ACCIDENT REPORT

Report on the investigation of the collision between

ACX Hibiscus

and

Hyundai Discovery

in the approaches to the eastern Singapore Strait TSS

at 0756 local time on 11 December 2011

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

SERIOUS MARINE CASUALTY REPORT NO 15/2013 JUNE 2013

Extract from

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2012 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

NOTE

This report is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

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GLOSSARY OF ABBREVIATIONS, ACRONYMS AND TERMS

AB	-	Able bodied seaman
AIS	-	Automatic Identification System
ARPA	-	Automatic Radar Plotting Aid
BCR	-	Bow Crossing Range
Cable	-	0.1nm or 185.2m
CoC	-	Certificate of Competency
COLREGS	-	International Regulations for Preventing Collisions at Sea 1972 (as amended)
CPA	-	Closest point of approach
DPA	-	Designated Person Ashore
EBL	-	Electronic Bearing Line
ECS	-	Electronic Chart System
GMDSS	-	Global Maritime Distress and Safety System
GPS	-	Global Positioning System
IMO	-	International Maritime Organization
kW	-	kilowatt
LOA	-	Length Overall
LPG	-	Liquefied Petroleum Gas
m	-	metre(s)
MGN	-	Marine Guidance Notice
OOW	-	Officer of the watch
PMA	-	Panama Maritime Authority
SMS	-	Safety Management System
SOLAS	-	Safety of Life at Sea
STCW	-	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, as amended
TCPA	-	Time to closest point of approach

TSS	-	Traffic Separation Scheme
UK	-	United Kingdom
UNCLOS	-	United Nations Convention on the Law of the Sea
UTC	-	Universal Time, Co-ordinated
VDR	-	Voyage Data Recorder
VHF	-	Very High Frequency
Zodiac	-	Zodiac Maritime Agencies Ltd.

Bow crossing range	-	The calculated distance that one vessel will pass ahead of the other
Casualty Investigation Code	-	IMO's Code of International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident

Times: All times used in this report are UTC +8 hours unless otherwise stated

SYNOPSIS

The container ships *ACX Hibiscus* and *Hyundai Discovery* collided in the eastern approaches to the Singapore Strait on 11 December 2011; visibility at the time was restricted by localised heavy rain. Both vessels' officers of the watch took action to avoid the collision only after they saw the other vessel emerge from the rain shower at close range. This was too late to be effective. Both vessels were severely damaged; nobody was injured and no pollution was reported.

The United Kingdom registered *Hyundai Discovery* was inbound to Singapore and the Panamanian registered *ACX Hibiscus* was outbound from Singapore. The bridge watches on both vessels were being kept by chief officers. *ACX Hibiscus*'s chief officer, unaware of *Hyundai Discovery'*s course and position, turned his vessel to the north to follow its planned route. He did not check that it was safe to turn before he began to alter course. Despite several radio warnings from *Hyundai Discovery*'s chief officer, *ACX Hibiscus*'s chief officer continued to turn his vessel into *Hyundai Discovery*'s path.

The MAIB led a joint investigation into the accident with the Panama Maritime Authority. The investigation found that both vessels were operating in restricted visibility, but neither vessel's bridge watchkeepers had taken the precautions required by the International Regulations for Preventing Collisions at Sea 1972 (as amended). The Panama Maritime Authority investigators concluded that the behaviour of *ACX Hibiscus'*s chief officer was adversely affected by fatigue.

The MAIB's ability to conduct an effective investigation was restricted because access to primary evidence from *ACX Hibiscus*, which was outside the MAIB's jurisdiction, was denied by the vessel's owners. The owners subsequently put pressure on the Panama Maritime Authority not to release critical evidence to the MAIB. As a result, this report has been obliged to focus on the actions that should be taken to avoid rogue vessels, rather than deal with the underlying causes of the accident. The obstructive behaviour of *ACX Hibiscus*'s owners, by influencing a flag state to not comply fully with the International Maritime Organisation's Casualty Investigation Code, has highlighted a significant weakness in the effectiveness of the Code.

Simulations were conducted to consider what action could have been taken by *Hyundai Discovery*'s chief officer when confronted by *ACX Hibiscus* turning towards him. It was concluded that had *Hyundai Discovery*'s chief officer taken action to turn his vessel hard to starboard at the time he began calling *ACX Hibiscus* by VHF radio, *Hyundai Discovery* could have passed 0.4nm ahead of *ACX Hibiscus*.

Hyundai Discovery's managers have delivered training to share the lessons learnt from this accident with the bridge officers in their fleet. They have been recommended to further develop their safety management and training systems to improve inter alia, their watchkeeping officers' understanding of collision avoidance methods and conduct in restricted visibility. The MAIB has also recommended that the Panama Maritime Authority takes appropriate action with the owners of *ACX Hibiscus* to address the underlying causes of ineffective watchkeeping on vessels in their fleet, and to ensure it is compliant with the mandatory standards of the International Maritime Organization's Casualty Investigation Code.

Hyundai Discovery

ACX Hibiscus

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *ACX HIBISCUS* AND *HYUNDAI DISCOVERY* AND ACCIDENT

SHIP PARTICULARS		
Vessel's name	*ACX Hibiscus*	*Hyundai Discovery*
Flag	Panama	UK
Classification society	Nipon Kaija Kyokai (NKK)	Lloyd's Register
IMO number	9159141	908576
Type	Container ship	Container ship
Registered owner	ACT Carriers Corp.	Acadia Maritime Ltd.
Manager(s)	Onward Marine Service Co. Ltd.	Zodiac Maritime Agencies Ltd.
Construction	Steel	Steel
Length overall	193.00m	274.67m
Registered length	181.54m	264.95m
Gross tonnage	18,502	64,054
Minimum safe manning	Unknown	Unknown
Authorised cargo	No	No
VOYAGE PARTICULARS		
Port of departure	Singapore	Hong Kong
Port of arrival	Laem Chabang (intended)	Singapore
Type of voyage	International	International
Cargo information	Container	Container
MARINE CASUALTY INFORMATION		
Date and time	11 December 0756 LT	
Type of marine casualty or incident	Serious Marine Casualty	
Location of incident	8nm ENE of the start of the Eastern Singapore Strait Traffic Separation Scheme	
Injuries/fatalities	Nil	Nil
Damage/environmental impact	Structural damage	Structural damage
Ship operation	Container carrier	Container carrier
Voyage segment	On passage	On passage
External & internal environment	Heavy rain	Heavy rain
Persons on board	21	28

1.2 BACKGROUND TO THE INVESTIGATION

This investigation was carried out jointly between the United Kingdom's (UK) Marine Accident Investigation Branch (MAIB) and the Panama Maritime Authority (PMA). It was conducted in accordance with the International Maritime Organization's (IMO) Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code)[1] **(Annex A)**. The PMA agreed that the UK would act as the lead investigating state.

The vessel's owners denied MAIB inspectors access to the Panamanian registered vessel, *ACX Hibiscus,* which at the time was lying outside the MAIB's jurisdiction. Similarly, the MAIB was denied access to *ACX Hibiscus*'s Voyage Data Recorder (VDR). The PMA was not willing to contradict the owner's instructions and did not require that they gave the MAIB access to primary sources of evidence. Consequently, this report has been prepared based on evidence gathered by the MAIB's inspectors, from *Hyundai Discovery,* and a report from the PMA on the circumstances on board *ACX Hibiscus* at the time of the accident.

Timings and navigational data were taken from *Hyundai Discovery*'s VDR, which included a recording of the Automatic Identification System (AIS) data for *ACX Hibiscus*.

1.3 NARRATIVE

1.3.1 Events leading up to the collision

At midday on 8 December 2012, *Hyundai Discovery* departed Hong Kong for the Port of Singapore.

At 0400 on 11 December, *ACX Hibiscus* departed from the Port of Singapore on passage to Laem Chabang in Thailand. *ACX Hibiscus*'s chief officer completed his duties on deck and arrived on the bridge at 0515, where he took over the duty of officer of the watch (OOW) from the third officer. The master was also present on the bridge. At 0700 *ACX Hibiscus* passed Horsburgh Light **(Figure 1)** at a speed of 14.5 knots on an autopilot-controlled heading of 049º. At around the same time, the master left the bridge leaving the chief officer and an Able Bodied Seaman (AB) on watch.

At 0711 *Hyundai Discovery*'s master went to the bridge and talked to the chief officer, who was on watch with a cadet and an AB. *Hyundai Discovery* was making a speed of 20 knots through the water on an autopilot-controlled heading of 203º.

ACX Hibiscus cleared the Singapore Strait Traffic Separation Scheme (TSS) at 0720; the weather was overcast with moderate rain.

At 0721 *Hyundai Discovery*'s master instructed the chief officer to reduce speed to 18 knots in order to arrive at the Singapore pilot station at the correct time. At around this time *Hyundai Discovery* passed through a rain shower and visibility decreased.

