Final Report

COLLISION

BETWEEN

CHEMROAD MEGA AND SINICA GRAECA

OFF HORSBURGH LIGHTHOUSE

SINGAPORE TERRITORIAL WATERS

17 AUGUST 2017

MIB/MAI/CAS.020

Transport Safety Investigation Bureau
Ministry of Transport
Singapore

28 June 2019

The Transport Safety Investigation Bureau of Singapore

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

The sole objective of TSIB's marine safety investigations is the prevention of marine accidents and incidents. The safety investigations do not seek to apportion blame or liability. Accordingly, TSIB reports should not be used to assign blame or determine liability.

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SYNOPSIS

On 17 August 2017, the Panama-flagged chemical tanker Chemroad Mega and the Marshall Islands-flagged bulk carrier Sinica Graeca were involved in a collision at the eastern approaches to the Singapore Strait, about eight nautical miles northeast of Horsburgh Lighthouse, in Singapore Territorial Waters.

Before the collision, Chemroad Mega, loaded with 26,229 metric tonnes (tonnes) of methyl alcohol, had left the Singapore Strait Traffic Separation Scheme and was heading about 049°True, at about 14 knots. Sinica Graeca, loaded with 49,500 tonnes of coal, was heading about 300°True at about 10 knots, to eventually join the westbound lane of the Singapore Strait Traffic Separation Scheme. Before the collision, Sinica Graeca encountered patches of localised heavy rain.

Sinica Graeca's bunker tank was ruptured as a result of the collision, and a loss of about 200 tonnes of fuel oil into the sea was reported. Both vessels were rendered unfit to continue their respective passage, in the opinion of their respective Masters. There were no injuries reported.

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

The investigation revealed that Chemroad Mega's bridge composition was downgraded prematurely resulting in inadequate bridge composition for the area of its operation, density of traffic and prevailing conditions. The Officer on Watch did not call the Master, as required by the Master's standing orders, when the AIS transmission ceased or visibility deteriorated. While taking actions to avoid collision, the bridge team did not sound signals as required.

The bridge team of Sinica Graeca did not maintain a proper lookout by sight and all available means on board to maintain situational awareness and did not assess risk of collision with Chemroad Mega. In addition, Sinica Graeca's course was altered without proper assessment in an area which had hampered her visibility due to rain and sound signals for operating in restricted visibility were not used. The investigation also revealed that there was ineffective application of Bridge Resource Management and watchkeeping principles on board Sinica Graeca in the run up to the collision.

VIEW OF VESSELS

CHEMROAD MEGA

SINICA GRAECA

DETAILS OF VESSEL

Name	CHEMROAD MEGA (CM)	SINICA GRAECA (SG)
IMO No.	9228318	9717486
Flag	Panama	Marshall Islands
Classification Society[1]	Nippon Kaiji Kyokai (Class NK)	Lloyds Register
ISM[2]	Class NK	Bureau Veritas
Ship Type	Oil & Chemical Tanker	Bulk Carrier
Builder	Shin Kurushima Dock, Japan	Yangzhou Dayan, China
Year	January 2000	November 2013
Owner	SCP Tankers S.A.	Sinica Graeca Shipping Ltd
Company	IINO Marine Service Co. Ltd	Angelakos (Hellas) SA
Gross tonnage	20,043	35,884
Length overall	174.38m	199.99m
Breadth moulded	27.70m	32.26m
Depth moulded	16.00m	18.50m
Designed Draft	10.02m	13.30m
Summer Freeboard	6.01m	5.23m
Main Engine(s)	Mitsubishi 6UEC 52LS / Set 7493 kW x 120 rpm	MAN B&W 5S6OME-C8.1 -TH 8300 Kw x 91 rpm
Propeller	1 x Right-Hand propeller	1 x Right-Hand propeller

[1] 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.

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

1 FACTUAL INFORMATION

All times used in this report are Singapore Time (H=UTC[3] + 8H).

1.1 Narrative according to CM

1.1.1 On the morning of 5 August 2017, CM departed Mesaieed, Qatar, after loading 26,229 tonnes of methyl alcohol, for Taiwan. On passage, the vessel was scheduled to take bunkers at the port of Singapore.

1.1.2 On 17 August 2017, at about 0448H, the CM arrived and anchored at Sudong anchorage, Singapore, for taking of bunkers. At about 1354H, the vessel departed the anchorage area and joined the eastbound lane of the Singapore Strait Traffic Separation Scheme (TSS) at about 1415H.

1.1.3 Following the on-board passage plan, the bridge team's composition, at that time, was at bridge watch-keeping level (BW-II)[4] as per the company's Safety Management System.

1.1.4 At around 1950H, CM was on auto steering of 049°True (T) at 14.1 knots and was about 1.5 nautical miles[5] (nm) southwest of Horsburgh Lighthouse. The vessel's passage was to continue a straight course line to the next waypoint, taking her out of the TSS. The Master, after scanning the horizon and observing that there were three vessels in the TSS ahead proceeding in the same direction with the closest being about 1.5nm away, downgraded the composition of the bridge watch level from BW-II to BW-I[6], in accordance with the approved passage plan for this leg of the passage. The stage at which this level was to be attained was not specified in the plan, as it was typically at the Master's discretion.

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

[4] BW-II composition comprised of the Master, one Officer, a lookout and a helmsman, i.e. for harbour or transit through areas high traffic density.

[5] Knots (kts) is a unit of speed equal to one nautical mile (1.852km) per hour

[6] BW-I composition comprised of one Officer and a lookout, i.e. for transit through areas of less traffic density.

1.1.5 The Master, having been on the bridge for the past six hours since departure and ascertained that the Third Officer was comfortable with the traffic condition ahead, handed over con[7] with instructions[8] for him to be called whenever the Third Officer was in doubt. The Master also instructed the Third Officer to set the main engine at sea speed on "Full Away On Passage" (FAOP[9]) at 2000H. The Master left the bridge to freshen-up and to take his dinner. The Master had intended to return to the bridge after dinner to write his night orders before retiring for the night.

1.1.6 At that time, the BW-I comprised of the Third Officer, being the Officer on Watch (OOW), who was assisted by an Able Seafarer Deck (ASD) as a lookout. The Third Officer noted the weather was fair with light rain, with visibility of about 5nm. The skies were cloudy with occasional thunder and lightning.

1.1.7 Shortly after the Master left the bridge, there was thunder and lightning in close vicinity, followed by a loss of transmission alarm on the Automatic Identification System (AIS)[10]. The Third Officer acknowledged the AIS alarm but did not notify Master. Except for the AIS, all other navigational equipment continued to function normally[11].

1.1.8 At about 2000H, the Third Officer set the main engine for sea passage as instructed. The Third Officer, after scanning the horizon and consulting the Electronic Chart Display and Information System (ECDIS) with the AIS and automatic radar plotting aid (ARPA) overlay, had also identified the three targets ahead. (see **Figure 1**).

