H. SS’ course line in dotted red line, annotated by TSIB (not to scale)

1.1.18 By about 0452H, the tug and tow were still maintaining a northerly heading and

⁴³ A point is about 11.25° (from centreline of the vessel measured from the bow). Fine on the bow, thus, indicated bearings that are less than a point or close to the bow.

doing about 2kt towards ASSPU. TL had passed clear astern of Koi 5 and the CO assessed that SS⁴⁴ would be passing ahead of Koi 3's bow at a close range. According to the CO, to allow SS to pass⁴⁵ Koi 3's bow at a greater passing distance, Koi 3's speed was reduced to minimum⁴⁶ (see **figure 12**).

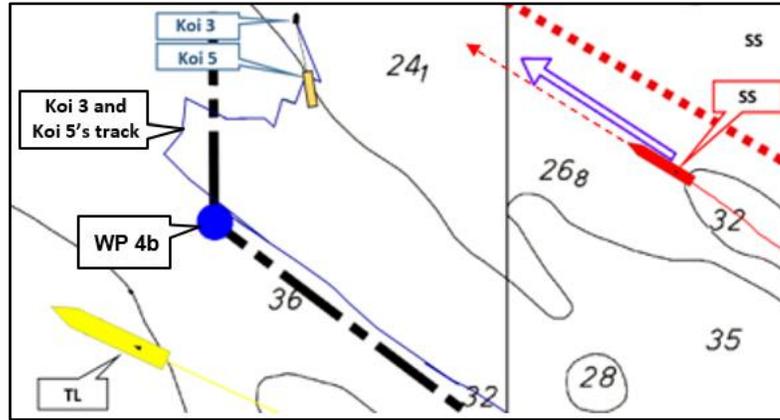
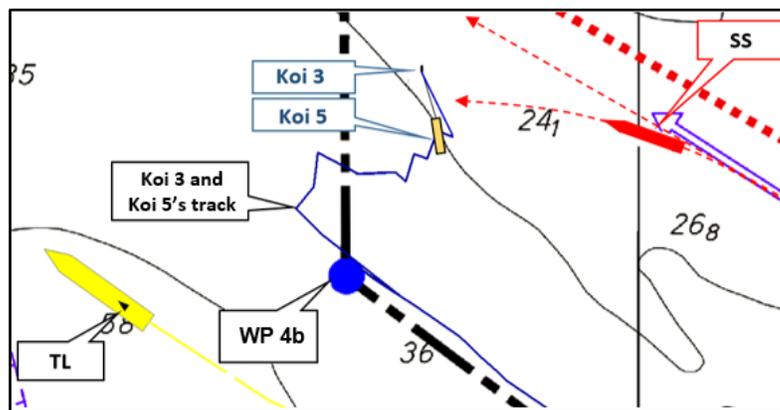


Figure 12 – Positions of SS and TL relative to the tug and tow at about 0452H
(not to scale)

1.1.19 By about 0453H, when the speed of the tug and tow was about 1.3kt, the CO overheard VTIS West calling SS on VHF Channel 73, advising SS to keep a lookout for the tug and tow ahead. On hearing the conversation between VTIS West and SS, the CO looked over to the starboard side through the window of the tug, and saw SS which was about 0.2nm away displaying two masthead lights and a green side light, noting that SS had turned to port and was heading towards the barge (see **figure 13**).



⁴⁴ SS was about 0.4nm away.

⁴⁵ Rule 15 of COLREGs indicated that "When two power-driven vessels are crossing so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way and shall, if the case of the circumstances of the case admit, avoid crossing ahead of the other vessel".

⁴⁶ Information obtained from VTIS revealed the slowing down of Koi 3.

Figure 13 – Positions of SS and TL relative to the tug and tow at about 0453H
(not to scale)

- 1.1.20 Assessing that there was a likelihood of collision between the barge and the SS, the CO immediately gave the wheel hard to port and moved the engine throttle to full ahead, with the intention of steering the tug and tow away.

The collision – Koi 3

- 1.1.21 At a time recorded as 0454H, SS' bow collided⁴⁷ into the starboard forward section of Koi 5 (see **figure 14** showing the approximate angle of impact between SS and Koi 5).

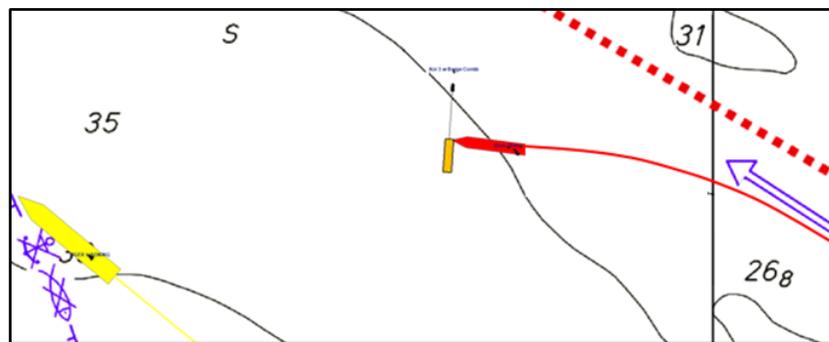


Figure 14 - The approximate angle of impact between SS and Koi 5 (not to scale)

- 1.1.22 Koi 3's Second Engineer who was in the engine room, heard a shout from the ASD-A and immediately exited the engine room to the main deck. Meanwhile, the Master, who was on his way to the bridge, heard a loud 'crackling' sound (of the towing line under stress), followed by several jolting movements which caused Koi 3 to heel and to subsequently capsize.
- 1.1.23 The CO recalled being underwater and attempted to escape from Koi 3's bridge. Once at the surface, the CO only saw the Master and two other crew members in the vicinity. They also noticed that the barge was still afloat and adrift (see **figures 15, 16 and 17**).

⁴⁷ Prior to the collision, the ASD-A and CO warned the other crew by shouting to brace for a collision.



Figure 15 – Image of Koi 3 in capsized position taken in daylight hours
(Source: MPA)



Figure 16 – Image of Koi 5 port side taken in daylight hours (Source: MPA)



Figure 17 - Close-up view of Koi 5's forward section showing the "Red Light"
(Source: MPA)

- 1.1.24 Of the six crew members of Koi 3, four were rescued by Singapore Police Coast Guard's craft, which responded while on a routine patrol in the vicinity. The Chief Engineer and ASD-B were reported missing.
- 1.1.25 The investigation team confirmed that the tow was provided with one red light to indicate its presence as informed by the CO. The Owner or the flag Administration of the barge could not provide the investigation team any information about the characteristic and specification for this light. The crew

confirmed that they would typically use the search light on the tug to further highlight the presence of the tow to other vessels in the vicinity, but this was not done on this day prior to the collision.

- 1.1.26 According to the CO, the events leading up to the collision unfolded rapidly. As such, no sound or light signals could be given to warn SS of the presence of the barge ahead.

According to the bridge⁴⁸ team of SS

- 1.1.27 In the afternoon of 2 February 2019, SS departed Hong Kong, China bound for Lumut, Malaysia with an ETA of about noon on 7 February 2019. As per the passage plan, SS would transit the westbound lane of the Singapore Strait TSS⁴⁹ on its voyage to Lumut.
- 1.1.28 On 7 February 2019 at about 0005H, the Master arrived on the bridge, took over the conn from the Second Officer (2O), who was performing (0001H–0400H) navigational watch and set the main engine to manoeuvring⁵⁰ 'Full Ahead'. The bridge watchkeeping (BW) was at Level II⁵¹. SS continued to be steered on a heading of 252°True (T) on autopilot⁵², doing a speed of about 13kt, and entered the Singapore Strait TSS at about 0100H.
- 1.1.29 SS continued to be navigated in the TSS at BW level II for about an hour. Noting the light traffic and fine weather condition, the Master handed over the conn back to the 2O but remained on the bridge. The active bridge team at this time comprised the 2O, who had the conn of SS, and the ASD-1 who was performing the lookout duties and the BW was thus at level I⁵³.
- 1.1.30 At about 0345H, the CO arrived on the bridge to keep his usual (0400H–0800H) morning watch. The CO checked SS' position on the ECDIS⁵⁴ and the navigational paper chart (hereinafter referred to as chart) for the expected

⁴⁸ The bridge of a ship or the wheelhouse from which the ship can be commanded. When a ship is underway, the bridge is manned by an officer of the watch (OOW), aided with a lookout and additional persons, depending on the bridge watch keeping level established as per the Company's Safety Management System (SMS).