[1] IMO Resolution MSC.255(84) entered force in January 2010

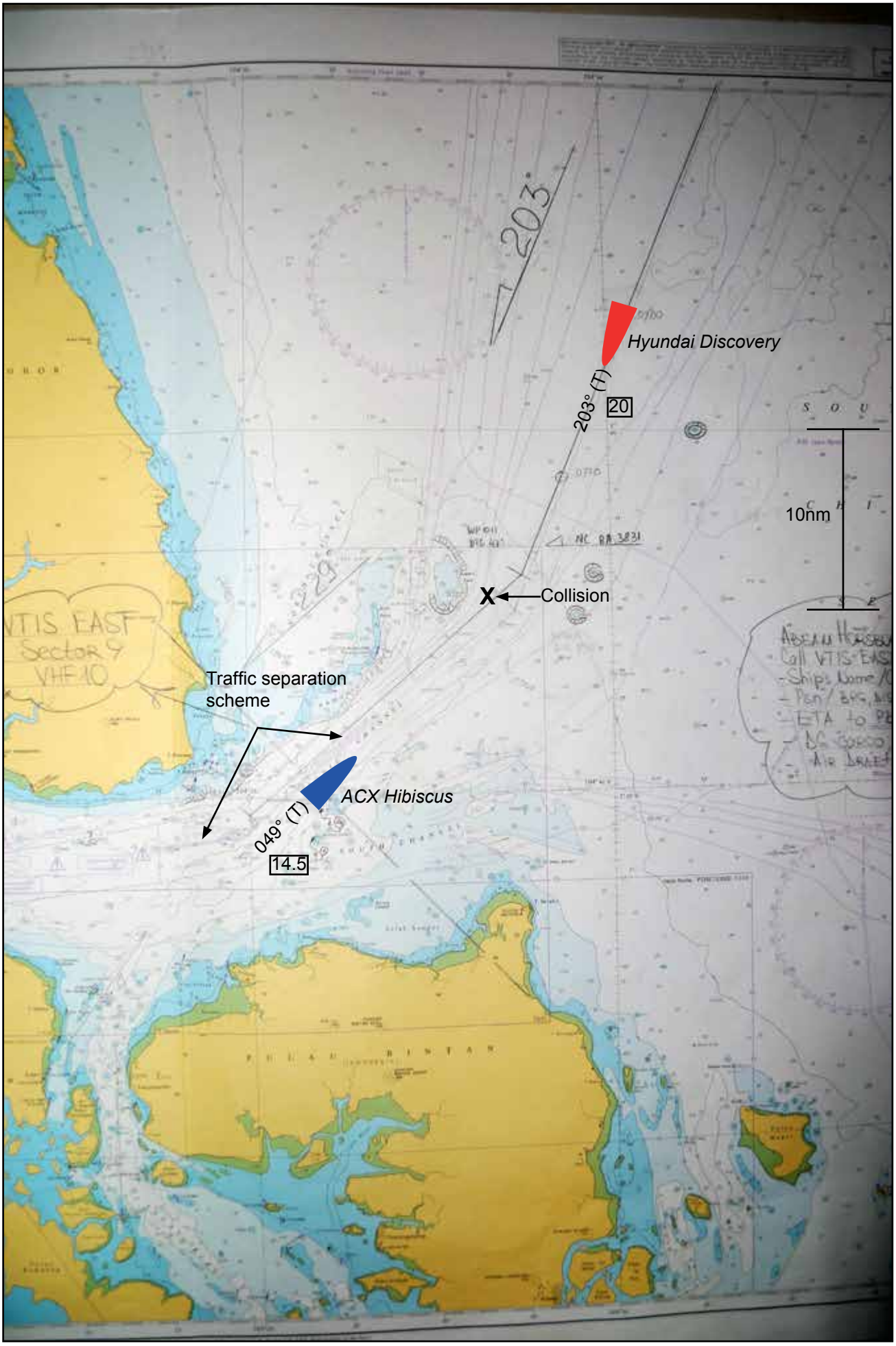

Figure 1: *Hyundai Discovery*'s chart with the positions of *ACX Hibiscus* and *Hyundai Discovery* at 0700 superimposed

At 0730 *ACX Hibiscus* entered a heavy rain shower and the visibility from her bridge reduced accordingly. The chief officer acquired the radar targets of several ships using his Automatic Radar Plotting Aid (ARPA) system, but did not acquire *Hyundai Discovery*.

By 0740 *Hyundai Discovery*'s chief officer had seen and acquired, using ARPA, the radar targets of four vessels that were out-bound from the Singapore Strait TSS. The vessels' positions were fine on his starboard bow. It was reported that heavy rain had reduced the visibility on *Hyundai Discovery*'s port side to approximately 5 miles at around this time.

At about 0740 *Hyundai Discovery*'s cadet looked at the AIS information that was displayed on the Electronic Chart System (ECS) and saw that one of the vessels was *ACX Hibiscus*. The cadet told the chief officer that he thought *ACX Hibiscus* would pass clear down *Hyundai Discovery*'s port side. At 0741 the master returned to the bridge; the chief officer mentioned the recent rainfall to the master. The master instructed the chief officer to inform the on-watch engineer at 0800 that the main engine should be available to manoeuvre by 0900. At 0744 *Hyundai Discovery*'s chief officer used the autopilot control to alter course to starboard to a new heading of 209° **(Figure 2)**. During the turn *ACX Hibiscus* was lost from sight.

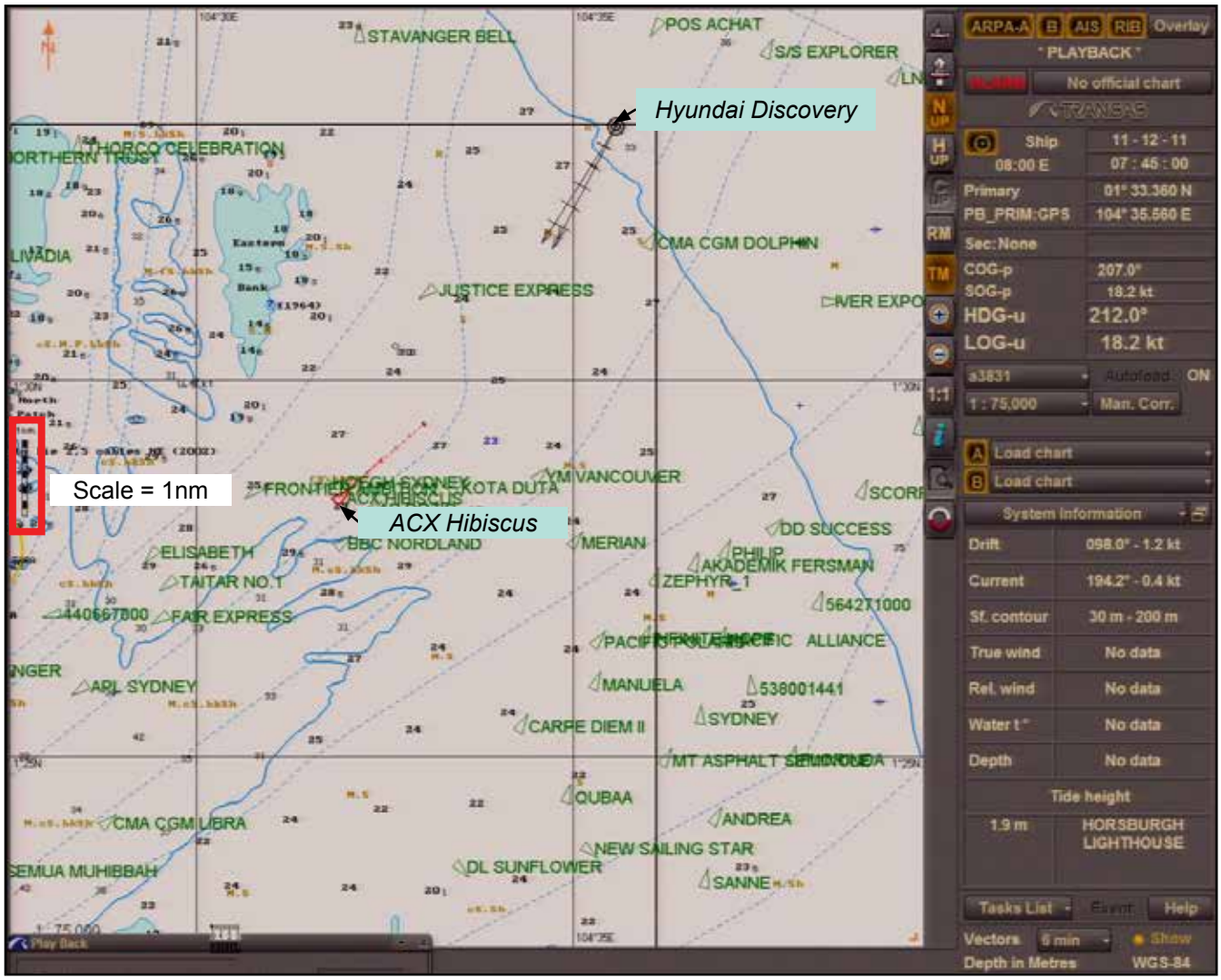

Figure 2: *Hyundai Discovery*'s ECS showing positions of *ACX Hibiscus* and *Hyundai Discovery* at 0744

1.3.2 Watchkeeping in restricted visibility

ACX Hibiscus continued on its heading of 049º at a speed of 14.5 knots. It was reported that, at 0745, the rainfall increased and it was estimated that the visibility from *ACX Hibiscus* reduced to around 2 cables. The rainfall caused the radar picture on *ACX Hibiscus* to become cluttered, and most of the targets that had been acquired were lost from the ARPA radar screen.

At 0747:00 the ARPA radar display on board *Hyundai Discovery* showed that *ACX Hibiscus* was 5nm right ahead of *Hyundai Discovery*. The radar plot indicated that the ships would be passing close, but clear, down each other's port sides **(Figure 3)**. The chief officer on *Hyundai Discovery* used the autopilot control to turn to starboard to a heading of 216º to converge onto his next charted course of 229º and to increase his passing distance from *ACX Hibiscus*. At 0748:30, once close to the charted course, the chief officer turned further to starboard onto a heading of 229º.

By 0750:00 *Hyundai Discovery* was steady on a heading of 229º, with *ACX Hibiscus* about 15° on the port bow at a range of 3.5nm **(Figure 4)**. The ARPA on *Hyundai Discovery* indicated that *ACX Hibiscus*'s closest point of approach (CPA) would be approximately 7 cables on the port side. *Hyundai Discovery*'s chief officer placed the radar's electronic bearing line (EBL) over *ACX Hibiscus'*s radar target to confirm that its bearing was opening to port as he was expecting.

At 0750 *Hyundai Discovery*'s master returned briefly to the bridge to check the situation, and found that the visibility from his vessel had reduced to about 5 cables in a heavy rain shower. Neither *ACX Hibiscus* nor *Hyundai Discovery* made sound signals for making way in restricted visibility.

1.3.3 Course alteration

*ACX Hibiscus'*s third officer arrived on the bridge at around 0750 ready to take over the watch at 0800. At 0751:30, *ACX Hibiscus'*s chief officer started to alter his vessel's course to port by adjusting the desired heading on the autopilot to turn the ship incrementally onto the next planned track of 350º **(Figure 5)**. It was reported that the third officer looked at the radar display and found that radar targets were not seen due to clutter, and that he informed the chief officer about the situation.

At 0752, with about 2.2nm distance between the vessels, *Hyundai Discovery*'s chief officer noticed that the radar trail of *ACX Hibiscus* changed direction towards his vessel. The trail was set to display its motion relative to *Hyundai Discovery* and showed that *ACX Hibiscus* was altering its course to port. The chief officer checked the AIS information on the ECS and confirmed that the vessel turning to port was *ACX Hibiscus*. At 0753:15, and again at 0753:30 **(Figure 6)**, *Hyundai Discovery*'s chief officer called *ACX Hibiscus* by VHF radio using the distress and calling channel, channel 16. Once communication was established, both officers changed their VHF radios to a working channel, channel 6.