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[7] Con of the vessel means having command of the vessel's movement at sea

[8] Instructions written in the Master's order book and the Bridge Standing Orders (BSO), require the Officer on Watch (OOW) to notify the Master, among others, include, deteriorating visibility, traffic conditions or the movements of other ships are causing concern, difficulties in maintaining course, etc.

[9] CM's sea speed on FAOP at about 13 knots @ 114 rpm. Under normal operating condition, would require about half an hour for CM's engine to be reduced to manoeuvring speed @ 85rpm. According to Master's orders, OOW was fully authorised to use the engine at any time to avoid emergency..."

[10] The IMO Resolution A.917 (22) states that the purpose of the AIS is to identify vessels; assist in target tracking; simplify information exchange (e.g. reduce verbal mandatory ship reporting) and provide additional information to assist situation awareness. The on-board AIS broadcast a series of standardized information to achieve the purpose.

[11] Item 8h of the Master's BSO required the OOW to notify the Master, among others, includes, any malfunction or breakdown of radio equipment, main engine, navigational equipment, etc. AIS formed a part of the navigational equipment.

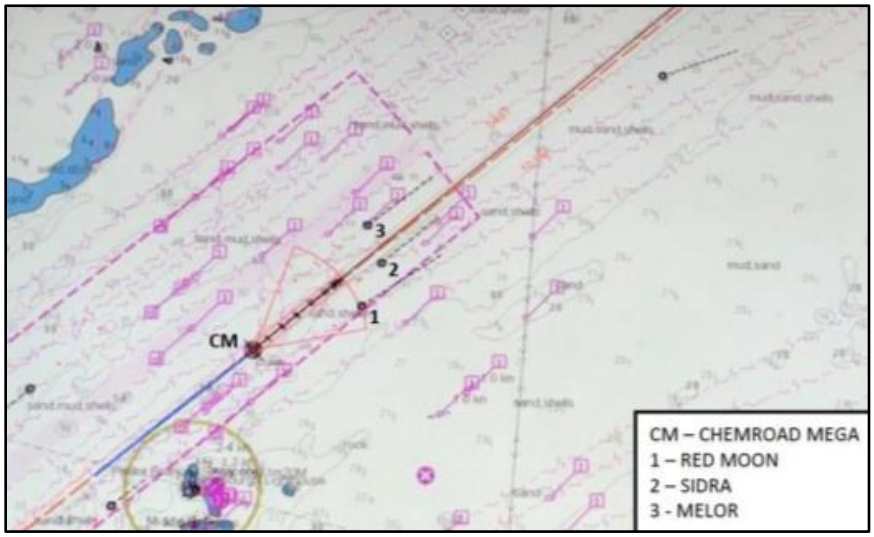

Figure 1: CM's ECDIS display with AIS and ARPA overlay at 2000H

1.1.9 The three targets' positions indicated on the ECDIS display, beginning with the closest distance to CM, are indicated in **Table 1**:

Number	Name	Distance	Bearing	Remarks
No.1	Red Moon	1.5nm	1.5 points[12]	On CM's starboard bow
No.2	Sidra	2.0nm	0.5 point	On CM's starboard bow
No.3	Melor	2.2nm	0.5 point	On CM's port bow

Table 1: Details of other vessels in CM's vicinity as observed at 2000H

1.1.10 The Third Officer identified that CM was in an overtaking situation with the three vessels. He further determined that, if he maintained CM's course and speed, Melor would pose a concern, considering that she was on a converging course which could result in a close quarters situation during the overtaking.

1.1.11 The Third Officer thus altered CM's heading slightly to port to overtake Melor and the other two vessels from CM's starboard side.

[12] A point is about 11.25 degrees (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.

1.1.12 By about 2010H, the Third Officer observed that visibility had reduced to less than 5nm as a result of light rain. The Third Officer, using the binoculars, scanned the horizon and having satisfied that the stern lights of the three vessels ahead were still visible, did not notify the Master of the change in weather conditions[13].

1.1.13 At about 2016H, the Third Officer observed a new target on the ECDIS, about three points on CM's starboard bow, identified as SG at about 3.7nm. The ECDIS information further indicated that SG's closest point of approach (CPA) with CM would be 0.5nm (crossing CM's bow), in about 12 minutes. (See **Figure 2**).

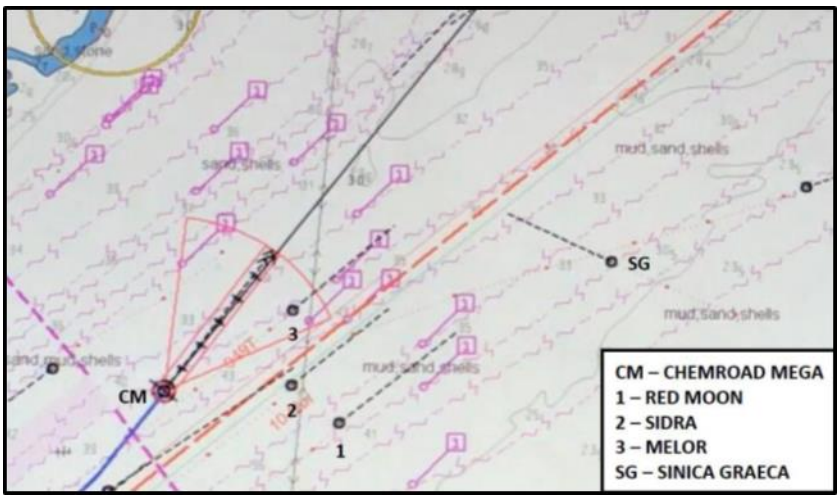

Figure 2: CM's ECDIS showing vessels of interest at 2016H

1.1.14 At about 2018H, using the binoculars, the Third Officer visually confirmed that SG was displaying two white lights (masthead lights) and a red light (sidelight). The Third Officer assessed that there was a risk of collision, his vessel was the give-way[14] vessel in the crossing situation[15], and that he would be required to keep well clear of SG.

[13] Item 8a of the Master's BSO require the OOW to notify the Master when the vessel encounter deteriorating visibility of less than 5nm and restricted visibility encountered or expected less than 3nm.

[14] COLREGs Rule 16 – Action by Give-way vessel *means 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.*

[15] COLREGs Rule 15 – Crossing Situation *means 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 circumstances of the case admit, avoid crossing ahead of the other vessel.*

1.1.15 The Third Officer assessed that SG was likely going to join the westbound lane of the TSS. To give way to SG, the Third Officer planned to alter CM's heading to starboard so as to increase the passing distance away from SG's stern, after CM had overtaken Melor. The Third Officer was confident that he would be able to take appropriate collision avoidance actions and hence did not see the need to inform the Master (see footnote 8).

1.1.16 By about 2020H, the Third Officer noted that SG, which was about 2.4nm and was maintaining a nearly constant bearing at about three points on CM's starboard bow with the bow crossing range, now reduced to 0.3nm.

1.1.17 Satisfied that Melor, Sidra and Red Moon would not pose any problem, the Third Officer instructed the ASD to put CM on hand steering with the intention[16] to alter course to starboard to pass SG's stern. (See **Figure 3**).