⁴⁹ During most of this transit, according to the approved passage plan, a BW level III (three licensed officers and one qualified ASD and/or one extra lookout) on the bridge was to be maintained, until after passing Raffles Lighthouse. After this BW level II was to be maintained for a few legs before upgrading to BW level III again. At the time of the incident SS was supposed to be on BW level II.

⁵⁰ Allows for safe and rapid reduction of the revolutions of the main engine.

⁵¹ BW II composition comprised two licensed officers and one qualified ASD on the bridge.

⁵² Autopilot is a function that enables a ship to be steered by using a Gyro as the heading input.

⁵³ BW I composition comprised one licensed officer and one qualified ASD on the bridge. According to the SMS this level was to be maintained typically during open sea conditions.

⁵⁴ Electronic Chart Display and Information System – a geographic information system used for nautical navigation that complied with IMO as an alternative to paper nautical charts. On SS, ECDIS was the primary means of navigation and charts were the back-up.

navigational condition to be encountered during his watch, as well as the display of targets in the vicinity. Satisfied with the vessel's condition, the CO signed the Master's night orders⁵⁵ and prepared to take over the watch from the 2O.

- 1.1.31 The Master was on still on the bridge, and the CO noted that SS was on autopilot and was on a south-westerly heading, the engine telegraph was at manoeuvring 'Full Ahead' and SS was doing about 13.8kt. After having adjusted his vision to the moonless night⁵⁶, the CO assessed the visibility to be about 3nm to 5nm. The weather was fine with slight seas and swell and the north easterly wind was light.
- 1.1.32 The CO observed the traffic condition to be light with only one vessel about 1nm on the port bow ahead, later identified as TL, which was on a similar course and speed.
- 1.1.33 The CO took over the conn from the 2O who left the bridge soon after. The active bridge team now comprised the CO and ASD-2 who had taken over the watch from ASD-1 at about the same time and continued to perform the role of a lookout. The Master continued to remain on the bridge but was not a part of the active bridge team, i.e. BW remained at level I.
- 1.1.34 During the watch, the CO continued plotting SS' positions on the chart⁵⁷ (see **figure 18**⁵⁸) at five minutes intervals, despite the vessel being fitted with an ECDIS. The chart was in the chart room (which was separated by a curtain) at the aft part of the bridge, a typical layout of a vessel. The bridge was also fitted with an AIS with its display monitor located at the forward part of the bridge near the windows. The AIS targets were also displayed on the ECDIS.

⁵⁵ 6 February 2019, the Master wrote his usual night orders, among others include, keeping sharp look-out, maintaining piracy watch, calling the Master when in doubt, etc.

⁵⁶ 3rd day of new moon (new moon on 5 February 2019).

⁵⁷ The chart in use – British Admiralty chart no. 3833 for Singapore Strait Western Part.

⁵⁸ Some of the positions were GPS positions, while others were based on range and bearing of radar conspicuous objects. The GPS was fitted near the chart table behind the curtain. To take a range and bearing of a radar conspicuous object, would require the OOW to use the radar, and then go to the chart room to plot the position on the chart, before returning to the front part of the wheelhouse.



Figure 18 – SS' positions, at various timings, plotted on the navigational paper chart (Source: TSIB)

- 1.1.35 By about 0430H, SS was about 2nm east of Raffles Lighthouse, on a south westerly heading at about 13.5kt as per the passage plan (indicated by the red dotted course line) and had TL about 0.9nm ahead (coloured yellow with black dotted circle), see **figure 19**.

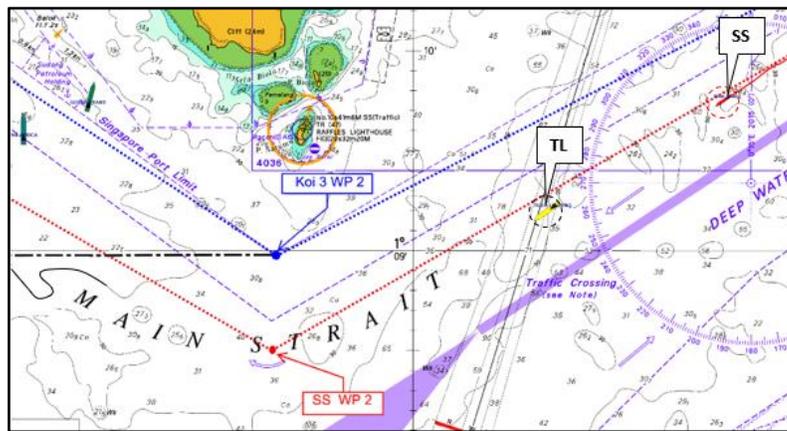


Figure 19 - SS' approximate position annotated with red dotted circle at 0430H. SS' course line as per the passage plan was indicated with a red dotted line (not to scale) and next alteration point

- 1.1.36 About five minutes later, with Raffles Lighthouse at a bearing of about $293^{\circ}T$ and about 1.3nm, and with SS heading towards WP 2, the CO instructed the ASD-2 to switch from autopilot to manual steering and gave a 5° starboard helm order, for turning SS' heading slowly towards the next course (see **figure 20**). At this time, there was no additional person performing the role of a lookout.

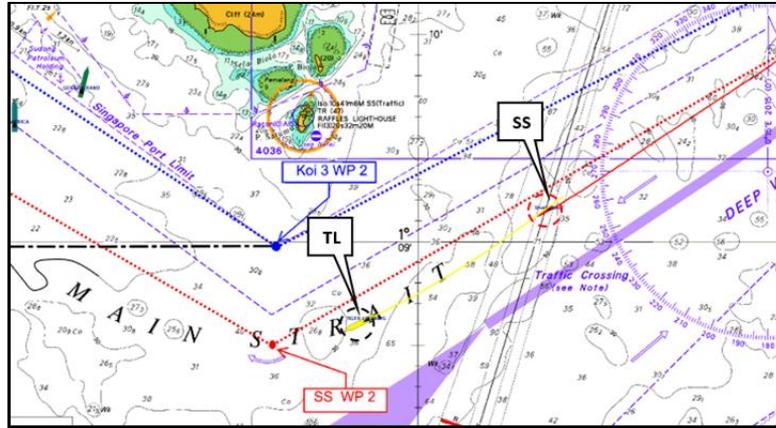


Figure 20 – SS' and TL's position at 0435H (*not to scale*)

1.1.37 By about 0440H (see **figure 21**), SS was on a westerly heading and maintaining a speed of about 13.5kt, as it passed about 0.8nm south of Raffles Lighthouse⁵⁹. At that time TL was also about 0.8nm at one point on SS' port bow. The Master observed SS was steadied on a north-westerly heading and with light traffic condition ahead decided to return to his cabin. The Master informed the CO to call him whenever required and left the bridge soon after.

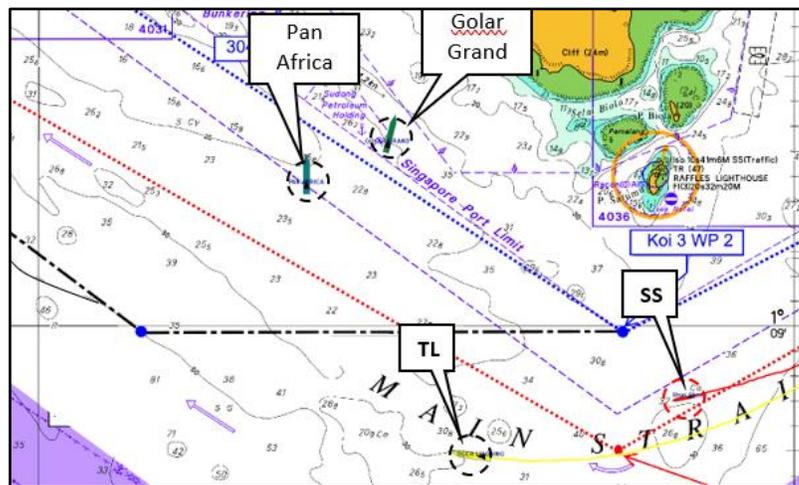


Figure 21 – SS' and TL's position at 0440H (*not to scale*)

1.1.38 At about 0445H (see **figure 22**), SS was on a heading of about 295°T and doing about 13kt south of Sudong anchorages. According to CO, he observed

⁵⁹ According to the passage plan, SS was to maintain BW Level-2 i.e. two licensed officers and one qualified ASD on the bridge from this waypoint.

an anchored⁶⁰ vessel south of ASPH. The CO then instructed the ASD-2 to switch the steering back to autopilot, who then resumed with the lookout duties.