1.3.4 Action to avoid collision

At 0754:00 *Hyundai Discovery*'s chief officer asked *ACX Hibiscus*'s third officer '*why are you altering course to port side?'* The response from *ACX Hibiscus* was unclear, but it was apparent that the third officer said that his vessel was turning to the north. *Hyundai Discovery*'s chief officer continued*… 'Do not cross my bow …the visibility*

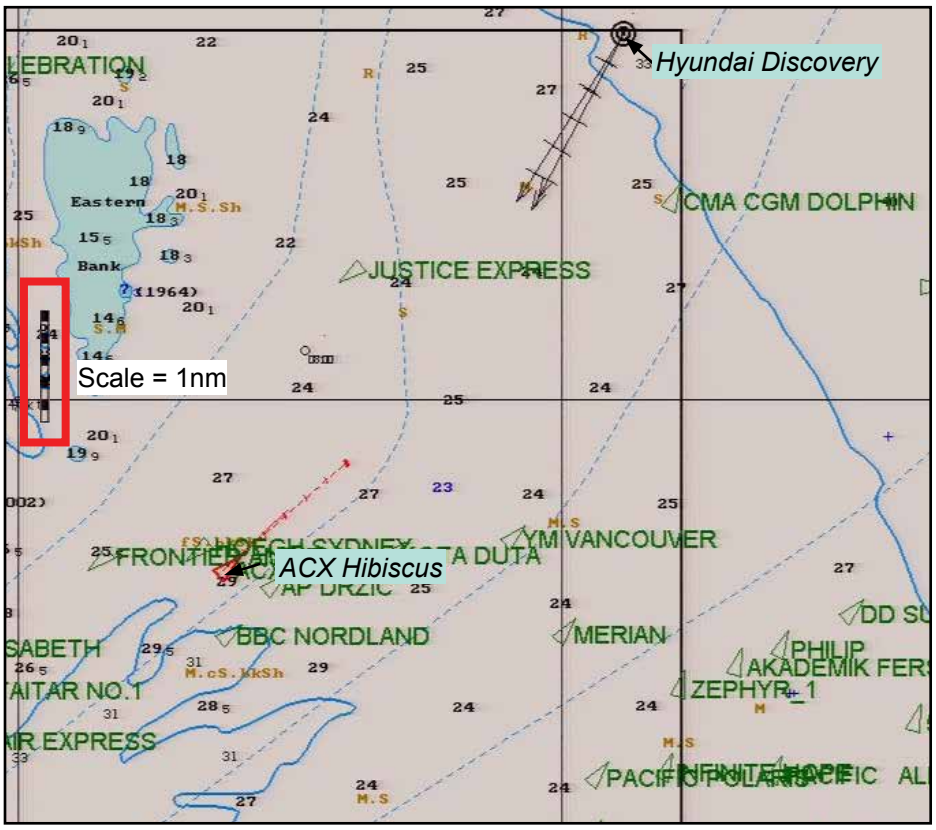

Figure 3: Position of *ACX Hibiscus* and *Hyundai Discovery* at 0747

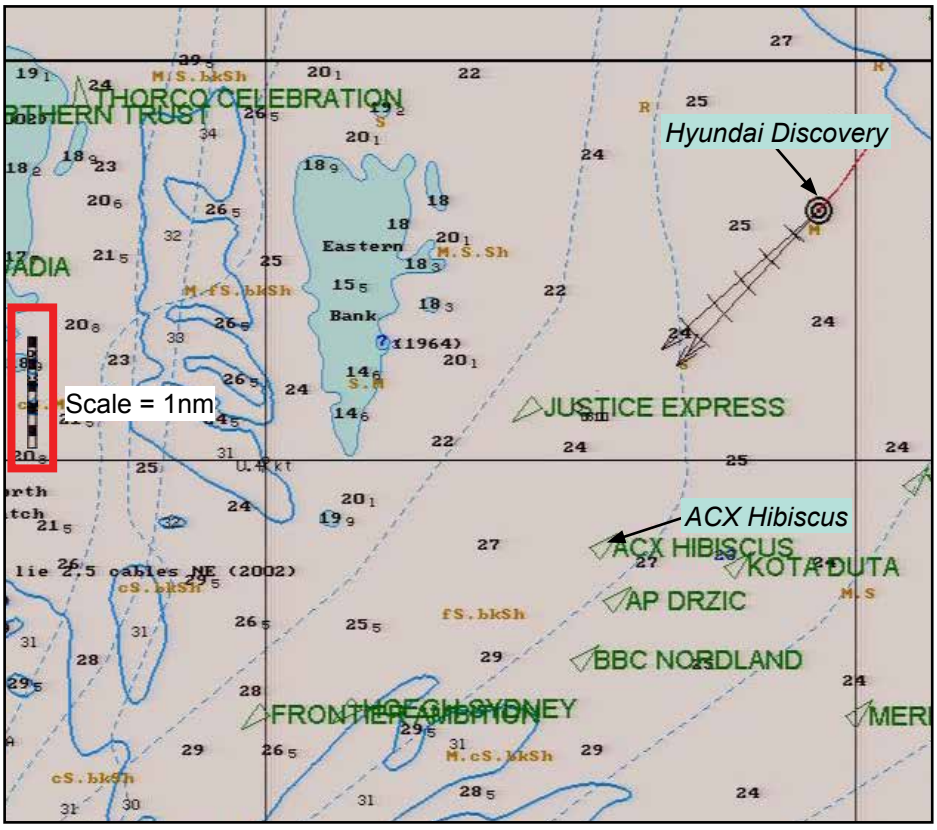

Figure 4: Position of *ACX Hibiscus* and *Hyundai Discovery* at 0750

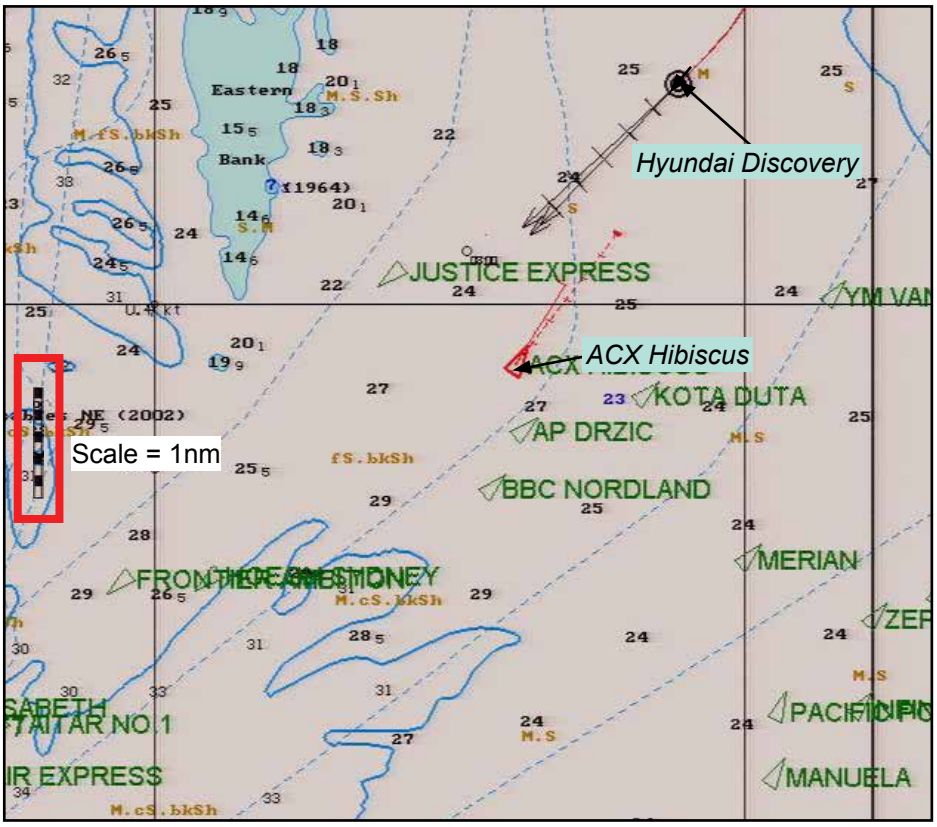

Figure 5: Position of *ACX Hibiscus* and *Hyundai Discovery* at 0751:30

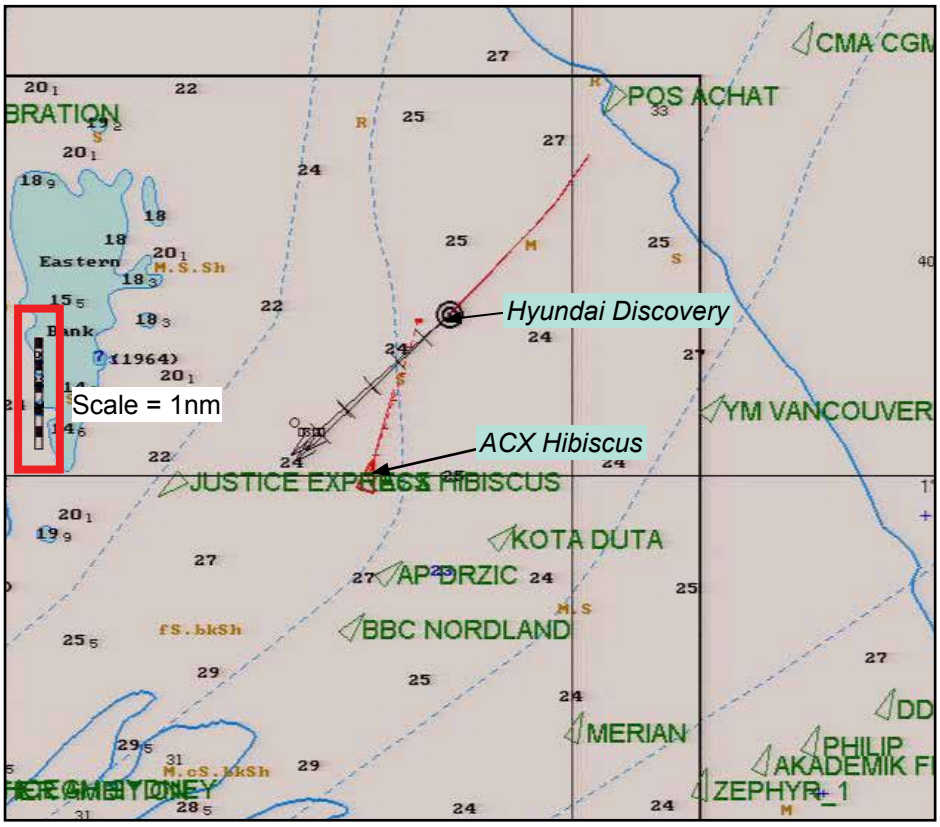

Figure 6: Position of *ACX Hibiscus* and *Hyundai Discovery* at 0753:30

is zero you must alter course to starboard'. At 0754:20 *Hyundai Discovery*'s chief officer told *ACX Hibiscus*'s third officer to alter course to starboard and create a minimum CPA of 3 cables. He then asked '*the visibility is zero, what are you doing?'*

At 0754:34, *ACX Hibiscus*'s third officer replied that '*we are altering course to the north now'.* The chief officer continued to turn *ACX Hibiscus* to port, passing a heading of 017º.

At 0755:00 *Hyundai Discovery*'s chief officer called *ACX Hibiscus* by VHF radio again. He stated *'go hard to starboard, to starboard... what are you doing?*' *ACX Hibiscus'*s third officer did not reply.