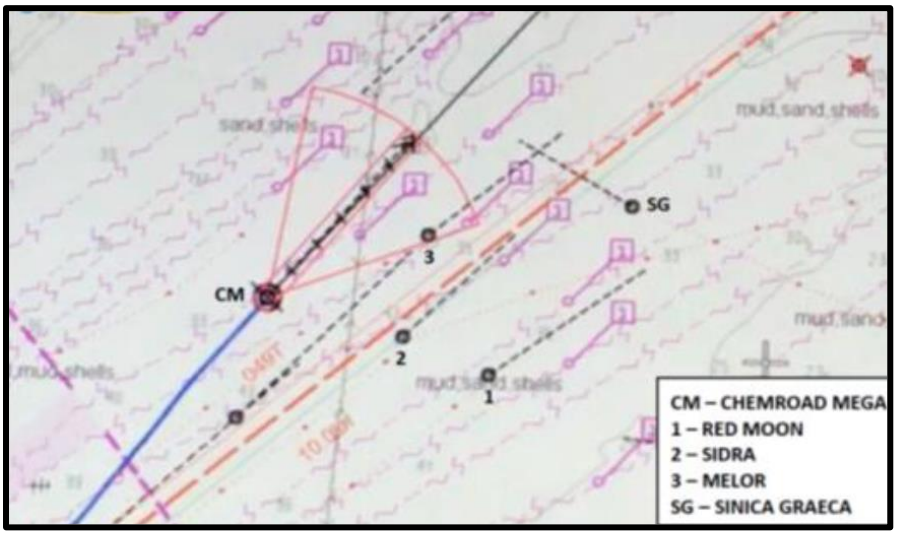

Figure 3: CM's ECDIS showing vessels of interest at 2020H

[16] The Third Officer did not feel the need to reduce the ship's speed from 114 RPM for executing his plan to keep well clear of SG.

1.1.18 At around 2021H, the Third Officer ordered a helm of about five degrees to starboard towards SG's stern. The Third Officer intended to turn CM slowly towards starboard while maintaining a passing distance of about 0.5nm with Melor. At around 2024H, the Third Officer ordered an amendment to the helm to 15 degrees. By this time, CM was on a heading of about 044°T and doing about 14.2 knots.

1.1.19 By about 2025H, the Third Officer confirmed that SG at 0.8nm away was at two points on the starboard bow and was visually seen displaying two white masthead lights and a red sidelight. CM's heading continued to turn to starboard, as planned. (See **Figure 4**).

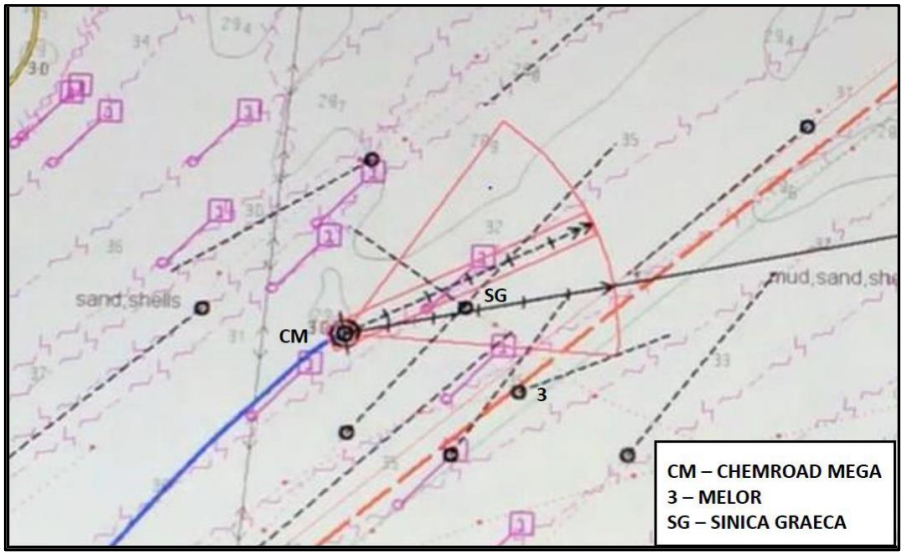

Figure 4: CM's ECDIS showing SG nearly ahead (bow crossing aspect)

1.1.20 When both vessels were about 0.5nm away from each other, the Third Officer observed SG was now showing both sidelights (red and green), which was later followed by her showing a steady green sidelight, indicating that SG had altered its course to port towards CM instead of its expected display of a red sidelight.

1.1.21 Drawing close to SG, the Third Officer instructed the ASD to put the wheel hard to starboard. At a time recorded as 2027H, CM's bow collided with SG's starboard side, in-way of no.2 cargo hold. Both vessels separated after the collision but remained in close vicinity.

1.2 After the collision - CM

1.2.1 Immediately after the collision, the Master arrived on the bridge and took over the con. He stopped the engines and sounded the ship's general alarm followed by an announcement on the public address system, informing the crew of the collision.

1.2.2 The Master then notified the Singapore Vessel Traffic Information System[17] (VTIS) and made a general safety broadcast on VHF Ch.16 and Inmarsat-C[18].

1.2.3 A damage inspection carried out on-board CM indicated that there were no injuries or oil pollution. As a result of the collision, CM lost both anchors and sustained a hull breach above the water line in-way of the bow, which in the opinion of the Master rendered the vessel unfit to continue its passage. (see **Figure 5**)

Figure 5: CM undergoing repairs in dry-dock

[17] The Maritime and Port Authority of Singapore (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.

[18] Inmarsat C is a two-way store and forward communication system that transmits messages in data packets in ship-to-shore, shore-to-ship and ship to ship communication.

1.3 Narrative according to SG

1.3.1 On the morning of 13 August 2017, SG departed Samarinda, Indonesia, after loading 49,500 tonnes of coal and was bound for India. During this voyage, SG was scheduled to take bunkers at the port of Singapore.

1.3.2 On 17 August 2017 at about 1830H, in fair weather, cloudy skies with visibility of about 5nm, the bridge team comprised of the Master who had the con of the vessel, the Chief Officer as the OOW, for supporting the Master in navigation and radar watch, an ASD and an Ordinary Seaman (OS). The ASD was on hand steering while the OS was performing the role of a lookout.

1.3.3 As per the company's Safety Management System (SMS) on pre-arrival checks, all navigational aids were operational, checked and working satisfactorily. Both radars (X and S-band) with automatic radar plotting capabilities and ECDIS had the AIS overlay.

1.3.4 The bridge team had set both radars at 6nm range scale (ranges toggled depending on traffic of concern), with a head-up and relative motion display. Both the radars had their centre off-set for greater coverage of the traffic condition ahead.

1.3.5 Following the passage plan, SG was steering a course of 282°T doing a manoeuvring speed of about 10.7 knots and heading towards way-point No.14 (WP-14), which would take the vessel towards the westbound lane of Singapore Strait TSS. In the Master's opinion, the traffic in Singapore Strait was normal, based on his prior experience having navigated the area on several occasions.