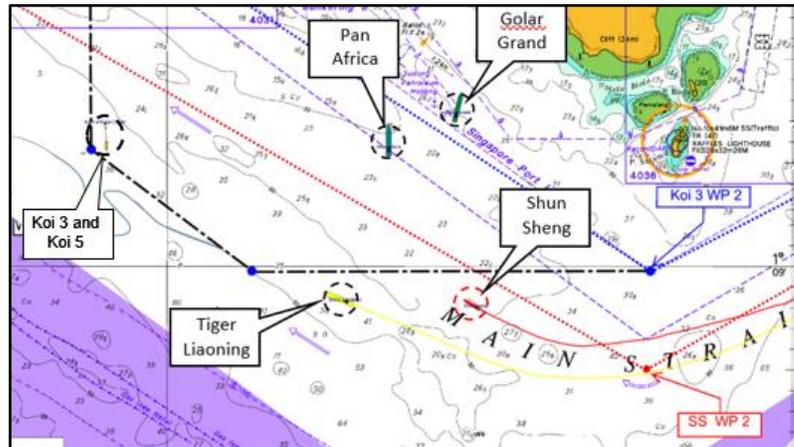
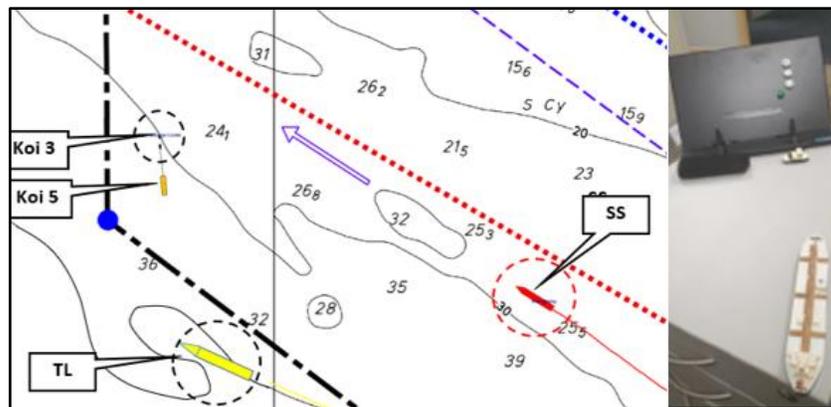


Figure 22 – SS, TL and the tug and tow position at 0445H (*not to scale*)

- 1.1.39 The CO, maintaining a safe distance from TL, decided to pass about 0.4nm south of the Pan Africa and reported SS' position to VTIS West on VHF Channel 73 as required by STRAITREP, at about 0446H.
- 1.1.40 By about 0450H, SS was about 0.1nm south of its planned course of 300°T, on a heading of about 302°T and doing a speed of about 12.8kt. At that time TL was about 0.7nm and four points on SS' port bow. The CO recalled seeing a vessel with three white masthead light(s) and a green side light, about one point on SS' port bow, later identified belonging to Koi 3 (see **figure 23**).



⁶⁰ The nearest vessel to SS was Pan Africa, about 0.8nm and three points on SS' starboard bow. The investigation team sought clarification from VTIS and noted that Pan Africa was anchored within ASPH but due to a large swinging circle, had swung out during change of tide and later returned to its original anchored position.

Figure 23 - SS' approximate position relative to Koi 3 at 0450H and the display light configuration sighted by the CO as shown during the interview
(not to scale)

- 1.1.41 According to the CO, there were no other lights on Koi 3 or astern of it. Furthermore, checking the ECDIS, the CO assessed that with Koi 3 moving northerly, there was a likelihood of crossing situation, and SS would be passing ahead of Koi 3's bow at a close range. The CO decided to alter SS' heading by about 15° to the port to place Koi 3 on SS' starboard bow. The CO informed the investigation team that the surrounding area was checked prior to alteration.
- 1.1.42 At about 0452H, the CO instructed the ASD-2, who had been performing the role of a lookout, to perform the role of a helmsman and to again engage the hand steering and steered SS on a new heading of about 287°T, in order to pass Koi 3's stern⁶¹ (see **figure 24**).

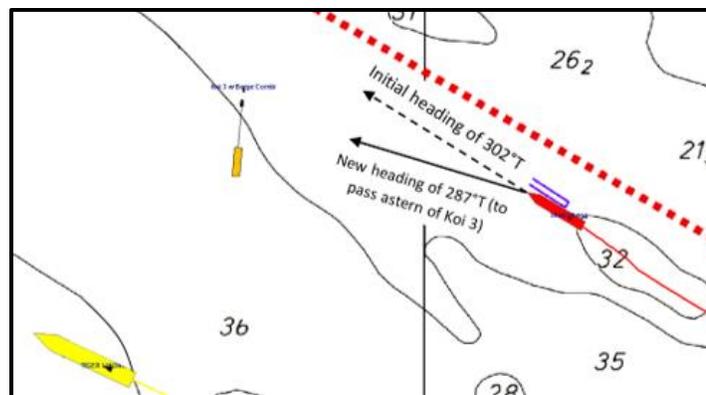


Figure 24 - SS' position at about 0452H (not to scale)

- 1.1.43 Following the alteration of course and with SS steadied on a new heading of about 287°T, SS received call from VTIS West advising of a tug and tow ahead⁶², to which the CO responded, "yes understand understand". After talking to VTIS West, SS received another call, this time in Chinese from TL to warn SS of the tug and tow, and to which the CO replied, "already clear".
- 1.1.44 After the VHF communication, the CO again confirmed that the tug had indeed crossed SS' bow from port to the starboard side. The CO used a torch (later shown to the investigation team to be a green laser light) to scan the horizon (*sic*) but could not see any barge.

⁶¹ At about 0452H - distance from SS' bow to the forward starboard end of the barge was about 0.42nm.

⁶² At about 0453H - distance from SS' bow to the forward starboard end of the barge was about 0.18nm.

- 1.1.45 According to the CO, at a time recorded as 0454H, SS shook as it collided with an unlit object, later identified to be the barge, Koi 5.
- 1.1.46 The CO reduced SS' engine speed⁶³ by pulling the main engine telegraph from 'Full Ahead' to 'Half Ahead' and called the Master to the bridge. The CO recalled noticing a dimly lit red light at the forward end of the barge, as the barge drifted astern along SS' port side after the collision.
- 1.1.47 The CO gave instructions to the ASD-2 for the wheel to be put hard to port to move SS' propeller away from the barge. A crew member on SS who was on deck keeping an anti-piracy watch also confirmed that a dimly lit red light was on the barge when the barge drifted past SS.
- 1.1.48 On being asked why the three white masthead lights were not taken into consideration of a possibility of an object being towed by the tug, the CO informed the investigation team that this did not come to his mind. The CO further added that the AIS should display information about the tug and tow (combination) to avoid a situation where a tug is towing an unlit object because the AIS feeds data into the ECDIS and it would help in assessing targets in the vicinity when using the ECDIS for navigation⁶⁴.

The collision – SS

- 1.1.49 Immediately after the collision, the Master came to the bridge and was informed by the CO that SS had collided with something. The bridge team and the Master were unaware of the consequence to the tug at this time⁶⁵. The Master noted that the main engine was '*Stopped*' and the helm, which was at '*Hard to Port*', was being turned back to '*Midship*'.
- 1.1.50 The Master sent the deck crew to the bow to carry out a damage assessment (visual and sounding of tanks) on SS. The deck crew reported that no apparent damage was noted, and the Master instructed the CO to call VTIS West to report the occurrence, who then advised SS to stand-by for further instructions.
- 1.1.51 SS did not sustain material damage from the collision, except for deformation at the bulbous bow (see **figure 25**), and remained fit to continue its passage,

⁶³ The logbook where engine movements were recorded (manually) contained the following entries using symbols – 0442H: Half Ahead; 0443H: Slow Ahead; 0450H: Stop (engine). Another logbook indicated that the ship's speed at 0500H (after the collision was 12kt). The records obtained by the investigation team from the ECDIS indicated that, immediately before the collision SS' speed was between 12.6kt-13kt and at 0454H the speed registered was 11.4kt and 9.4kt at 0455H.