At 0755:13, about 1 minute before the collision, *Hyundai Discovery*'s chief officer ordered the AB to put the helm control into manual steering and he sounded one long blast on the ship's whistle. At 0755:35 *Hyundai Discovery*'s master arrived on the bridge and the chief officer reported the situation with *ACX Hibiscus* to him. *ACX Hibiscus* became visible at about 0755:50 at an estimated range of about 2 cables; the chief officer ordered the helm hard to starboard **(Figure 7)**.

At around the same time, *ACX Hibiscus*'s chief officer saw *Hyundai Discovery* become visible on his port bow; he took the steering into manual control, placed the wheel hard to port and set the engine telegraph to 'emergency stop'.

1.3.5 Collision

At 0756:10 *ACX Hibiscus*'s bow collided with *Hyundai Discovery*'s port side wing ballast tank adjacent to No. 2 hold. At the time of the collision *Hyundai Discovery* was heading 229º at a speed of 18 knots; *ACX Hibiscus* was heading 321º at a speed of 14.1 knots **(Figure 8)**.

ACX Hibiscus's starboard bow scraped along *Hyundai Discovery*'s port side. Five containers fell from *Hyundai Discovery*'s deck either into the sea, or onto *ACX Hibiscus'*s forward mooring deck. *Hyundai Discovery*'s master placed the rudder hard over to port in an attempt to separate the sterns of the two ships.

ACX Hibiscus's master was alerted by the impact, and went to the bridge; the ship's electrical power failed and propulsion was lost.

Hyundai Discovery listed to port due to the flooding of the empty No.2 wing ballast tank. *Hyundai Discovery*'s master called *ACX Hibiscus* on VHF radio to establish the condition of the other vessel, but the reply from *ACX Hibiscus* was unclear.

At 0800 *Hyundai Discovery*'s master sounded the general alarm and the crew all reported to their muster stations. Several crewmen then assisted in sounding the ship's holds, tanks and void spaces and reported their findings to the chief officer. *Hyundai Discovery*'s chief officer ballasted No.2 starboard wing tank and the list reduced. The master contacted the vessel's managers, Zodiac Maritime Agencies Limited (Zodiac), by satellite telephone and reported the collision to the Designated Person Ashore (DPA). *Hyundai Discovery*'s master reduced to the vessel's manoeuvring speed, which was about 16 knots, and continued on passage to Singapore's outer anchorage.

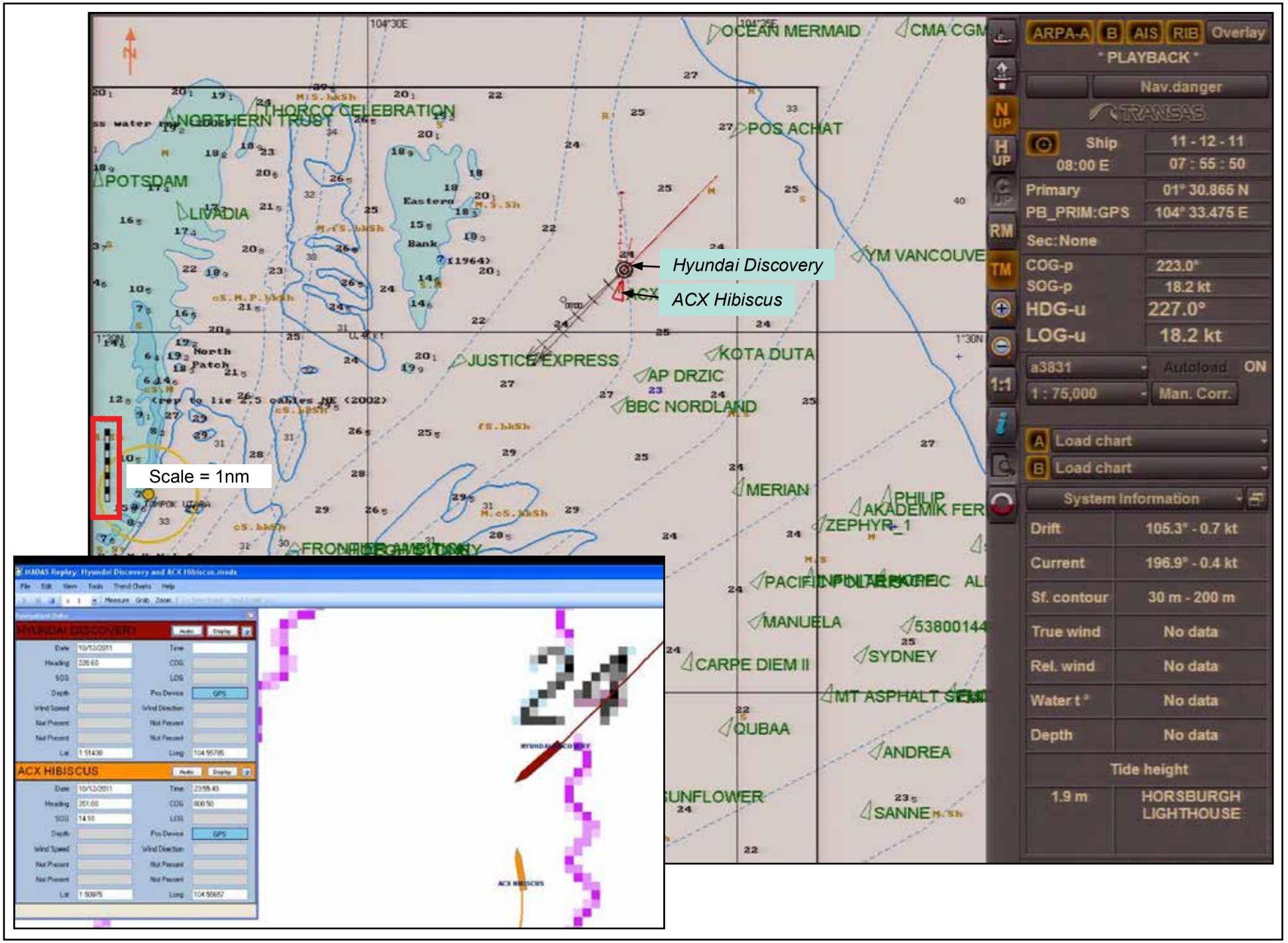

Figure 7: Position of *ACX Hibiscus* and *Hyundai Discovery* at 0755:50

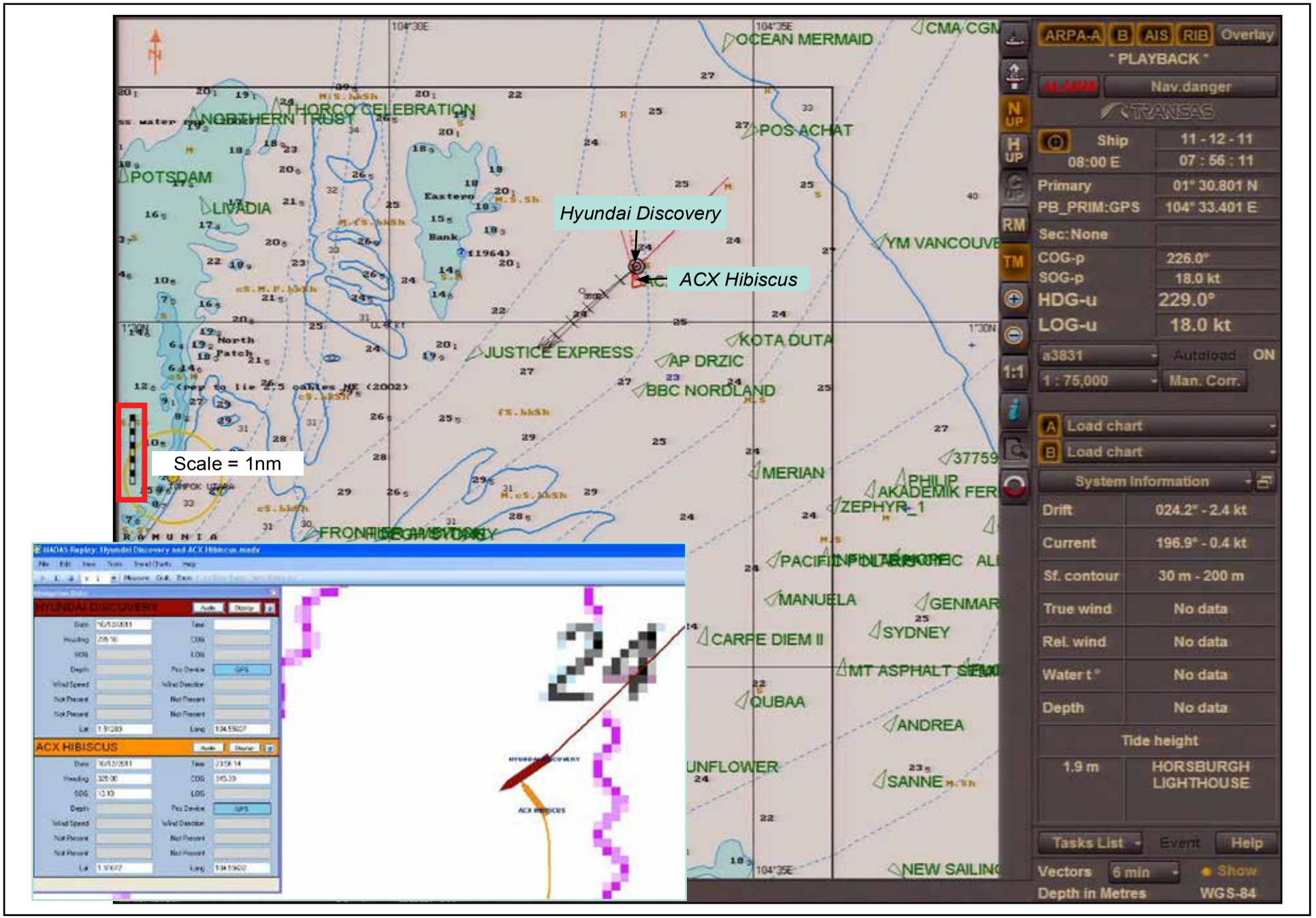

Figure 8: Position of *ACX Hibiscus* and *Hyundai Discovery* at 0756:10

ACX Hibiscus's master mustered his crew on the bridge and then instructed them to sound the tanks and bilges to check where the hull had been breached. *ACX Hibiscus* was flooded in the fore peak tank and took on a list to starboard. Water also flooded into the forward hold. At 0830 the master advised the Malaysian Coastguard about his ship's damaged status by VHF radio. Following this, the master turned *ACX Hibiscus* to head west at slow speed with the intention of beaching the vessel if necessary to prevent it from sinking. At 0920 the master, satisfied that *ACX Hibiscus*'s condition was stable enough to resume passage, navigated his vessel back to Singapore's outer anchorage at slow speed.