1.3.6 At about 2000H, SG under the Master's con was being steered on 285°T and doing about 10 knots. She was about 5.7nm away from WP-14, when the Chief Officer handed over the navigation watch to the Third Officer and stayed on the bridge on his own accord. SG's bridge had five persons at this time.

1.3.7 The Third Officer, upon taking over watch, observed from the radar display several vessels within the clutter of rain clouds near WP-14 and informed the Master accordingly. (see **Figure 6**).

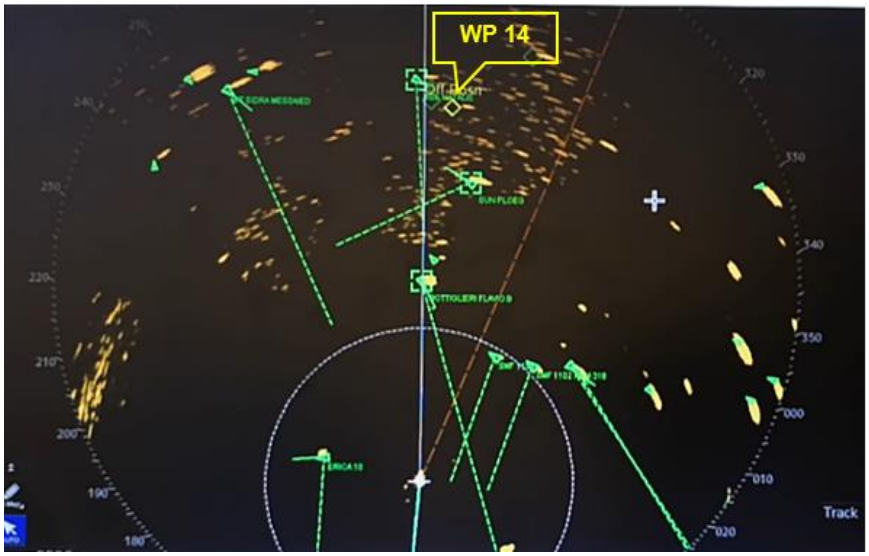

Figure 6: SG's X-Band radar display at 2000H on head-up display

1.3.8 At about that time, the bridge team observed that the weather had deteriorated. Occasional patches of heavy rain had caused visibility to reduce to less than 1nm. The condition of heavy rain could be heard from vessel's Voyage Data Recorder (VDR) playback. The bridge team did not make any sound-signal[19] during this period.

1.3.9 At about 2010H, SG's heading was 293°T and she was at about 9.7 knots. The Third Officer informed the Master of three northeast-bound targets which were visible both on the radar and ECDIS, at about same distance from SG's port bow, exiting the eastbound lane of the Singapore Strait TSS (see **Table 2**).

Number	Name	Distance	Bearing	Remarks
No.1	Red Moon	about 4nm	4 points	On SG's port bow
No.2	Sidra	about 4nm	3.5 points	On SG's port bow
No.3	Melor	about 4nm	3 points	On SG's port bow

Table 2: SG's ECDIS display with AIS and ARPA overlay at 2010H

[19] COLREGs Rule 35 (Sound Signals in Restricted Visibility), requires vessels, in or near an area of restricted visibility, whether by day or night the signals prescribed in this Rule shall be used as follows:
(a) "*A power-driven vessel making way through the water shall sound at intervals of not more than 2 minutes one prolonged blast*."

1.3.10 A radar target (without an AIS triangle) which appeared on the X-band radar, later identified as CM (circled red in **Figure 7**), was not observed or tracked by the bridge team. This target was not visible on the ECDIS display (see **Figure 7a**).

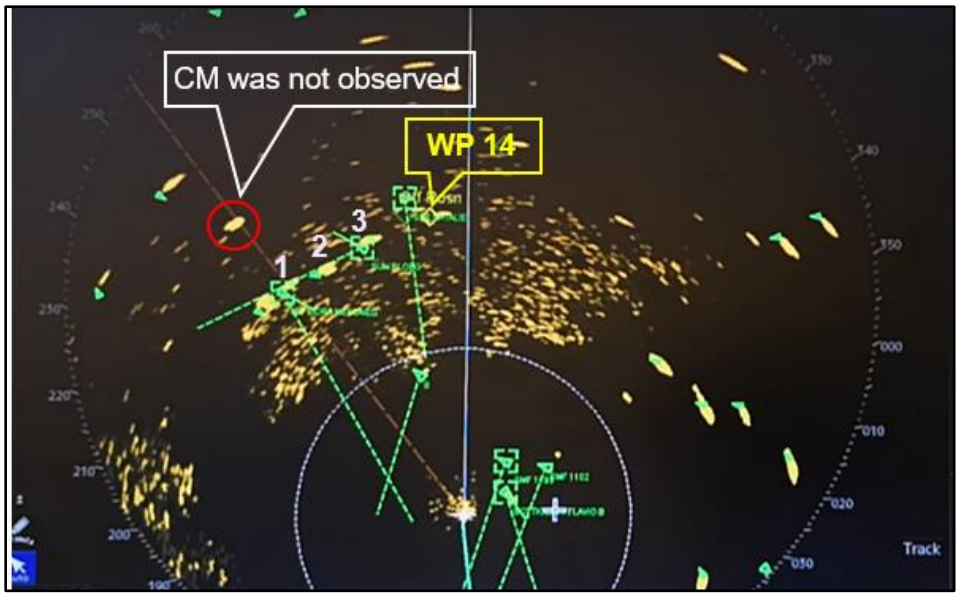

Figure 7: SG's X-Band radar display at 2010H showing CM (annotated red circle by TSIB)

Figure 7a: SG's ECDIS display (with AIS overlay) at 2010H

1.3.11 Of the three targets displayed on SG's radar, the Master deemed target No.3 (Melor) to be of concern which could develop into a close quarters situation (see **Figure 8**). The Master communicated with Melor on VHF Ch.16 and both vessels agreed that SG was to keep course and speed, while Melor would alter course to starboard, so as to pass astern of SG.

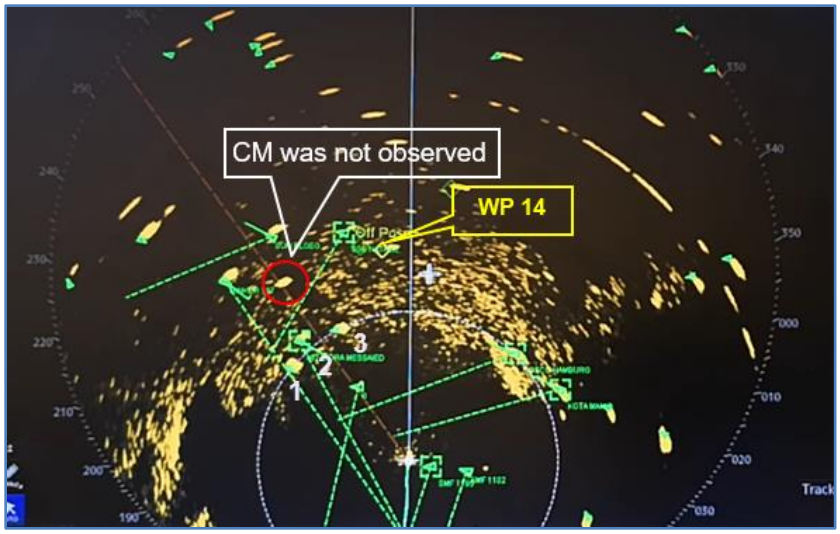

Figure 8: X-Band Radar display at 2016H

1.3.12 At about 2020H, the Master of SG, altered his vessel's heading further to starboard from 291°T to 300°T, to increase the passing distance between his vessel and Melor. By this time the other two vessels, i.e. Red Moon and Sidra were passing well clear on SG's port beam (see **Figure 9 and 9a**). There was no change in SG's speed.