⁶⁴ IMO Resolution 1106(29) recognises the limitations of using the AIS as a collision avoidance tool.

⁶⁵ The bridge team became aware that the tug had, as a result of the collision, capsized, when informed by the investigation team during the interviews.

and there was no report of injury or pollution. The Master assessed the situation and instructed the CO to continue passage at a slow speed instead of stopping the vessel inside the TSS. Shortly after, VTIS West called SS and instructed the Master to return to Singapore. SS subsequently anchored at ASSPU.



Figure 25 – SS' condition with damaged bow (*Source: TSIB*)

1.2 Inspection of Koi 3 and Koi 5

1.2.1 The investigation team visited the salvaged Koi 3 and Koi 5 at the yard and confirmed with the salvage company that there had been no change or alteration to the status of the equipment and/ or machinery from the time of the salvage operation up to the day of the inspection.

1.2.2 A summary of the key observations showing Koi 3's condition and some of the equipment⁶⁶ on board (see **figure 26**):

- I. No structural or significant damages to the hull;
- II. Doors and ventilator flaps of the accommodation, machinery spaces and steering gear compartment were secured in open position;
- III. Navigational lights arrangement indicated the tug was fitted with sidelights and stern light. The mast for masthead light was broken, likely as a result of the sinking and hitting the seabed;
- IV. Light switches (annotated with yellow marking by TSIB) on the panel

⁶⁶ The investigation team documented from the inspection of the wreck that the Koi 3 had a marine VHF, a GPS navigator, and a marine radar and a magnetic compass fitted in the wheelhouse.

indicated 'ON' position for Mast 1, Mast 2 & Mast 3, port and starboard (side lights).

- V. A search light was fitted on top of the bridge and was capable of being operated from the conning position; and
- VI. The engine throttle handle at the wheelhouse was at "Ahead" position.



View of the forward part of the bridge



View from the starboard quarter



View inside the bridge



View of engine room and access door



Figure 26 – Relevant photographs of Koi 3 taken after being salvaged
(Source: TSIB)

1.2.3 Likewise, a summary of the key observations of Koi 5 is indicated below:

- I. The starboard side inboard section (annotated by yellow lines) of the barge showed a bulge and buckling of the deck (see **figure 27**);
- II. The forward hull section, along the port side and aft of the barge appeared to be intact;

- III. The hull section on the forward starboard side was breached inwards, above and below the water line; and
- IV. There was a small red light fitted at the forward post of the ramp structure. There were no other light⁶⁷ fittings found on the barge.

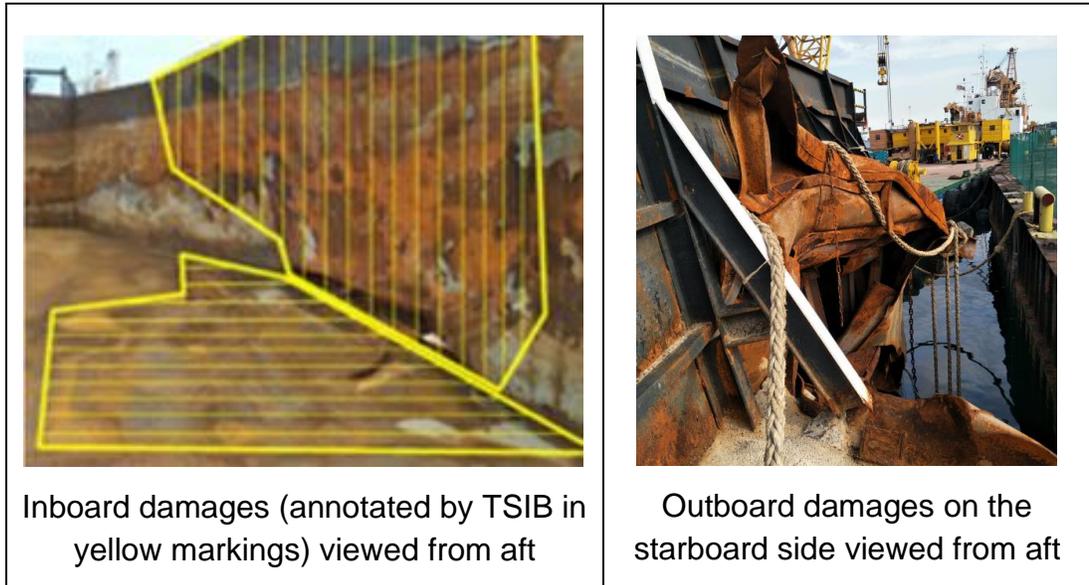


Figure 27 – Showing damages sustained by Koi 5 (*Source: TSIB*)

1.3 Search and Rescue Operation

1.3.1 On being notified of the occurrence at about 0457H, the MPA initiated the following:

- I. Navigational broadcast for all vessels in the vicinity to keep a lookout for men in the water and to render assistance; and
- II. Activated tugs to tow the barge and capsized tug for safety of navigation within the TSS and advising Rescue Coordination Centre Tanjung Pinang (RCC TP).

1.3.2 The following surface assets were deployed to search for the missing persons, in addition to divers to search underwater:

- I. Two MPA crafts (MPA 2 and MPA 3);
- II. One PCG craft (PT 71);

⁶⁷ COLREGs Rule 24 (e) – A vessel being towed shall exhibit sidelights and stern light.

- III. One Republic of Singapore Navy vessel (RSS Dauntless);
- IV. One Singapore Civil Defence Force craft (Red Swordfish); and
- V. Two Indonesian vessels - TP's Purworejo and TNI's (Lanar Batam).

1.4 Crew information of Koi 3 and Koi 5

1.4.1 In accordance with the Minimum Safe Manning document (MSMD) issued by the flag Administration, Koi 3 was manned by six officers and crew (four deck and two engine crew) of Indonesia nationality.

1.4.2 The investigation team was able to recover some statutory certificates and qualifications of the crew, from the wreckage of Koi 3, all of which were valid. The relevant experience and qualifications⁶⁸ are appended in Table 5.

Rank	Joined Koi 3	In-Rank Experience	Remarks
Master COC Class IV	January 2019	About seven years	New to the Owner, however, had been working on similar tug and tow services in Singapore waters for about three years
CO COC Class IV	January 2019	About five years	Had been on this route with similar tug and tow, but first time on this route with Koi 3
ASD-A	January 2018	About three years ⁶⁹	Assisted in lookout and steering
ASD-B	December 2018	About six years	Missing after the collision. Body was later recovered from Koi 3
Chief Engineer COC Class IV	August 2018	About 13 years	Missing after the collision. Body was later recovered from Koi 3
Second Engineer COC Class IV	September 2018	About three years	Ran up from engine room when heard call from ASD-A

Table 5

⁶⁸ Based on the documents obtained from the salvaged tug. The investigation team could not establish whether the crew held valid flag State endorsements. The flag Administration did not respond with the information requested.

⁶⁹ ASD certificate of Proficiency for Rating forming part of navigational watch - Date of issue February 2016.

- 1.4.3 The survivors told the investigation team that the bridge team was divided into two groups (the Master and the ASD-B in one group while the CO and the ASD-A in the other), each maintaining six hourly rotations of bridge watchkeeping at sea (as the maximum sea passage was about 24 hours). There was no report of any equipment or machinery failure on board Koi 3 prior to the occurrence.
- 1.4.4 The crew confirmed that Koi 5 was not fitted with sidelights and/or stern light, as required for a vessel or object being towed. They added that it was a practice for them to illuminate the barge using the searchlight, but this had not been done on the day of the occurrence. However, they assured as normal practice, they were observing the barge from the tug while on passage to verify the set and drift of the barge. The crew indicated that this was possible as the barge front section was always illuminated from the reflected light received from the tug's stern and towing light.
- 1.4.5 The crew also informed the investigation team that Koi 3 had a towing hook which was used for connecting the towing rope with Koi 5. When asked, the crew confirmed that there was no gob rope⁷⁰ fitted on Koi 3 (see **figure 28**).