1.4 NAVIGATION AND ENVIRONMENTAL CONDITIONS

1.4.1 Approaches to the Port of Singapore from the east

Ships approaching the Port of Singapore from the east and sailing from the port heading east are required to follow the IMO approved TSS **(Figure 1)** that extends from the port to the east of Horsburgh Light. Ships inbound to Singapore, heading south-west, use the northern lane, while the outbound ships follow the opposing southern lane.

1.4.2 Regional climate and weather

The Admiralty Sailing Directions for the Malacca Strait and West Coast of Sumatera (NP44) **(Annex B)** states that *'The mean annual rainfall is abundant… Heavy showers and thunderstorms are responsible for most of the rain'* and *'Visibility is generally good except in thundery showers when visibility may fall to near fog limits'*.

1.4.3 Environmental conditions

The weather and tidal conditions at the time of the accident were:

- Visibility - around 2 cables
- Weather - heavy rain showers
- Wind - Beaufort force 5 from the east-north-east
- Temperature - 29ºC
- Tidal flow - west-south-west at 1.7 knots

A picture taken soon after the collision shows the typical conditions at the time **(Figure 9)**.

1.5 DAMAGE

1.5.1 Damage to *ACX Hibiscus*

ACX Hibiscus sustained significant damage to its bow section **(Figure 10)**. The forward mooring deck, chain locker, fore peak tank and bow thrust room were very heavily damaged. Both anchors were unusable. The collision bulkhead was breached and damage extended into the forward hold.

Figure 9: Environmental condition shortly after the collision

Figure 10: Damage to *ACX Hibiscus*'s bow

1.5.2 Damage to *Hyundai Discovery*

Hyundai Discovery's hull was holed in No.2 water ballast wing tank, both above and below the waterline **(Figure 11)**. No.2 hold port bulkhead was indented but remained watertight. Five, 40-foot long containers were lost overboard and several other 20 and 40-foot long containers and their securing arrangements were damaged. The port side of the vessel was indented along the length of the hull from No. 2 hold, aft to the accommodation where the port accommodation ladder and surrounding structure was heavily deformed **(Figure 12)**.

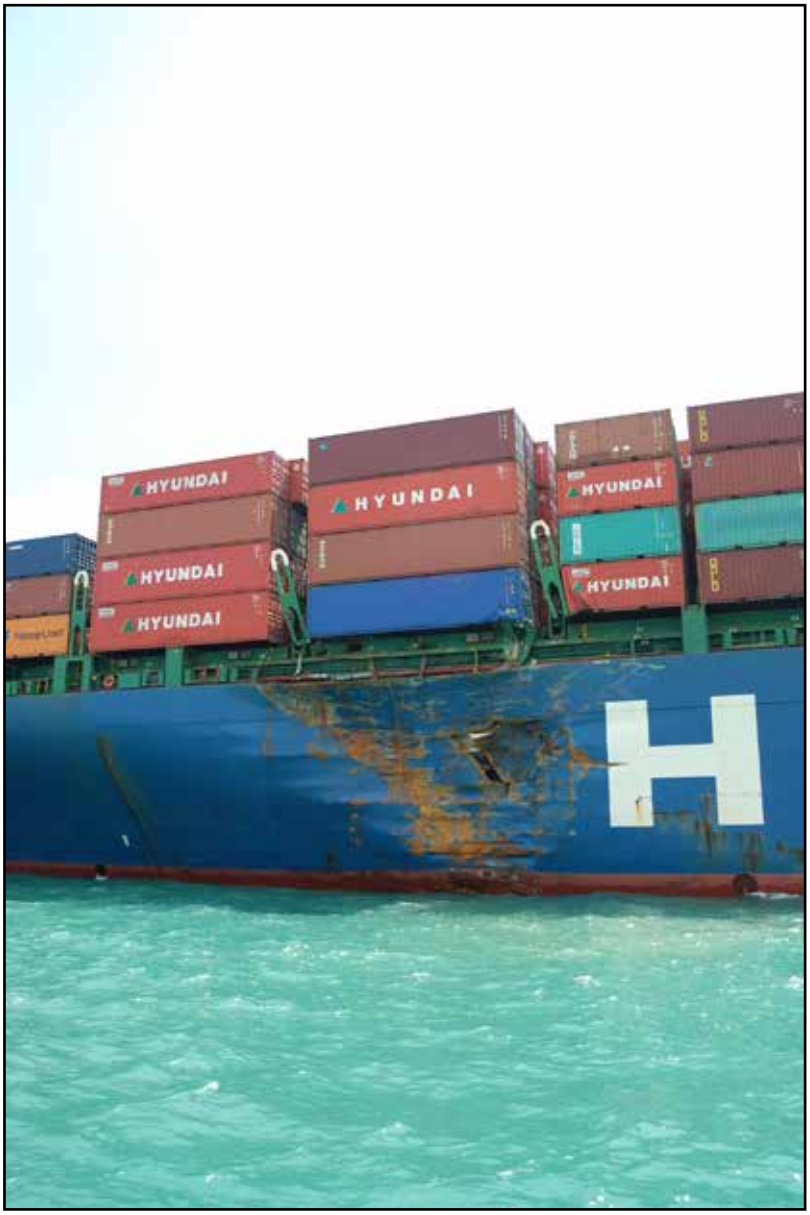

Figure 11: Damage to *Hyundai Discovery*'s port side No. 2 water ballast tank

Figure 12: Damage to *Hyundai Discovery*'s port side accommodation section

1.6 *ACX HIBISCUS*

1.6.1 Key personnel

Master. The 43 year old South Korean master held a Panamanian Standards of Training, Certification and Watchkeeping (STCW) II/2 Certificate of Competency (CoC) and had sailed as a master for over 10 years. He had been on board *ACX Hibiscus* for 2 months.

Chief Officer. The 42 year old Filipino chief officer had been a watchkeeper for the previous 16 years; he held an STCW II/2 CoC and had sailed as a chief officer for the last 4 years. He had been on board for 3 months.

Third Officer. The 32 year old Filipino third officer held an STCW II/1 CoC as OOW. He had been on board for 3 months.

AB lookout. The 24 year old Filipino AB lookout held an STCW II/4 CoC; he had been on board for 3 months.

1.6.2 Bridge operation

At sea, the three bridge watchkeepers[2] kept 4 hour watches, with 8 hours off between each watch. The master did not take a watch. In port, the chief officer oversaw the cargo operation; the other two watch officers worked cargo watches of 6 hours on duty, followed by 6 hours off.

[2] Bridge watches were taken by the chief officer and the two deck officers

1.6.3 Navigation

ACX Hibiscus's primary means of navigation was with approved paper charts **(Figure 13)**.

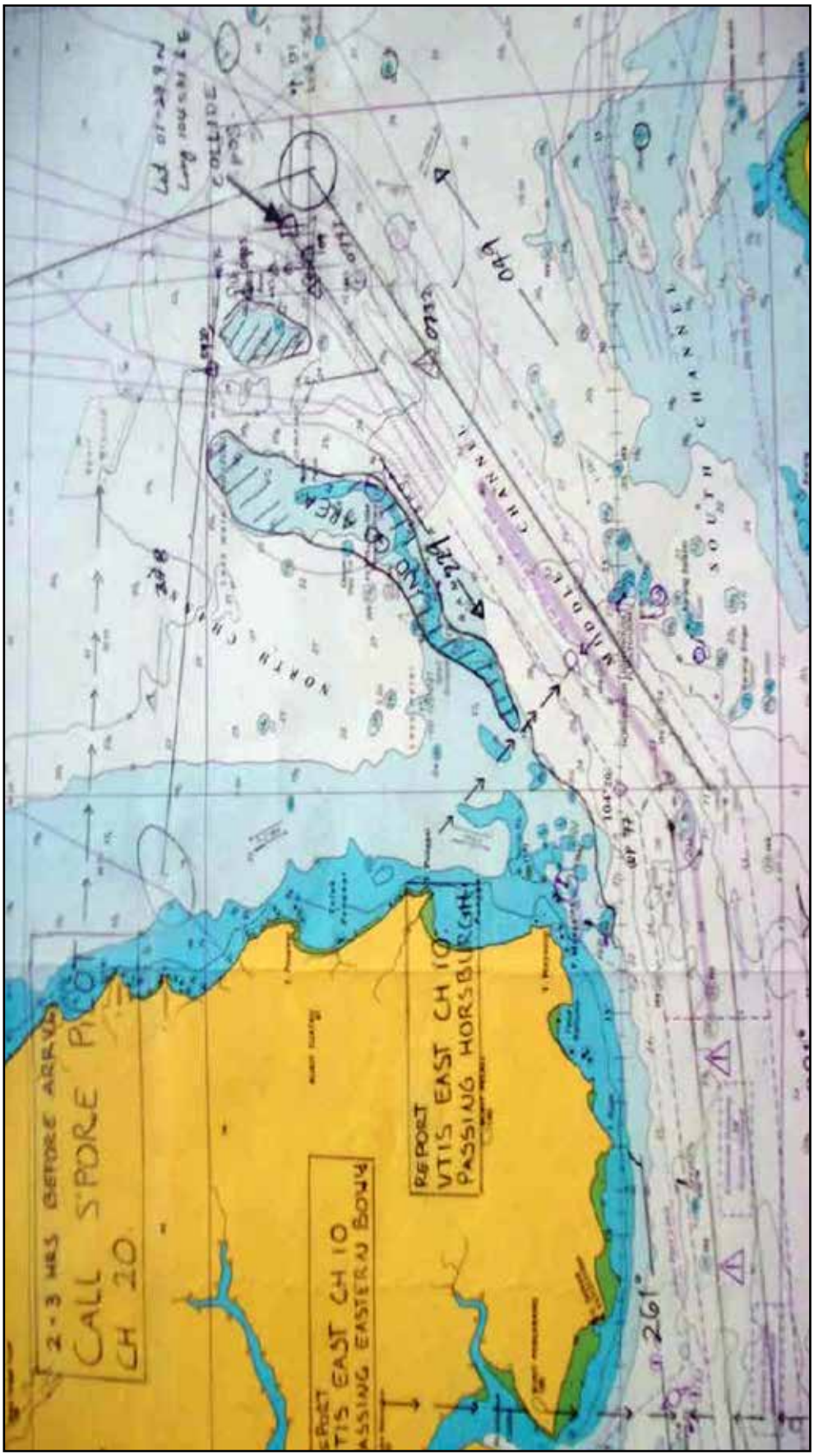

Figure 13: *ACX Hibiscus*'s chart

1.6.4 Bridge radar

The bridge was fitted with two fully operational radars. One ‘S band’ (10cm wavelength) radar fitted with an ARPA; the ‘X band’ (3cm wavelength) radar did not have an ARPA. The chief officer operated the radars on both the 3nm and 6nm range scales as necessary during the watch preceding the accident.

1.6.5 AIS

The AIS unit’s display screen was small and showed only nearby vessels’ ranges, bearings, and names, either in text form, or in a radar-style format. The unit was located next to the steering console **(Figure 14)**.