Figure 9: SG's X-Band Radar display at 2020H

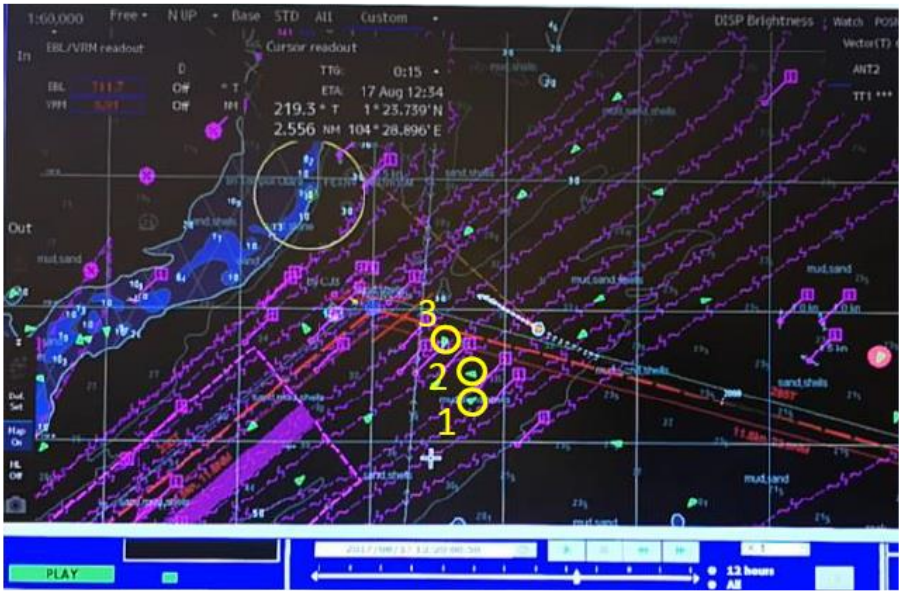

Figure 9a: SG's ECDIS display at 2020H

1.3.13 At about 2023H, with WP-14 bearing westerly (about 268°T) at 2.1nm from SG, the Master noted that Melor was about 0.5nm on the port beam and was heading easterly towards SG's stern.

1.3.14 The Master having ascertained that Melor had passed clear of SG's stern, gave a port helm of 15° to turn SG's heading anti-clockwise, slowly from 300°T to 268°T, towards WP-14, as his vessel was off-course by now. At that time, according to the bridge team, no other vessels were showing up on the radar and ECDIS.

1.3.15 During SG's turn to port towards WP-14, the Master who was standing at the conning[20] position, saw a silhouette of a vessel appearing suddenly about one point on SG's port bow.

1.3.16 The Master gave series of starboard helm orders[21] to reduce his vessel's port rate of turn. A visual confirmation using the binoculars showed that the vessel, later identified as CM, was displaying two white lights (masthead) and a green light (sidelight), which led him to think that CM would cross SG's bow.

[20] SG's conning position is situated forward of the steering stand along the centreline of the vessel. The position provides the navigator, with a commanding view of the ship when manoeuvring and control.

[21] Series of helms order as follows: Port 15° →Mid-ship →Hard-to-Starboard →Mid-ship

1.3.17 The Master checked the radar and noted that CM had not been acquired and was about 0.8nm away. The Master noting the green sidelight[22] which indicated that CM would likely cross SG's bow, reverted to port 15° helm with the intention to further increase the bow passing clearance and thus to pass starboard-to-starboard with CM. (See **Figure 10**).

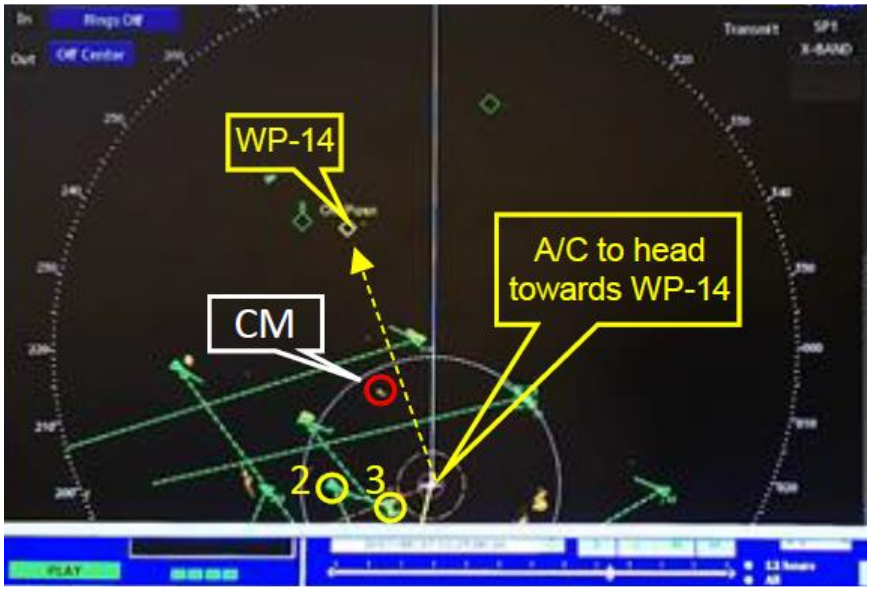

Figure 10: SG's X-Band radar display at 2025H

1.3.18 When both vessels were about 0.3nm apart, the Master noticed that the aspect of CM's white masthead lights began to change, and her sidelight was changing from green to red, indicating that CM had now altered her course to starboard towards SG.

1.3.19 The Master ordered for a hard-to-port on the wheel. At about 2027H, SG's starboard side, in-way of the no.2 cargo hold and no.2 bunker top side tank was struck by CM's bow. The collision resulted in an oil spill, later assessed by the crew of SG to be about 270 tonnes. Both vessels separated after the collision but remained in the close vicinity of each other.

[22] Indicating CM's likely path would be crossing SG's bow

1.4 **After the collision - SG**

1.4.1 Immediately after the collision, the Master stopped the engine and sounded the ship's general alarm followed with an announcement of the emergency.

1.4.2 The Master reported the occurrence to Singapore VTIS and made a general safety broadcast on VHF Ch.16 and Inmarsat-C.