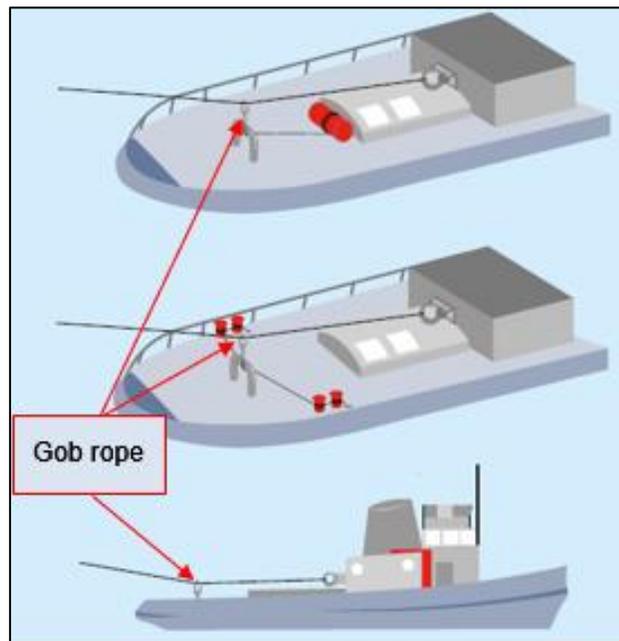


Figure 28 - Illustration of a gob rope (Source: The Shipowners Club)

⁷⁰ A gob rope (gob wire), sometimes referred to as a guest rope or bridle, is a short wire or rope made fast to the towline at the aft end of a tug. In this way the use of the gob wire effectively moves the towing point aft, closer to the tug's stern. This gives the tug master greater control and allows more manoeuvrability to prevent girting when the tug is acting as a stern tug. Girting refers to the situation when a vessel, usually a tug, is pull broadside by a towline and is unable to manoeuvre out of this position which may result in higher risk of capsizing. Source: *The Shipowners Club*.

1.5 Crew information of SS

1.5.1 SS was manned in accordance with the MSMD issued by the flag Administration. At the time of the occurrence SS was manned by 20 officers and crew from the People's Republic of China (PRC) and Myanmar. The experience and qualifications of the persons relevant to the occurrence are appended in Table 6.

Rank	Nationality	Joined SS	In-Rank Experience	Remarks
Master COC Class I	PRC	September 2018	About four months	Under training for one-month on board SS prior to taking over from outgoing Master
CO COC Class II	PRC	June 2018	About two years	First time in this Company. Experienced in navigating through Singapore TSS
Able Seafarer Deck 2	Myanmar	July 2018	About three years	Assist in lookout and hand steering

Table 6

1.5.2 The records of hours of rest and work documented by SS were as per their Company's SMS and indicated that the bridge team's rest hours met the requirements of 'Hours of rest'⁷¹.

1.5.3 The statutory certificates for SS and the bridge team were valid at the time of occurrence, including the flag State's endorsement. There was no report (as confirmed by the Master) of any equipment or machinery failure.

1.5.4 The investigation team became aware that the daylight signalling lamp (commonly known as the aldis lamp)⁷², as provided for and stated on Form 'E' of the Safety Equipment Certificate on SS, was kept in the chart room in a cabinet, and not used during navigation watches. The aldis lamp was found to be disconnected from the battery and the officers keeping the navigation watch

⁷¹ Maritime Labour Convention (MLC) 2006 provides guidelines on minimum number of hours of rest required for seafarers on merchant ships. Same establishment of rest periods for watchkeeping personnel contained in the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended (STCW Convention).

⁷² As required by SOLAS 74 V/19.2.2.2, as amended, for ships of over 150 gross tonnage.

had not tested⁷³ it during their watchkeeping period. A function test by the investigation team confirmed that the aldis lamp was not working.

1.5.5 The CO stated that Koi 3 showed on the AIS (and was also visible on the ECDIS) but he was unaware that there was a barge astern of Koi 3. The CO added that he did not recall whether the radar showed the 'echo or blip' of Koi 5. The investigation team could not verify the radar echo of Koi 5 from the S-VDR data (see footnote 12).

1.5.6 SS was also fitted with a manoeuvring light⁷⁴ as required by COLREGs and was connected to the ship's whistle. A function test by the investigation team indicated that light too was not working, and the crew were not aware of its status. On enquiring further, the investigation team gathered that, the bridge team would typically use a green laser light to capture the attention⁷⁵ of (or give signal to) other ships, if needed (see **figure 29**). The CO added that this light had been on the bridge since he had joined SS.

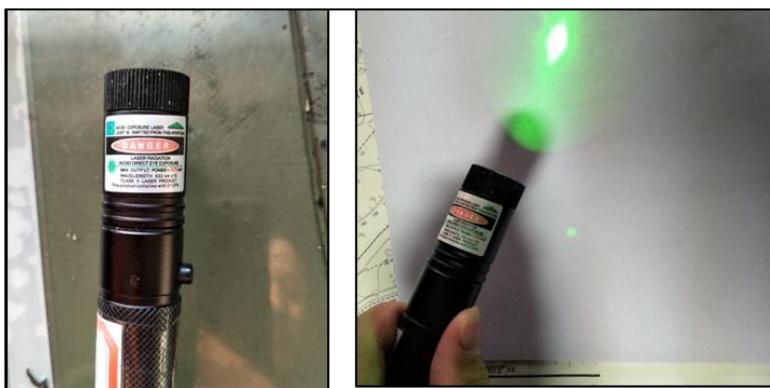


Figure 29 - Laser light used by the bridge team for capturing attention of other ships (*Source: TSIB*)

1.6 Bridge Resource Management and SMS Procedures

1.6.1 International Maritime Organisation (IMO) Resolution A.893 (21) Annex 25, provided guidelines for voyage planning with the objectives, among others, the

⁷³ Bridge watch handover checklists as per the Company's SMS indicated that the daylight signalling lamp had been checked and was in order.

⁷⁴ Reference COLREGs Rule 34(b); Position and technical details of lights and shapes contained in Annex I (12) – Manoeuvring Light. The purpose of this light is to supplement sound signals to be made while a collision avoidance manoeuvre is being carried out by a power-driven vessel.

⁷⁵ The investigation team noted with concern that there has been an increase in the use of such laser lights by ships, instead of using the approved light signals, as noted by the Japan Transportation Safety Board (JTSB). According to JTSB's safety flyer, accident investigations and a survey questionnaire of passenger ferries (in Japanese waters) found 25 instances of laser pointers being pointed at another vessel instead of an approved light signal. The flyer further cautioned that use of a laser pointer can have damaging effect on the eyes of the seafarers.

close and continuous monitoring of vessel's progress and position, are of essential importance for safety of life at sea, safety and efficiency of navigation and protection of the marine environment.

1.6.2 The definition of effective Bridge Resource Management (BRM⁷⁶) or Bridge Team Management (BTM) as provided in the International Chamber of Shipping's (ICS) Bridge Procedure Guide⁷⁷:

A bridge team, well briefed and supporting each other will have good situational awareness. Its members will then be able to anticipate dangerous situations arising and recognize the development of a chain of errors, thus enabling them to take action to break the sequence.

1.6.3 BRM which is part of a vessel's SMS, begins at the initial passage planning stage and includes preparation of berth-to-berth operational matters.

1.6.4 BRM is the effective management and utilisation of all resources, human and technical, available to the bridge team to ensure the safe completion of the vessel's voyage. BRM reduces the risk of marine casualties by helping the bridge team to anticipate and correctly respond to their operating condition.

1.6.5 Among others, the critical elements of communication, teamwork, decision-making and fatigue, form the principles of BRM and when correctly practised would assist the bridge team in:

- Maintain its situational awareness;
- Continually monitor vessels' progress;
- Anticipate dangerous situations; and
- Undertake appropriate contingency plans when required.

1.7 The tug and tow light arrangement

1.7.1 Below illustrations were made based on the information gathered by the investigation team through statements and interviews of the bridge team of both vessels (see **figures 30 and 31**).