Figure 14: *ACX Hibiscus*’s AIS unit

1.6.6 Passage planning

A passage plan had been prepared for the voyage; however, this plan did not consider the possibility of heavy rain, operation in restricted visibility, or the need to cross the traffic that was inbound to the Singapore Strait when altering course to the north. The master had not signed the passage plan.

1.6.7 Supporting information

No information was available to the MAIB at the time of the investigation to state which master’s standing orders, company’s instructions or contingency plans were available to *ACX Hibiscus*’s crew. Similarly, the results of previous company audits and inspections were unknown.

1.7 *HYUNDAI DISCOVERY*

1.7.1 Key personnel

Master. The 45 year old Bulgarian master held an STCW II/2 CoC. He had worked at sea for 21 years and with Zodiac for the previous 8 years. He had been on board for over a month.

Chief Officer. The 34 year old Russian chief officer held an STCW II/1 CoC. He had worked at sea for the previous 8 years, all of which were with Zodiac. He had been on board for 5 months.

Cadet. The 24 year old Indian cadet was on his second trip to sea and had been on board for a month.

AB lookout. The 25 year old Indian AB lookout held an STCW II/4 CoC. He had been at sea for 5 years and had been on board for 7 months.

1.7.2 Bridge operation

The three bridge watchkeepers kept a routine of 4 hour watches, with 8 hours between each watch while at sea. The master did not keep a watch. An AB assisted the OOW on the bridge during the hours of darkness. If required by the OOW the AB was also available to assist at other times, such as in busy traffic and restricted visibility.

1.7.3 Navigation

The primary means of navigation was with British Admiralty paper Standard Nautical Charts **(Figure 15)**.

1.7.4 Radar operation

The bridge had two radars, both fitted with ARPA: an ‘S band’ (10cm wavelength) radar and an ‘X band’ (3cm wavelength) radar. While both radar displays worked effectively, due to the age of the equipment neither was capable of showing AIS data **(Figures 16a** and **16b)**.

At the time of the accident, the chief officer primarily used the S band radar for collision avoidance, alternating between the 12 and 6 mile range scales. The ‘own ships’ position was offset from the centre of the radar screen to increase the area of the display available for monitoring traffic ahead. The predicted paths of radar targets were displayed with vectors whose length represented the distance travelled in 6 minutes. This gave an indication of each target vessel’s true course and speed. Each target’s track history was displayed with vector trails representing the distance moved in the last 6 minutes. The trails showed each target vessel’s movement relative to *Hyundai Discovery*’s track. The chief officer suppressed the interference caused by the rain to the radar picture by adjusting the rain clutter control manually.

The X band radar was operated mainly on the 12 mile range scale. Radar targets were displayed with predictive vectors and historic trails that showed target vessels’ true courses and speeds.

Figure 15: *Hyundai Discovery*'s chart table

Figure 16a: *Hyundai Discovery*'s port side X band radar

Figure 16b: *Hyundai Discovery*'s starboard side S band radar

1.7.5 AIS and ECS

AIS data was shown on a display unit located near the chart table at the front of the bridge **(Figure 17)**. The AIS information was also displayed on an Electronic Chart System (ECS) located by the communication station at the aft of the bridge on the port side by the communications desk **(Figures 18a** and **18b)**. The ECS displayed the ship's Global Positioning System (GPS) position and the AIS data for nearby vessels on an electronic navigation chart. The ECS had not been approved as a primary means of navigation and was provided to help the bridge watchkeepers improve their situational awareness. There were no instructions provided on how watchkeepers should use the combined ECS and AIS displayed information.

Figure 17: *Hyundai Discovery*'s AIS unit

1.7.6 Manoeuvring data

Hyundai Discovery's manoeuvring data diagram **(Figure 19)** was displayed on the bridge. The data predicted the ship's turning performance - with full rudder applied - to both port and starboard. This was provided for both full sea speed and manoeuvring speed, in both the vessel's loaded and ballast conditions.

This information showed that when loaded and travelling at 18 knots, *Hyundai Discovery* would advance[3] around 4.5 cables and transfer[4] around 2.5 cables during 90° turns to both port and starboard. The time taken to turn through 90º was estimated, from the manoeuvring data, to be approximately 2 minutes and 30 seconds.

[3] The advance of a ship for a given alteration of course is the distance that a ship moves in the direction of its original line of advance, measured from the point where the rudder is put over.

[4] The transfer of a ship for a given alteration of course is the distance that the ship moves at right angles to the direction of its original line of advance, measured from the point where the rudder is put over.