1.4.3 The collision did not result in any injuries on SG, However, SG sustained damages to the ballast water topside tank, bunker tank and water ingress into the cargo hold. In the opinion of the Master, the collision rendered the vessel unfit to continue its passage. (See **Figure 11 and 11a**)

Figure 11: SG's no.2 cargo hold as viewed from water level

Figure 11a: View from inside of SG's no.2 cargo hold

1.5 CM's bridge team and statutory matters

Rank	Nationality	Joined CM	In-Rank Experience	Remarks
Third Officer (3O)	Filipino	15 January 2017	One year	Officer on Watch (OOW) for 0800-1200H/ 2000-2400H watchkeeping
Able Seafarer Deck	Filipino	4 April 2017	1.8 years	Assist as a lookout
Master	Republic of Korea	24 December 2016	7.7 years	Was having dinner in the mess room

Table 3

1.5.1 The records of hours of rest and work documented by CM were as per their company's SMS and indicated that the bridge team's rest hours were following the 'Hours of rest' requirements[23].

1.5.2 The Statutory certificates for CM and the bridge team were valid at the time of occurrence. Other than the loss of AIS signal before the collision, there was no report of any equipment or machinery failure.

1.6 SG's bridge team and statutory matters

Rank	Nationality	Joined SG	In-Rank Experience	Remarks
Master	Filipino	26 June 2017	Two months	First command and had the con
Third Officer	Filipino	27 April 2017	Four months	Officer on Watch (OOW) for 0800-1200H/ 2000-2400H watchkeeping

[23] 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).

Able Seafarer Deck 1	Filipino	20 January 2017	Six years	On hand steering
Ordinary Sailor	Filipino	20 January 2017	One year	Assisted as a lookout
Chief Officer	Filipino	27 July 2017	20 years	Stayed on the bridge after handing over watch to the Third Officer

Table 4

1.6.1 The records of hours of rest and work documented by SG were as per their company's SMS and indicated that the bridge team's rest hours were following the 'Hours of rest' requirements.

1.6.2 The Statutory certificates for SG and the bridge team were valid at the time of occurrence. There was no report of any equipment or machinery failure before the collision.

1.7 Weather condition

1.7.1 The weather was fair with pockets of light to heavy rain followed by thunder and lightning. The wind varied from southerly to south-southeast at about 15 – 20 knots, with moderate to rough sea condition. Visibility preceding the collision was about 5nm, which was significantly reduced to less than 1nm due to passing heavy rain.

1.8 Location of occurrence

1.8.1 The incident occurred within Singapore Territorial Waters, about 8nm northeast of Horsburgh Lighthouse[24], near the termination of, but outside the Singapore Strait TSS.

[24] Location of occurrence: Latitude 01°26.2N, Longitude 104°29.3'E.

1.8.2 Within this area, high traffic density and numerous crossing situations were expected, where vessel traffic exiting the northeast bound lane of the TSS might encounter crossing traffic[25] joining the southwest bound traffic lane. (See **Figure 12 and 12a**).

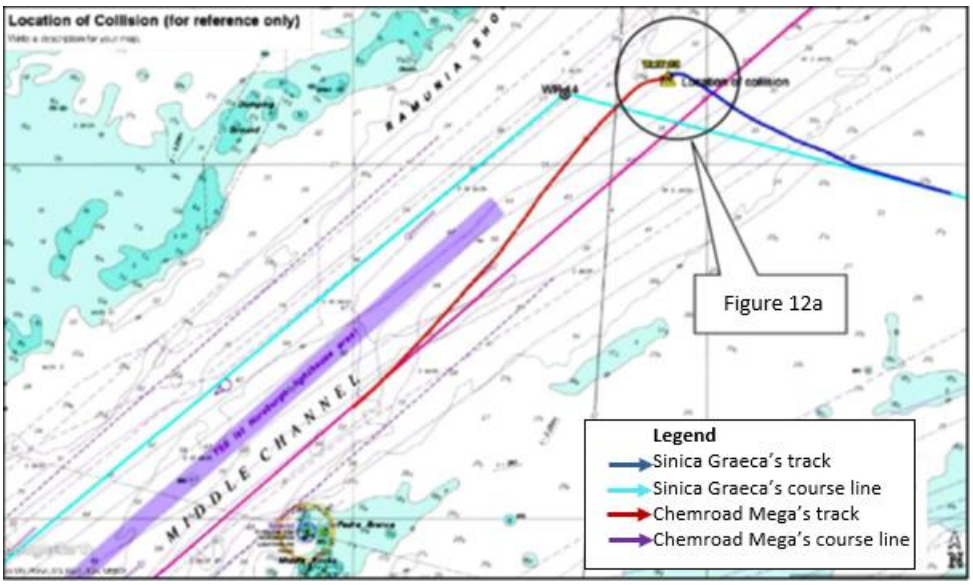

Figure 12: Location of collision

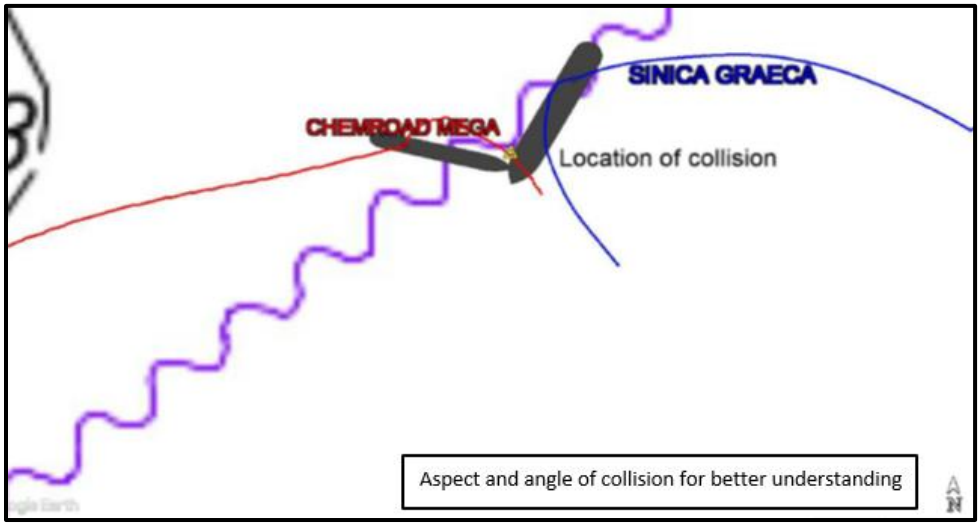

Figure 12a: Enlarged view of collision (Approximate and not to scale)

[25] COLREGs Rule 10 (f) – "navigating in areas near the termination of TSS shall do so with particular caution".

1.9 Identification of vessels

1.9.1 There was no VHF radio communication between CM and SG before the collision. VHF radio communication was established only after the collision for information exchange.

1.9.2 The playback of VTIS data also confirmed that CM's AIS was not transmitting[26] at the time of the collision.

1.10 Oil-spill detection

1.10.1 Once the incident was reported to Singapore VTIS, the MPA activated its oil spill contingency plan and broadcasted to vessels passing the area to report of any oil pollution sighting. Nil sighting of pollution was reported to Singapore VTIS by other vessels.