⁷⁶ STCW Convention and Code on Bridge Resource Management was already in force since 1 January 2017. The definition of BRM is also provided in the the Bridge Procedures Guide – publication by the ICS which is intended to reflect best navigational practice on merchant ships and embraces internationally agreed standards and recommendations adopted by the IMO.

⁷⁷ A copy of the guide was available on SS and referenced in the SMS. There were no BRM related procedures for the tug Koi 3.

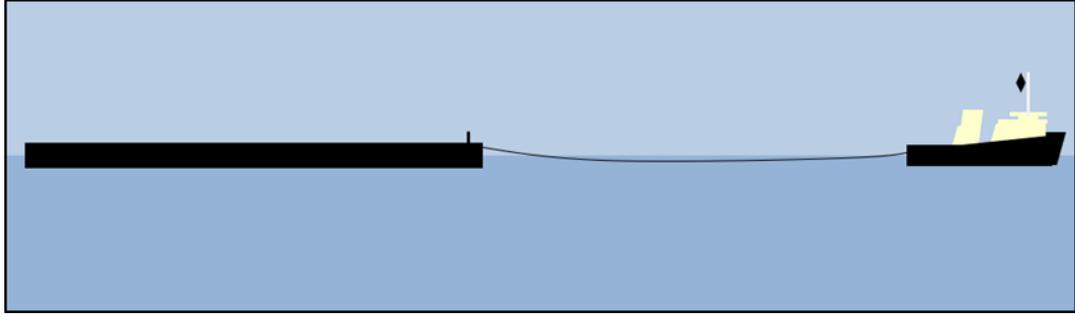


Figure 30 - Starboard side view of Koi 3 (displaying a diamond shape symbol) towing Koi 5 during daylight hours (for illustration only – *not to scale*)



Figure 31 - Starboard side view Koi 3 (displaying three all-round white lights and a green side light) towing Koi 5 during hours of darkness (for illustration only – *not to scale*)

1.8 Additional information

- 1.8.1 At about 0440H, according to TL (vessel in the vicinity of the occurrence), its bridge team noted the presence of the tug and tow on the radar at about 2.6nm after rounding off the bend south of Raffles Lighthouse. The bridge team further confirmed that the AIS indicated the name of the tug but did not indicate any other information of it towing a barge. The bridge team of TL could not recall the lights displayed by Koi 3 at that time but confirmed that the barge was not lit.
- 1.8.2 The bridge team of TL further confirmed to the investigation team that they called SS at about 0453H (communicating in Chinese) – “*Please pay attention⁷⁸ to the ship in front of you*”. In response SS replied, “*Do not worry, already clear*”. The investigation team also established that TL’s radar showed an echo of the tug and tow.

⁷⁸ Based on the assessment of the crew of TL, from the radar that SS was attempting to go in between the tug and the tow.

- 1.8.3 The investigation team reviewed the VTIS data for the period and confirmed that the radar 'echo and blip' of the tug and tow were distinctly visible and an alarm of a potential conflict between SS and Koi 3 about three minutes prior to the collision which prompted the VTIS West operator to call SS.
- 1.8.4 The investigation team noted from the investigation by the UK Marine Accident Investigation Branch (MAIB)⁷⁹ into another similar incident that took place in the Dover Strait TSS between a general cargo ship and a crane barge being towed by a tug in 2014, that one of the safety issues identified was over-reliance by the crew of the general cargo ship on AIS, for collision avoidance.
- 1.8.5 The MAIB further recommended that the Channel Navigation Information Service (CNIS)⁸⁰ improve the safety broadcasts. The Maritime and Coastguard Agency updated its procedures for the CNIS to ensure that the operators (watchkeepers) broadcast to other traffic when a vessel was transiting the Dover Strait area that posed a potential hazard to other shipping but was not transmitting on AIS, including tugs and tows.
- 1.9 Location of occurrence
- 1.9.1 The occurrence⁸¹ took place about 0.78nm south of Raffles buoy, within the westbound lane of the Singapore Strait TSS. This area was under the coverage of Singapore VTIS (West) sector 7 (VHF Channel 73).

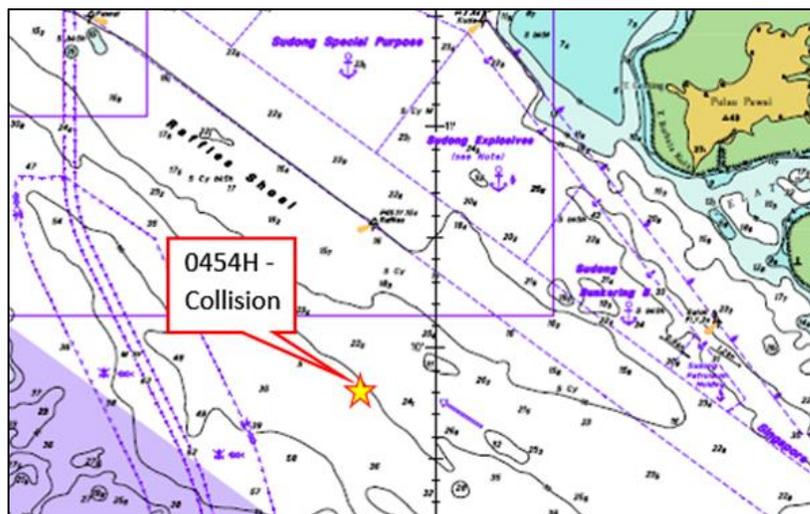


Figure 32 – Approximate location of the collision

⁷⁹ UK MAIB 29/2014

⁸⁰ CNIS provides a 24-hour radio and radar safety service for all shipping in the Dover Strait and is jointly operated by the UK and France.

⁸¹ Occurrence location at Latitude 01°09.8'N, Longitude 103°41.7'E

- 1.9.2 The Singapore Strait TSS was bound by an area of about 4.8nm long by 1.3nm wide and had a north-westerly orientation of about 308°T. There were aids to navigation in the vicinity to allow for position taking including parallel indexing.
- 1.9.3 Vessels transiting this area would not typically expect crossing situations as most ships would be on a northwesterly route. However, there were instances where tugs and tows could be expected to leave the TSS bound for ASSPU.
- 1.9.4 According to the Standard Operating Procedures (SOP) of the VTIS, safety broadcasts were issued to advise vessels about other vessels in the TSS such as those constrained by their draught, vessels not under command as well as vessels restricted in their ability to manoeuvre⁸², when these vessels inform VTIS of their condition. Hourly broadcasts were also done for long and unwieldy tows⁸³. There was also a SOP to transmit a list of vessels constrained by draught using NAVTEX⁸⁴ so that other vessels in the vicinity of these vessels are aware of the presence of such vessels.
- 1.9.5 The VTIS operator would also issue a navigational warning or advice if there was a potential risk of collision between the vessels and a tug and their tows.
- 1.9.6 In responding to the investigation team's query on the possibility of providing regular broadcasts for tugs and tows in the TSS, the VTIS indicated that due to busy traffic in the TSS, frequent broadcasts over the VHF may be arduous and prove to be impractical causing more VHF noise.

1.10 Environmental Factors

- 1.10.1 The weather was fine with visibility of about 3nm to 5nm. The wind was light with slight seas and swell. The predicted tidal streams at the TSS (off Tuas View) on 7 February 2019, was about north westerly at about 0.4kt.

During the hours of darkness, the north side of the TSS could be bright from the Singapore skyline, as compared to the relatively darker coastline to the south.

⁸² Such vessels are required to display specific lights under COLREGs. Typically tugs towing vessels are not restricted in their ability to manoeuvre unless explicitly displaying such lights.

⁸³ Typically, this would mean where the length of the tow exceeded 300m, or oil rigs, dead ships, barges loaded with oversized cargo/structure etc.

⁸⁴ Navigational Telex – A receiver fitted on vessels that automatically receives maritime safety information specific to the area where the vessel is operating.

2 ANALYSIS

2.1 Conduct of navigation and passage planning by the tug and tow

2.1.1 In reviewing the conduct of navigation of the tug and tow, the investigation team first looked at the three passage plans.