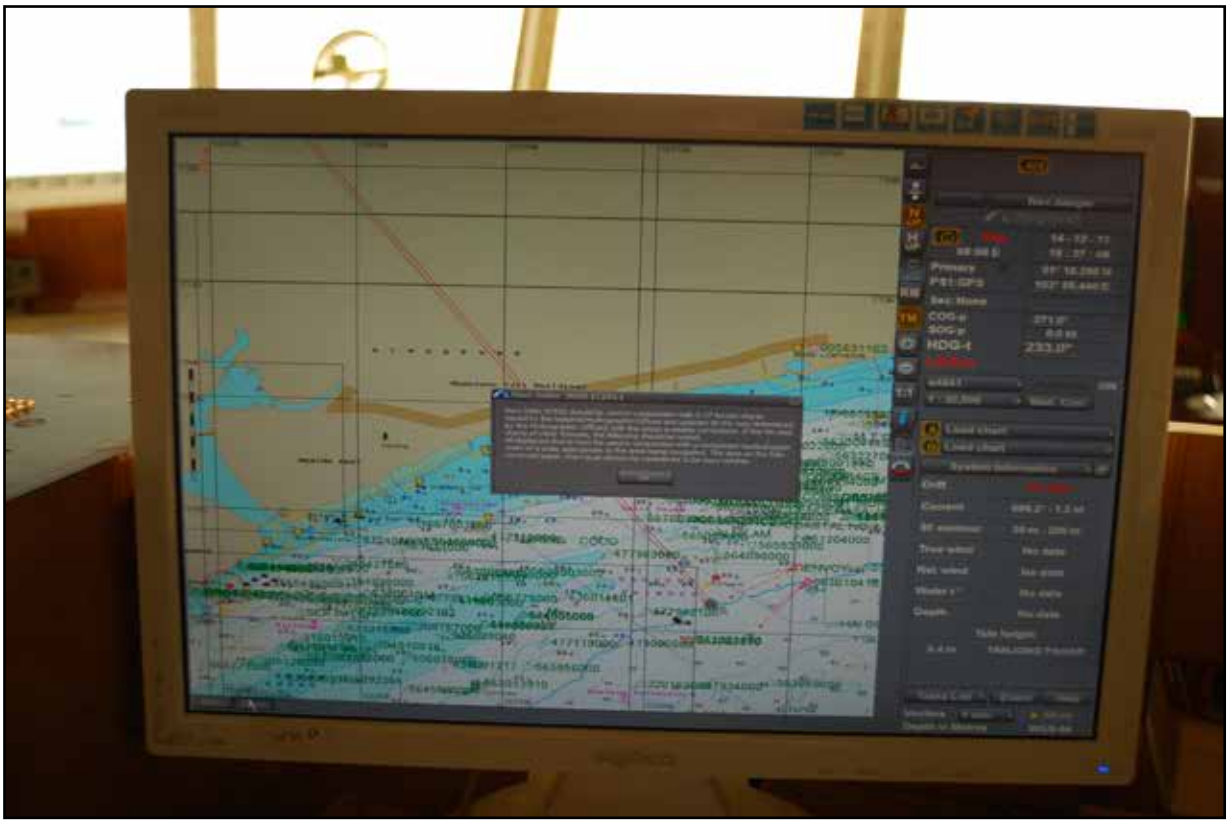

Figure 18a: *Hyundai Discovery*'s ECS - displaying vessel AIS tracks

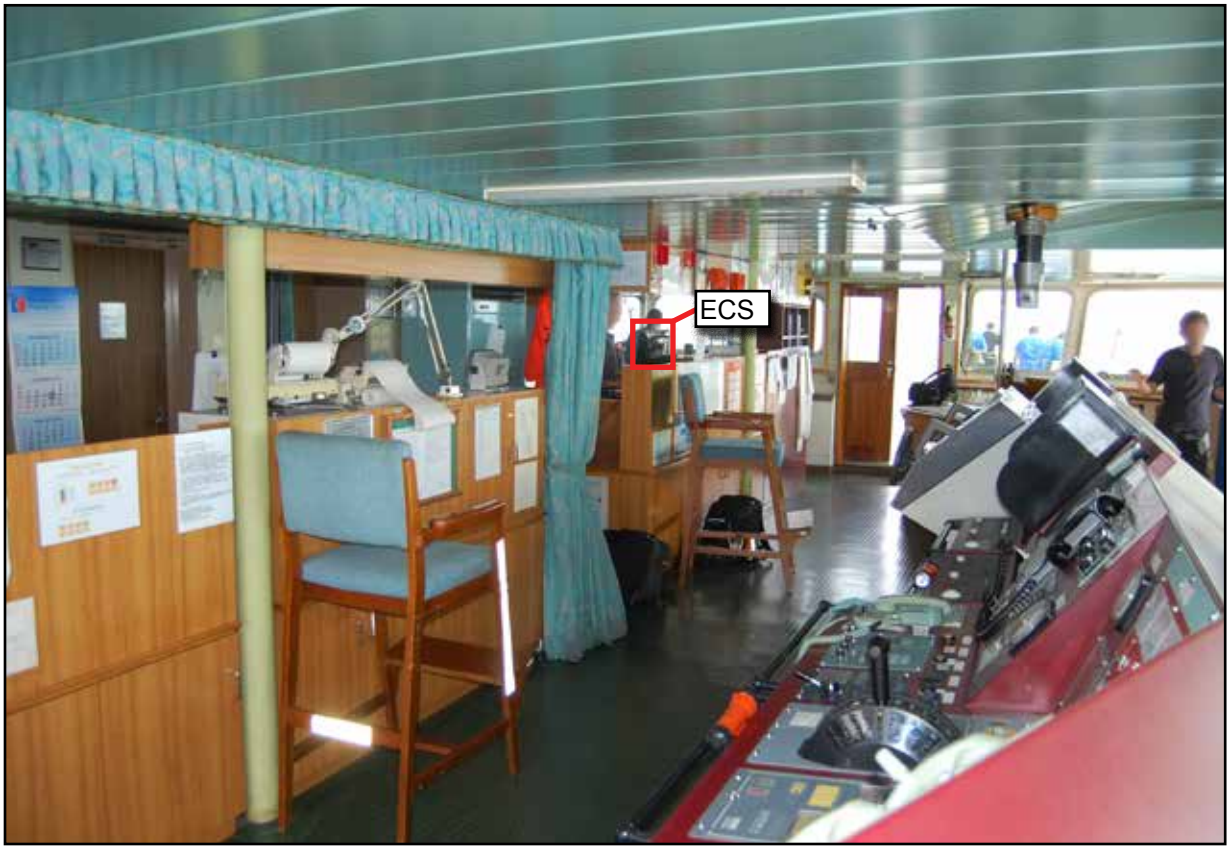

Figure 18b: Location of *Hyundai Discovery*'s ECS

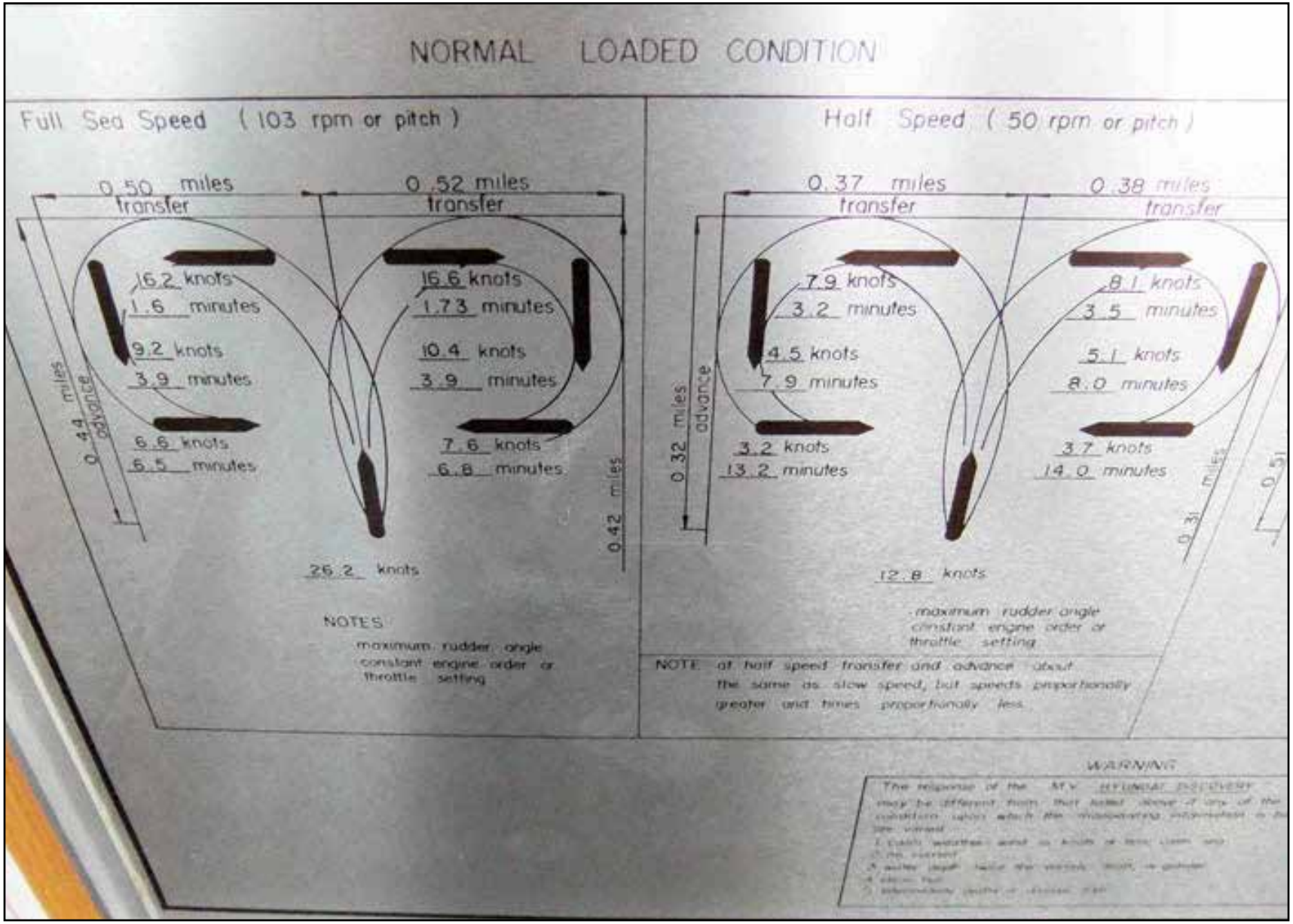

Figure 19: *Hyundai Discovery*'s manouevring data (extract)

The results of a crash stop test were also posted on the bridge **(Figure 20)**. The diagram showed that from full speed (100 RPM), astern propulsion would be started in 6 minutes and 38 seconds. Full astern propulsion would be achieved after 6 minutes and 47 seconds with the vessel brought to a stop after 9 minutes and 29 seconds.

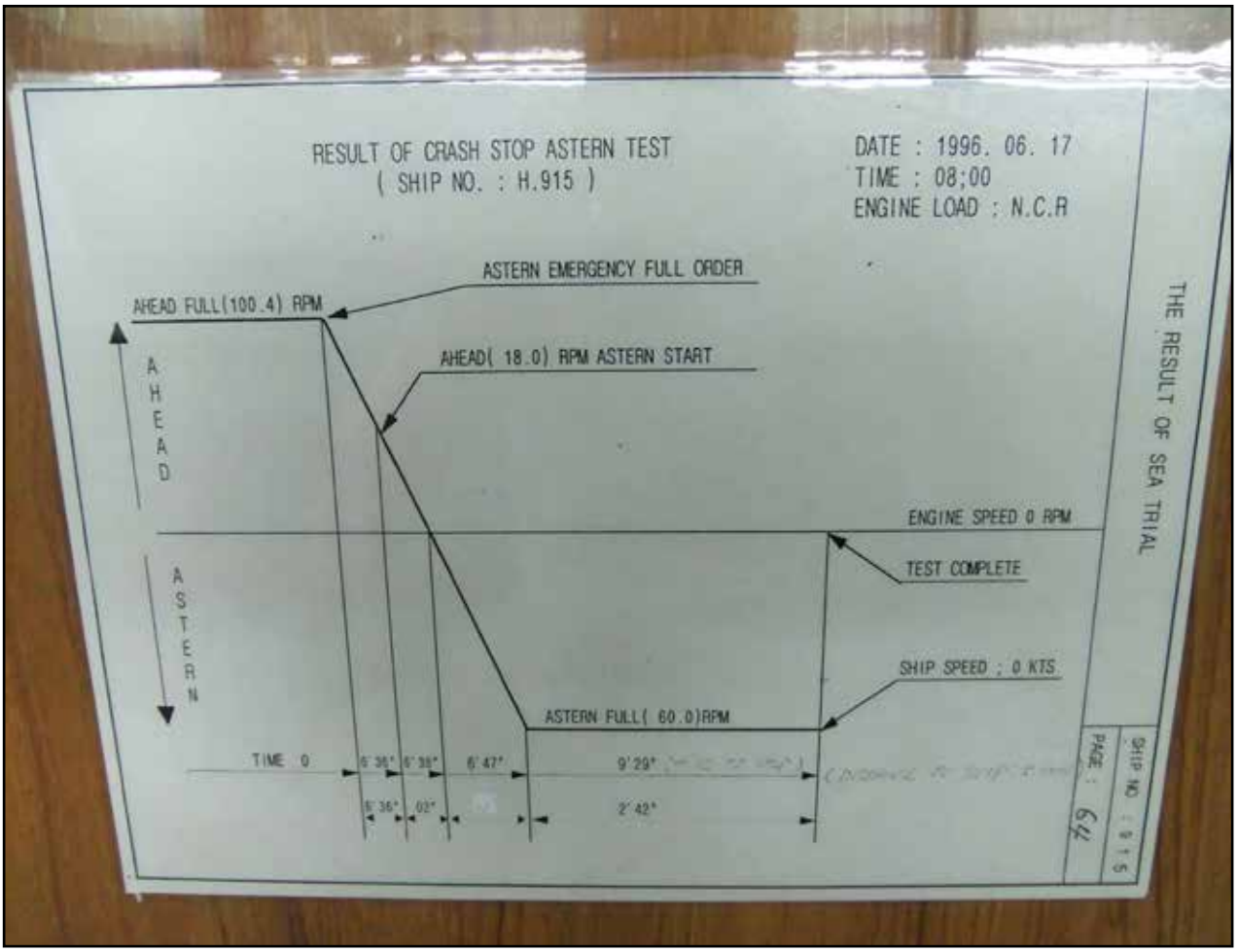

Figure 20: *Hyundai Discovery*'s crash stop test results

1.7.7 Master's standing orders

The master's standing orders **(Annex C)** stated that:

- The master should be called when visibility of less than 4 miles was either encountered or thought likely to occur.
- The OOW should not hesitate to take immediate action for the safety of the ship.
- The minimum CPA in a 'head on situation' was 1.5nm.
- The OOW should never rely on using VHF or AIS equipment as a method of avoiding a collision.

1.7.8 Actions to be taken by officers of the watch

The master expected that officers of the watch should, if confronted by another vessel that was not taking the necessary action to avoid a collision, take the following initial actions:

- Call the master
- Switch the helm to manual steering
- Sound the ship's whistle, or use the signal lamp, to alert the other vessel that it was required to take action.

1.7.9 Instructions on the use of VHF and AIS equipment

The instructions in Zodiac's Safety Management System (SMS) for the use of VHF and AIS equipment **(Annex D)** stated:

> *'The VHF or AIS should not in general be used for collision avoidance…. Valuable time can be wasted in trying to establish contact, positive identification cannot be guaranteed, and even if contact is established, misunderstandings may arise.'*

The MCA's Marine Guidance Note (MGN) 324 (M+F) "Radio: Operational Guidance on the Use of VHF Radio and Automatic Identification Systems (AIS) at Sea" **(Annex E)** provides additional best practice for the use of both systems.

1.7.10 Passage and contingency plans

The plan for *Hyundai Discovery*'s passage from Hong Kong to Singapore included contingency plans, which stipulated the actions that should be taken in restricted visibility. These included:

- Informing the master and the engine room
- Bringing into operation the following equipment: radar and ARPA; manual steering; navigation lights; fog signalling apparatus
- Posting of additional lookouts
- Proceeding at safe speed with regard to the traffic density.

1.7.11 Company audit

The most recent navigation audit **(Annex F)** carried out on board *Hyundai Discovery* prior to the accident had been conducted by Zodiac in May 2011. This included a review of the bridge equipment, bridge team management and the bridge watchkeepers' understanding of the actions required to avoid a collision.

The report of the audit did not refer to the AIS information that was available to the bridge watchkeepers from the ECS display located by the communications area of the bridge.

1.8 REGULATIONS FOR COLLISION PREVENTION

The following rules, from the International Regulations for Preventing Collisions at Sea 1972 (as amended) (COLREGS), are relevant to this accident and are reproduced at **(Annex G)**. These rules are summarised as follows:

- Rule 2 - Responsibility. This rule permits a departure from the collision prevention rules if required to avoid immediate danger.