1.10.2 The Republic of Singapore Navy's and Singapore Police Coast Guard's craft patrolling the areas, like the other vessels in the vicinity, did not sight any oil pollution.

1.10.3 On the afternoon of 19 August 2017, the MPA conducted aerial surveillance of the incident area and no oil pollution[27] was sighted.

1.11 Bridge Resource Management

1.11.1 Effective Bridge Resource Management[28] (BRM) is part of a vessel's SMS, that begins at the initial passage planning stage and includes preparation of berth-to-berth operational matters.

[26] VTIS's target plot data combines information from radar overlay and AIS. The last known position of CM's plot was at 2014H.

[27] MPA's "Spill Modelling Prediction" indicated that the oil pollution trajectory eastward, away from the Singapore Strait.

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

1.11.2 BRM is the effective management and utilization 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 ship's operating condition.

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

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

1.11.4 Bridge team members of both vessels held valid training certificates for BRM.

2 ANALYSIS

2.1 Environmental condition and COLREGs

2.1.1 The collision took place at night with both vessels reporting different weather conditions, and thus, different levels of visibility as a result of one being within a patch of heavy rain, i.e. SG, while the other being outside that patch, i.e. CM.

2.1.2 COLREGs deems vessels to be in sight of one another only when one can be observed visually from the other[29]. As CM claimed to have visually sighted SG's masthead lights and port sidelight at 2018H, it was appropriate for CM's Third Officer's assessment to apply COLREGs Section II[30] instead of Section III (see Footnote 30), in particular, CM's role as the give–way vessel in a crossing situation with SG which was the stand-on vessel. However, CM had to delay taking avoiding action to give-way to SG as a result of overtaking manoeuvres that CM was performing with Melor.

2.1.3 The bridge team of SG claimed that they did not sight CM until about 2023H, i.e. about four minutes before the collision, and were thus applying Section III[31] of COLREGs, i.e. conduct of vessels in restricted visibility[32]. However, the bridge team did not sound signals as per COLREGs Rule 35(a), considering that SG was navigating in areas of restricted visibility.

2.1.4 CM, when altering course to starboard, as an action to avoid collision, did not indicate her manoeuvre as per COLREGs 34(a) and (b)[33]. Doing so may have aided SG's bridge team for a better understanding of CM's actions.

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[29] COLREGS Rule 3 (k)

[30] Section II - Conduct of vessels in sight of one another – Includes:
COLREGs Rule 15 - Crossing Situation - *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 circumstances of the case admit, avoid crossing ahead of the other vessel.*

[31] Section III – Conduct of vessels in restricted visibility – Applies to vessels not in sight of one another when navigating in or near an area of restricted visibility.

[32] Restricted Visibility means any condition in which visibility is restricted by fog, mist, falling snow, heavy rainstorms, sandstorms or any other similar causes.

[33] One short blast supplemented by one flash indicating alteration of course to starboard.

2.1.5 SG's initial port swing (when her course was altered towards WP-14) was not for collision avoidance, as at that time she was reportedly not aware of CM's presence on her port side. Regardless, before the collision, both vessels were in sight of one another and were required to assess risk of collision[34] and take appropriate actions to avoid collision[35].

2.1.6 When SG became aware of CM's presence, that is, about four minutes before the collision, the Master took actions to reduce his vessel's port swing but changed his decision to cause SG to swing more to port, owing to his assumption that CM would cross SG's bow. CM was not tracked since the time she appeared on SG's radar. If she had been, the target data would have given a better assessment about CM's movement relative to SG. It is thus probable that the Master's assumption was based on scanty information[36] (see Paragraphs 1.3.10 and 1.3.16).

[34] COLREGs Rule 7 – Risk of Collision

(a) Every vessel shall use all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists. If there is any doubt such risk shall be deemed to exist.

(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.

[35] COLREGs Rule 8 – Action to Avoid Collision

(a) Any action to avoid collision shall be taken in accordance with the Rules of this Part and shall, if the circumstances of the case admit, be positive, made in ample time and with due regard to the observance of good seamanship.

(b) Any alteration of course and/or speed to avoid collision shall, if the circumstances of the case admit, be large enough to be readily apparent to another vessel observing visually or by radar; a succession of small alterations of course and/or speed should be avoided.

(e) If necessary to avoid collision or allow more time to assess the situation, a vessel shall slacken her speed or take all way off by stopping or reversing her means of propulsion.

[36] COLREGs 7(c) – Assumptions shall not be made on the basis of scanty information, especially scanty radar information.

2.2 CM's navigation procedures and conduct of navigation

2.2.1 When the Master left the bridge for his dinner, the bridge team comprised only of the OOW and a lookout. The Third Officer, then being the lone watch keeper, besides conning the vessel, was checking the vessel's passage, while taking collision avoidance actions. In such circumstances, an increased bridge composition would have been desirable, especially when the ASD had to take over the helm for collision avoidance actions thus compromising the lookout function.

2.2.2 The passage plan is expected to consider the status of main engine, composition of bridge team considering visibility, weather, traffic condition, navigation in or near the termination of TSS where crossing situations could be expected. COLREGs further emphasizes the need for proceeding at safe speed[37] and reducing the ship's speed to allow more time to assess a situation. If necessary, ships must take all way off by reversing the propulsion.

2.2.3 When the Third Officer visually observed SG at 2018H, he assessed that SG was likely to maintain its course and speed and subsequently join the westbound lane of the TSS. Noting the risk of collision with SG, as the give-way vessel in a crossing situation, an alteration of course was planned after overtaking Melor. Considering that there was less sea room (due to proximity to vessels being overtaken) to give way, in addition to alteration of course alone, a speed reduction should have been considered. Such an action would have been consistent with actions to be taken to avoid collision[38].

[37] COLREGs Rule 6 – *Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.*

[38] COLREGs Rule 8 – Action to Avoid Collision

(c) If there is sufficient sea-room, alteration of course alone may be the most effective action to avoid a close quarter situation provided that it is made in good time, is substantial and does not result in another close quarter situation.

(e) If necessary to avoid collision or allow more time to assess the situation, a vessel shall slacken her speed or take all way off by stopping or reversing her means of propulsion.

2.2.4 The investigation team however notes that the time required to reduce the main engine on CM from 114 rpm to 85 rpm could have been approximately 30 minutes (see paragraph 1.1.5). The collision happened about 10 minutes from the time CM first noted SG. The investigation team is thus of the view that, although the engines were at the Third Officer's disposal for use in an emergency to avoid a collision, taking into account COLREGs Rule 8(e), i.e. to allow more time to assess the situation, it was premature for the vessel's sea passage (FAOP) to have commenced especially in an area where traffic joining the TSS could be expected.

2.2.5 When it became apparent that SG had altered course towards CM, the Third Officer did not reduce the ship's speed and relied on rudder orders alone to best avoid the collision. The Master's standing orders were clear that engines were at the Third Officer's disposal, yet the Third Officer did not use them when it became apparent that a collision was imminent, i.e. emergency. It would have been prudent for the Third Officer to take all way off by stopping or reversing his means of propulsion.