- I. The original (first) passage plan - At about 0240H, when the tug and tow were about 4nm from ASSPU, the CO observed two vessels anchored at ASPH were near the planned passage. It was deemed reasonable for the CO to determine that a change in passage plan was required, considering that Koi 3 would need a speed of less than 1kt (0.7kt) to maintain the ETA of 0800H, and that at such a low speed the tug and tow could pose a risk to traffic within the TSS and to the anchored vessels, as it could drift due to the tidal stream.
- II. The revised (second) passage plan – The CO’s decision to thus steer on this plan (which was also pre-loaded into the GPS), taking the tug and tow away from Sudong anchorages towards Nipa island (outside of the TSS) was appropriate as it would have facilitated the tug and tow to wait⁸⁵ outside the TSS, as discussed below.

Revised passage plan	Course and Distance	Remarks
WP 2 to WP 3a	270°T x 3nm	Tug and tow position at about 0240H
WP 3a to WP 4a	308°T x 1.3nm	Wait outside the TSS for daybreak
WP 4a to ASSPU	038°T x 2nm	COLREGs Rule 10c – Crossing the TSS

Table 7

Following this passage plan, the tug and tow could proceed at a speed of about 2.5kt when crossing the TSS from WP 2 to WP 3a and thereafter to arrive at WP 4a at about 0445H.

From 0445H to about 0700H, the tug and tow could have waited outside the TSS⁸⁶, for daybreak before crossing the TSS on a heading of about

⁸⁵ According to the revised passage plan, the distance from WP4 to ASSPU was about 2nm. At full speed of about 3kt would allow the tug and tow to safely cross the TSS during daylight hours for 0800H ETA.

⁸⁶ To avoid impeding the passage of the vessels using the TSS.

038°T (right angles to the general direction of traffic flow) and at a speed of about 2kt for the ETA of 0800H.

- III. The improvised (third) passage plan – At about 0310H, the CO, prematurely altered to starboard and steered towards ASSPU without verifying the tug and tow’s position relative to ASSPU, which was thus deemed inappropriate by the investigation team.

Improvised passage plan	Course and Distance	Remarks
0310H to WP 3b	270°T x 1nm	
WP 3b to WP 4b	308°T x 1nm	Heading following the TSS orientation
WP 4b to ASSPU	000°T x 1.7nm	Exiting the TSS
Total Distance	3.7nm	
Constant speed required	About 0.8kt	Throughout the passage the tug and tow would be inside the TSS.

Table 8

- 2.1.2 If the CO had maintained the revised passage plan the tug and tow would have crossed the TSS from WP 4a, allowing the tug and tow to cross the lane on a heading (038°T) as nearly as practicable at right angles to the general direction of traffic lane (308°T), as required under COLREGs Rule 10 and provided a better situational awareness to the bridge team of Koi 3 for monitoring traffic coming up from south of Raffles Lighthouse.
- 2.1.3 Although, the CO was reportedly familiar with the route (exiting TSS towards ASSPU), having made the trip in the past, the reason for the improvisation of the revised passage plan and the premature deviation could not be established. As can be seen from the table above, the CO’s assessment that the tug and tow might be late for making the ETA if the revised plan was followed, appeared incorrect and unfounded. Considering the intended deviation, it would have been appropriate for the CO to consult the Master for making an informed decision.
- 2.1.4 Every vessel is required to maintain a proper lookout by sight and hearing as well as all available means appropriate to the prevailing circumstances and conditions so as to make a full appraisal of the situation and risk of collision. Although SS’ presence was noted about six minutes prior to the collision, which was also followed by overhearing the VHF conversation between VTIS and

SS, and the CO reduced Koi 3's speed to increase the passing distance of SS from Koi 3's bow, likely from the assessment of the crossing situation, SS' alteration towards port two minutes prior did not allow sufficient time for the bridge team of Koi 3 to react.

2.2 Identification of the tug and tow

2.2.1 Although Koi 3 was displaying the lights of a vessel engaged in towing, it was evident that Koi 5 was not lit as required under COLREGs for a vessel being towed, thus making the presence of the barge visually indistinct to other vessels in the vicinity, especially in the hours of darkness on a moonless night. There was also no attempt by the crew of Koi 3 to use a searchlight to warn other vessels in the vicinity, of the barge's presence.

2.2.2 The investigation team noted the risk posed by unmanned barges under tow (in this case Koi 5) to traffic in the TSS, especially in the hours of darkness on a moonless night. It is the responsibility of the flag Administration (where the barge is registered to ensure compliance) and also the Master of the tug which undertakes a towing voyage, to ensure the tow does not pose a risk to other vessels by virtue of being inadequately lit.

2.2.3 The name of the tug in the AIS is pre-programmed to reflect its identity. Although there are no statutory requirements for barges like Koi 5 to be fitted with an AIS transponder, the investigation team held the view that there is merit⁸⁷ in doing so. Having such a provision would provide additional information for the benefit of other ships as well. Regardless, it must be recognised that a prudent navigator should use information from all available means to make an informed assessment and not rely on any single piece of information.

2.3 Conduct of navigation by SS

2.3.1 The CO of SS had recognised that SS would likely pass ahead of Koi 3 at a close range in the crossing situation. However, the investigation team could not establish the reason for SS' course to be altered to port being a stand-on⁸⁸ vessel.

⁸⁷ Barges normally do not have any source of electrical power. The investigation team recognises that solar powered AIS transponders are fitted on fishing nets in some parts of the world, which provide indications to ships about the presence of fishing nets in the vicinity.

⁸⁸ COLREGs Rule 17(c) – *A power driven vessel which takes action in a crossing situation...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*".

- 2.3.2 The SS' SMS was intended to provide for an effective management and utilisation of all resources, human and technical, available to the bridge team to ensure the safe completion of the vessel's voyage.
- 2.3.3 Despite the requirements in the SMS and the approved passage plan, the bridge was not manned in accordance with the passage plan during the earlier stages of the transit, i.e. BW level III, which required the presence of four persons, as well as later on BW level II, which required the presence of three persons. At the time of occurrence SS was at BW level I, i.e. only two persons were on the bridge. The investigation team also noted that when the ASD-2 who was performing the role of a lookout was tasked to become the helmsman, there was no dedicated lookout on the bridge of SS.
- 2.3.4 Prior to the collision, there were some triggers available to the bridge team of SS. These triggers included the CO noting three white masthead lights (indicating a tug engaged in towing), being advised by VTIS West to watch out for the tug and (underline emphasis added) tow ahead, as well as the call from TL, all of which indicated that a tug engaged in towing an object was ahead of SS.
- 2.3.5 Like Koi 3, it was likely that the bridge team of SS too had not maintained an effective lookout. They had not utilised all available means, such as the radar's target echo (the target echo of the barge was visible on TL and VTIS' radar) to correlate the information available and had incorrectly assumed that Koi 3 was just a tug and not towing anything. The CO's over-reliance on the AIS feeding target information into the ECDIS (which did not show any AIS signal astern of Koi 3) could likely have influenced this assumption.
- 2.3.6 As recognised by the UK MAIB's investigation report, as well as in the IMO's Resolution 1106(29), it must be remembered that the AIS is one of the many navigational aids on a vessel which supports the decision-making process for the bridge team and should not become relied on entirely. This occurrence highlighted the importance of making use of all the resources on board to have a better situational awareness and to react accordingly.
- 2.4 Loss of situational awareness by the crew of SS
- 2.4.1 While Koi 5 was not adequately lit as required for an object under tow, considering the triggers that were available, it would have been better for SS' speed to be reduced to allow more time to assess the situation. It could not be established why the ASD-2 (when performing the role of a lookout) did not provide feedback or inform the CO about the three white masthead lights being

displayed in a vertical line by the tug (Koi 3) and yet there was nothing visible astern of it. While there is no certainty that the CO would have taken actions based on the ASD-2's feedback, it would have probably raised the level of awareness of the CO.

2.4.2 Instead of having an overall assessment of the targets in the vicinity to maintain a proper lookout and increase situational awareness, the CO was involved in plotting the positions of SS on the chart at frequent intervals. This likely resulted in the CO not paying attention to the targets displayed on the radar appropriately for ensuring the safety of navigation.

2.4.3 These actions reflect a lack of situational awareness of the area where SS was transiting. It is always extremely important for all members of the bridge team to be situationally aware and fully familiar with the COLREGs for ensuring the safety of navigation.

2.5 Plotting SS' position

2.5.1 The investigation team recognised the importance of plotting ship's position at regular intervals especially during coastal navigation, even with the presence of an ECDIS, as paper charts were as a back-up to the ECDIS.

2.5.2 To plot positions on the paper chart, would require the CO to alternate between the forward part of the wheelhouse to the chart room (separated by a curtain) every five minutes. As discussed earlier, SS was already operating at a reduced BW level prior to the collision while transiting the TSS. Noting the need for plotting the ship's position on the paper chart, maintaining the required BW level as per the SMS was even more necessary, as the additional person could have been utilised for plotting these positions and supporting the CO to perform the navigational watch effectively.

2.6 Maintenance and use of shipboard equipment

2.6.1 The investigation team further noted with concern the dangerous practice (see paragraph 1.5.6 and footnote 75) of the SS' bridge team using the green laser beam to scan the horizon and search for the barge.

2.6.2 It was further gathered that it was a common practice on board SS to use the green laser light to capture attention of the ships in the vicinity. Such a practice, not only is not permitted under COLREGs, was not as per the SMS and also reflected poor seamanship practices adopted by the bridge team of SS.

- 2.6.3 The use of a non-approved method for capturing attention, as well as the lack of knowledge on the status of the signalling lamp and the manoeuvring light were evident that the SMS was not effectively implemented on board SS.
- 2.7 Capsize of the tug
- 2.7.1 Koi 3 was not fitted with a gob rope, which could have minimised the chances of the tug to capsize when SS collided with the barge. All tugs involved in towing must be fitted with a gob rope to avoid girting and to minimise the risk of capsizing.
- 2.7.2 Post salvage, the investigation team noted that tug's windows and other openings to machinery spaces were found open and doors were latched in open position. It is likely that when the girting of the tug took place, sea water started to enter these openings and caused a rapid flooding of the spaces, causing the tug to sink almost instantly, giving very little reaction time to the crew who became trapped inside. It is extremely important that the water-tight integrity of vessels is not compromised at any time, as situations can change drastically.
- 2.8 Incidental observations
- 2.8.1 The lack of safety broadcasts by VTIS was not deemed as a contributing factor in this case. Noting that if a tow which is not well lit could pose a risk to traffic in the TSS, the investigation team recognised the merit of having safety broadcasts at reasonable intervals to advise ships in the TSS to monitor and be aware of the presence of such tows, especially during the hours of darkness.
- 2.8.2 Although hourly broadcasts were done by the VTIS for long and unwieldy tows, for other tows, such advisory was only issued when there is a risk of collision, as was in this case. The investigation team held the view that if a broadcast is made at regular intervals about a tug and tow, it not only helps to enhance the awareness of ships in the vicinity these ships could also provide a feedback if the tow is not well lit, as required, allowing for earlier intervention from the VTIS with the towing tug.
- 2.8.3 The investigation team is aware that such additional VHF broadcasts may add to the already arduous tasks of the traffic controllers, particularly during the heavy volume of traffic, technological advances to improve situational awareness for tug and tows could be considered.

3 FINDINGS

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 During the passage of the tug and tow in the Singapore Strait TSS, to minimise the risk of navigating close to anchored vessels, the passage plan was revised by the CO, who had the conn of the tug.
- 3.2 Although the revised plan would have taken the tug and tow outside the TSS to await daylight crossing towards ASSPU, the CO's decision to prematurely alter the course towards Singapore while still within the TSS was based on an unfounded assumption and the Master of the tug was not consulted.
- 3.3 The barge being towed by the tug was not adequately lit as required under COLREGs when it was transiting the TSS and this posed a danger to the safety of navigation for vessels navigating within the TSS.
- 3.4 Although Koi 3 was displaying lights for a vessel engaged in towing, its bridge team did not warn other vessels of the barge's presence astern of it. The bridge team of Koi 3 had little time to react when SS altered course towards Koi 5 two minutes prior to the collision.
- 3.5 The tug was not fitted with a gob rope that could have avoided girting and minimised the chances of the tug capsizing after the SS collided with the tow. The doors and windows and other openings of the tug were kept open, which resulted in sea water entering the tug rapidly during girting and its subsequent capsize, resulting in very little reaction time for the crew.
- 3.6 SS was being navigated at lower bridge watchkeeping levels than what had been prescribed within the SMS and did not have a dedicated lookout. The CO of SS altered course to port in a crossing situation despite being the stand-on vessel.
- 3.7 The CO of SS had missed the triggers indicating the presence of a tug and tow such as the presence of towing lights on the tug, advice by a vessel nearby and the VTIS. This missing out of the triggers by the CO could be attributed to the time spent in the chart room and the over-reliance on the AIS target information on the ECDIS.

- 3.8 With the OOW busy with plotting the positions of the ship and the ASD-2 toggling between being a helmsman and a lookout, the bridge team of SS had a degraded level of situational awareness.
- 3.9 The non-functioning of the signalling lamp and the manoeuvring light; the use of the laser pointer to capture the attention of other ships and to scan the horizon were indicative of lack of effective implementation of the SMS on board SS.
- 3.10 Considering the potential hazards posed by tugs and tows, such as possibility of objects being inadequately lit, there is merit to explore technological means to enhance situational awareness of the ships in the TSS.

4 SAFETY ACTIONS

4.1 By the Owner of Koi 3⁸⁹ and Koi 5

4.1.1 Issued fleet-wide instructions (other tugs) to ensure that the passage plan to be completed before the start of voyage. The plan is to be discussed among the bridge team members (Master and Officers) on all pertinent information concerning the passage. Any deviation to the original passage plan, the Master to be consulted before executing the change.

4.1.2 Issued fleet-wide instructions for its other tugs to, besides the usual reporting to VTS, to shine the tug's searchlight on the barge to increase the visibility of the barge in the hours of darkness and/ or to warn approaching vessel of the presence of the barge.

4.2 By the Company of SS

4.2.1 Refresher training on COLREGs for actions to avoid collision.

4.2.2 Refresher training of the Company's SMS on duties and navigational operation safety manual.

4.2.3 Carried out passage plan training on the importance and understanding the details of the navigational waters and navigational hazards, expected during the passage, before commencement of each voyage.

4.2.4 Carried out training on Risk Assessment for the passage plan to identify possible risks and thus, to develop preventive measure in advance to control and reduce the risk.

⁸⁹ As a result of the collision, Koi 3 was declared as "Total Loss" while Koi 5 was sold.

5 SAFETY RECOMMENDATIONS

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

5.1 For the Flag Administration of Koi 3 and Koi 5

5.1.1 To ensure that the objects being towed are fitted with and display appropriate lights and shapes as required under COLREGs. **[TSIB Recommendation RM-2021-15]**

5.2 For the Owner of Koi 3 and Koi 5

Although, the Owner had ceased ownership of Koi 3 and Koi 5, the investigation team recognised the relevance of issuing the Safety Recommendations, as the Owner owns and manages other tugs and barges.

5.2.1 To ensure that the objects being towed are fitted with and display appropriate lights and shapes as required under COLREGs. **[TSIB Recommendation RM-2021-16]**

5.2.2 To ensure that the tugs involved in towing operation are fitted with and use a gob rope to avoid girting to minimise the chances of the tug capsizing. **[TSIB Recommendation RM-2021-17]**

5.2.3 To ensure that the water-tight integrity of the tug is preserved by requiring openings, doors and windows to be closed to minimise the rapid flooding of the compartments. **[TSIB Recommendation RM-2021-18]**

5.3 For the Company of SS

5.3.1 To review and amend the Company's SMS for ensuring that the inspection regime of all equipment listed in the Record of Cargo Ship Safety Equipment (Form E) as fitted is effective. **[TSIB Recommendation RM-2021-19]**

5.3.2 To review and amend the Company's SMS to ensure Bridge Watch levels are maintained as per the requirements of the SMS and the passage plan. **[TSIB Recommendation RM-2021-20]**

5.4 For the service provider of the vessel traffic information system

5.4.1 To explore using technological advances for enhancing the situational

awareness of the ships using the Traffic Separation Scheme (TSS) regarding the presence of tugs and tows in the vicinity. **[TSIB Recommendation RM-2021-21]**

- **End of Report** -