2.2.6 The Master's instructions also stated that he was to be called if visibility deteriorated or was expected to deteriorate, or in the event of malfunction/ failure of navigational equipment, or anytime when needed. However, the Master was not called by the Third Officer. The Third Officer could not provide any explanation on why the Master was not informed or called, when the AIS malfunctioned. Though the Third Officer was confident of taking appropriate collision avoidance actions (see Para 1.1.5), the Master should have been called for assistance, considering the developing traffic conditions in the vicinity and the possibility of encountering restricted visibility. The Third Officer's relative experience for reasons unknown may have contributed to his decision making.

2.3 SG's navigation procedures and conduct of Navigation

2.3.1 All AIS-transmitted targets (displayed a triangle over the radar blip) in SG's vicinity were transmitting their respective signals except CM from 2000H, as her AIS transmission ceased as a result of a lightning strike.

2.3.2 While the rain clouds may have initially contributed to SG not being able to visually sight CM, CM (whose radar blip was consistently visible on SG's radar) remained un-acquired by SG's bridge team from 2010H till the time of the collision at 2027H. (See **Figures 7a, 8, 9 and 10**). The bridge team could not respond why this target remained un-acquired for about 17 minutes.

2.3.3 The proper use of radar equipment during heavy rain could have assisted the bridge team in improving their situational awareness. The investigation team believes that in all probability the bridge team was likely navigating using the ECDIS with the AIS overlay, and was relying on this representation of a triangle over a blip to be a valid target (see Paragraph 1.3.10).

2.3.4 The bridge team complied with the company's SMS with four persons actively involved in the vessel's navigation. However, it was evident that, despite this composition, following an approved passage plan, with the engine ready for immediate manoeuvre and helm on manual steering, the presence of CM was only realised less than 1nm away.

2.3.5 Although the use of AIS is widely recognised to enhance situational awareness, the bridge team of SG likely did not maintain a proper lookout by sight and all available means[39] appropriate to the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision. It also appeared that the situational awareness of the bridge team was further reduced as the principles of BRM were not adequately applied.

2.3.6 If SG's Master had appropriately assessed a risk of collision using all available means, the outcome may have been different. His decision to cause his vessel's course to be altered to port thereafter, when he sighted CM was not as per COLREGs Rule 17c[40].

[39] COLREGs Rule 7 (b) - Use of radar equipment for long range scanning to obtain early warning of collision and radar plotting or systematic observation of detected objects.

[40] COLREGs Rule 17 (c) – Action by Stand-on Vessel, requires *a power-driven vessel which takes action in a crossing situation in accordance with sub-paragraph (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…"***

2.3.7 If the Master had adequately utilised resources at his disposal to receive pertinent information from his team in ample time, he would likely have been in better position to re-assess his intentions of making the turn to port towards WP-14.

2.3.8 It was apparent that SG's turn to port towards WP-14 was executed situationally without the bridge team being fully aware of the traffic in the vicinity. Once this turn was executed and CM was sighted subsequently, the Master did not reduce the ship's speed and instead changed his rudder orders to best avoid the collision. It would have been prudent for the Master to reduce the ship's speed and if necessary, take all way off by stopping or reversing his means of propulsion.

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 The environmental conditions in the area where the vessels were operating were sporadic. While CM could visually sight SG, the latter could not visually sight CM until about four minutes before the collision. SG did not activate the sound signals when reportedly operating in an area near restricted visibility.

3.2 It was premature for CM's sea passage (FAOP) to have commenced, especially in an area where traffic joining the TSS could be expected and its bridge composition was deemed inadequate considering the area of its operation, density of traffic and prevailing conditions.

3.3 CM's OOW did not inform the Master when AIS transmission ceased or the visibility deteriorated as per the Master's standing orders.

3.4 Despite the presence of three active members, excluding the helmsman on the bridge of SG, CM's radar target (especially in the absence of an AIS signal) was not tracked for assessing a risk of collision. The SG's bridge team was likely over-reliant on the use of AIS to maintain situational awareness.

3.5 The bridge team of SG did not maintain a proper lookout by sight and all available means appropriate to the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision. As a result, the vessel's course was altered to port towards the WP-14, which was executed situationally, without the bridge team being fully aware of the traffic in the vicinity.

3.6 The subsequent decision by SG's crew to cause SG to swing more to port before the collision, was a result of inadequate assessment about CM's information such as bearing, distance, heading, speed and thus an assumption that CM would cross SG's bow.

3.7 The investigation revealed that there was ineffective application of Bridge Resource Management and watchkeeping principles on the bridge of SG in the run up to the collision.

4 SAFETY ACTIONS

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

4.1 Following the incident, the ISM Manager of CM prepared a road map to improve the safety culture in its fleet which included the following preventive measures, amongst others:

i. Sharing of information and highlighting the circumstances of the incident with all crew members of its fleet of vessels, with targeted Navigational Campaigns, by –

- Creating a Safety Information Video of the incident;
- Visiting of the fleet vessels by top management to motivate the officers to follow company's Navigational Procedures and Best Seamanship Practices;
- Issuing a Fleet Safety circular;
- Posting a COLREGs safety poster onboard vessels with respect to giving the early collision warning; and
- Conducting pre-joining briefing and seminar.

ii. Revised vessel's navigational procedures to include enhanced guidance to company's instructions on the importance of Master on bridge, safe speed, passage planning and premature execution of sea passage. The effectiveness of these procedures will be audited by means of exclusive internal and external navigational audit, as well as remote audits.

iii. Enhanced the company's training program for Bridge Resource Management (BRM) to include:

- All Bridge Officers' navigational and ship handling skills, in particular, incorporating Chief Officer as part of the BRM team when relieving the Master, especially during long passages;
- Reduced interval of BRM refresher training from five to three years;
- On-the-job training regarding COLREGs & navigational skill enhancement of the officers, by specially appointed trainers; and
- Incorporated a speed reduction drill in the Safety Management System (SMS) so as to provide training for Bridge Officers to use the main engine for collision avoidance in emergency.

4.2 Following the incident, the ISM Manager of SG implemented the following preventive measures, amongst others:

i. Enhanced the existing requirement for navigating officers to attend a pre-embarkation course on BRM, with a focus on high traffic density, negative effects of over-reliance on use of AIS and restricted visibility scenarios;

ii. Reviewed and enhanced the existing navigational audit procedures by Master to three monthly intervals with reports submitted to company's office. In addition, the Port Captains will carry out additional navigational audits during attendance;

iii. The company's annual training review has been amended to include specific training requirements regarding navigational training as follows:

- Navigational audit training and action plans included in the new SMS; and
- Bridge Officers to undertake Bridge Team Management, Voyage Planning and Bridge Simulation seminars prior their embarkation;

iv. Reviewed its navigation procedures for navigating officers not to be over-reliant on the use of AIS

5 SAFETY RECOMMENDATIONS

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

5.1 In view of the safety actions taken, there are no safety recommendations issued to the ISM Manager(s) of both vessels.

-End of Report-