- Rule 3 - General Definitions. The term ‘restricted visibility’ includes heavy rainstorms that decrease the available visibility.

- Rule 5 - Lookout. This rule states that, as well as visual lookout, radar and any other means can and should be used when required to assess the risk of collision.

- Rule 6 - Safe Speed. This rule states that a ship should be able to stop in a distance that is suitable for the conditions, taking into account such factors as the visibility, traffic situation and the ship’s own manoeuvrability. The rule also requires vessels with radar to assess the limitations of the radars being used, and to consider that not all targets may be displayed owing to interference due to the weather, such as heavy rain.

- Rule 7 - Risk of Collision. This rule requires that all means possible, including radar, should be used to assess if a risk of collision exists as early as possible. This rule does not specifically mention AIS as the last rule amendment predates the introduction of this equipment. However, AIS is considered to be included by the term ‘all means’. AIS provides the user with information about other vessels’ positions, courses and speeds.

- Rule 8 - Action to Avoid Collision. This rule requires that action to avoid collision is positive, clear, and made in ample time.

- Rule 19 - Conduct of Vessels in Restricted Visibility. This rule confirms that vessels’ watchkeepers must have “due regard” for the rules on lookout, safe speed, risk of collision and action to avoid collision while in restricted visibility. The rule applies to vessels out of sight of one another when either vessel is in, or near, an area of restricted visibility. The rule requires that speed should be appropriate to the visibility, and that control of the ship’s propulsion should be immediately available. The rule also states that when a risk of collision exists, an alteration of course to port for a vessel forward of the beam should be avoided if possible.

- Rule 35 - Sound Signals in Restricted Visibility. This rule requires that a power-driven vessel making way in restricted visibility should sound the ship’s whistle for around 5 seconds every 2 minutes.

1.9 *HYUNDAI DISCOVERY* - SIMULATION OF POTENTIAL AVOIDING ACTIONS

The MAIB carried out a trial, using a full mission bridge simulator, to evaluate what actions *Hyundai Discovery*'s chief officer might have been able to attempt in order to avoid the collision.

Software models representing container vessels of similar sizes and manoeuvring characteristics **(Annex H)** to *Hyundai Discovery* and *ACX Hibiscus* were used in the simulator. Information from *Hyundai Discovery*'s VDR was used to provide positions, courses over the ground, heading, and rate of turn data for both vessels. The simulation was run using the same navigational area, with similar environmental conditions to those at the time of the accident.

The exercise was limited by the fidelity of the software model being used to represent *Hyundai Discovery*. The manoeuvring data was similar, but not identical[5]. The limitations of the simulation are acknowledged and the results are presented to illustrate the credibility of the different options available to avoid collision.

Data from *Hyundai Discovery*'s VDR showed that the time between the chief officer's first indication that *ACX Hibiscus* had altered course, to the time of the collision, was around 4 minutes and 10 seconds. An allowance of 1 minute and 30 seconds was made for the time needed to assimilate the situation and determine that the risk of collision existed. This was comparable with the time that elapsed before the chief officer on *Hyundai Discovery* made his first VHF radio call to *ACX Hibiscus*.

The simulation considered alterations of course to starboard, port and an emergency stop. Action to avoid collision was taken:

- 1 minute and 30 seconds after identifying that *ACX Hibiscus* had altered course (2 minutes 40 seconds before collision)
- 2 minutes after identifying that *ACX Hibiscus* had altered course (2 minutes 10 seconds before collision)
- 3 minutes after identifying that *ACX Hibiscus* had altered course (1 minute 10 seconds before collision).

ACX Hibiscus was assumed to maintain the same courses and speeds as during the accident.

[5] The ship's particulars and manoeuvring data used in the simulation are shown at **Annex H**.

The table below indicates the likely outcomes of turning to starboard or port, and making a crash stop.

Action taken			
Time prior to collision	**Turn hard to starboard**	**Turn hard to port**	**Engine full astern**
2:40	Bow Crossing Range[6] (BCR) 4.0 cables	BCR 3.5 cables	Collision
2:10	BCR 2.0 cables	BCR 1.5 cables	Collision
1:10	Collision	Collision	Collision

Table 1: The likely outcomes of *Hyundai Discovery* turning to starboard or port, and making a crash stop

1.10 MASTER'S OBLIGATIONS FOLLOWING A COLLISION

The United Nations Convention on the Law of the Sea (UNCLOS) part VII General Provisions, Article 98: Duty to Render Assistance **(Annex I)**, requires that flag administrations ensure that ships' masters offer assistance to the other ship, its crew and passengers following a collision, provided this action does not risk his own vessel or crew.

1.11 SIMILAR ACCIDENTS

Three major collisions of SOLAS sized vessels[7] were reported to the MAIB in March 2012; investigations into the following collisions were started.

- The UK registered passenger ferry *Stena Feronia* and the Cook Islands registered general cargo vessel *Union Moon* collided in the approaches to Belfast Harbour (MAIB report 26/2012).

- The UK registered general cargo vessel *Seagate* and the Liberian registered reefer *Timor Stream* collided approximately 25nm north of the Dominican Republic.

- The Dutch registered reefer container vessel *Spring Bok* and the Maltese registered liquefied petroleum gas (LPG) carrier *Gas Arctic* collided 6nm south of Dungeness (MAIB report 24/2012).

[6] Bow Crossing Range (BCR) is the radar's ARPA calculated distance that one vessel would pass ahead of the other.

[7] Greater than 500 Gross Registered Tonnes (GRT)

SECTION 2 - ANALYSIS

2.1 AIM

The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

2.2 THE COLLISION

ACX Hibiscus's chief officer altered his vessel's course to port, in restricted visibility, into the path of *Hyundai Discovery*. The chief officer was told by the third officer that some radar targets could not be seen because of clutter. He was further alerted by the VHF radio calls from *Hyundai Discovery*'s chief officer asking him to alter course back to starboard. Despite these warnings, the chief officer on *ACX Hibiscus* continued to turn his vessel.

Hyundai Discovery's chief officer noticed *ACX Hibiscus* alter course soon after it began to turn, about 4 minutes before the collision occurred. This gave him little opportunity to assimilate this unexpected manoeuvre and take avoiding action.

2.3 RESTRICTED VISIBILITY

Both vessels had either entered, or were near to, areas of restricted visibility caused by heavy rain before the collision; *ACX Hibiscus* for at least 25 minutes and *Hyundai Discovery* for around 15 minutes. Immediately prior to the collision, the visibility had significantly reduced in the heavy rain and was reported to be as little as 2 cables. Consequently, both vessels were considered to be affected by restricted visibility as defined by the COLREGS. Neither vessel was in sight of the other, and consequently Rule 19 of the COLREGS - Conduct of Vessels in Restricted Visibility - applied to both *ACX Hibiscus* and *Hyundai Discovery*.

Rule 19 requires that vessels proceed at a safe speed, and that their engines are ready for immediate manoeuvring. This rule also states that all available means are used to establish whether a risk of collision exists. In addition, Rule 35 required that the whistle be sounded.

ACX Hibiscus's chief officer did not call the master to report the restricted visibility. *Hyundai Discovery*'s master was aware of the reduced visibility as he had been on the bridge intermittently prior to the collision. The master reduced speed, but only to arrive at the pilot station on time. Neither vessel's bridge teams reduced to manoeuvring speed, enhanced their ability to keep a lookout (either by eye or radar), transferred from autopilot to manual steering, or made the required sound signal.

Both vessels' bridge teams would have been much better prepared to respond to the traffic situation which they faced had they taken effective action to comply with the COLREGS.

2.4 *ACX HIBISCUS*

2.4.1 Fatigue

The PMA's investigation report stated that the chief officer on *ACX Hibiscus* had worked for 19 of the previous 24 hours. His working pattern prior to the previous 24 hours was not reported. However, in its report, the PMA concluded that the chief officer was fatigued, and that this adversely affected his performance to the extent that it was causal to the accident.

The master left the chief officer on the bridge at 0700. From the information available, it can only be assumed that he either did not realise that the chief officer's performance might be adversely affected by fatigue, or that he expected the chief officer to continue working effectively despite being fatigued.

If the master had properly considered the effect of the chief officer's recent working hours, he should have realised that the chief officer might have difficulty keeping an effective bridge watch in congested waters and restricted visibility. This should have prompted the master either to remain on the bridge until the end of the chief officer's watch, or call a better rested officer to take the watch instead.

Displaying decreased vigilance, failing to observe warning signs, and not appreciating the gravity of the situation have all been associated with fatigue. In light of what is known of the Chief Officer's actions and his working pattern prior to the accident, it is considered likely that the chief officer's ability to keep an effective bridge watch was adversely affected by fatigue. Both the chief officer and master should have recognised that this ill-equipped him for keeping a watch in an area affected by high traffic density and restricted visibility. The watchkeeping routine should have been adapted to avoid taking such a risk.

2.4.2 Watchkeeping

ACX Hibiscus's chief officer was qualified as a master, he had been a watchkeeper for 15 years, and chief officer for the last 4 years with his current employer. He was considered to be an appropriately trained and experienced officer.

The chief officer was not aware of *Hyundai Discovery*'s presence because the vessel's contact was not showing on the radar display and visibility was severely reduced. The third officer later reported that the radar display was obscured by clutter, so it is considered that the chief officer either did not adjust, or incorrectly adjusted, the rain clutter control to reduce the effect of the interference caused by the rain on his radar equipment.

ACX Hibiscus's AIS unit should also have indicated the presence of vessels closest to it, including *Hyundai Discovery*. Consequently, it is also concluded that the chief officer either did not use, or misinterpreted, the AIS information that was available to him.

The chief officer started the turn to port as his vessel approached the alter course position that was marked on the chart. Despite the restricted visibility, he did not make an adequate check that it was safe to turn across the traffic that was heading towards Singapore. The chief officer should have realised that *ACX Hibiscus* would

cross the paths of the south-west bound traffic once her course had been altered to the north. This should have emphasised the importance of checking that it was safe to turn to port.

There were no navigational restrictions or other pressures reported which obliged the chief officer to make the course alteration at that precise moment. It is possible that the chief officer wanted the ship to be steady on its new course before he handed over the watch to the third officer. However, this did not justify the risk of making a course alteration without adequately checking that it was safe to do so.

It is difficult to imagine that an experienced chief officer would have deliberately initiated an alteration of course into *Hyundai Discovery*'s path. It is therefore concluded that the chief officer was not aware of *Hyundai Discovery*'s position and course, or the hazardous situation that was developing.

The chief officer had insufficient situational awareness due to his ineffective use of the navigational aids that were available to him. Notwithstanding the potential effect of fatigue on the chief officer, the standard of watchkeeping on *ACX Hibiscus* at the time of the accident was far below the standard that should be expected of a qualified watchkeeper. Due to the limited evidence available to the MAIB, it has not been possible to examine the underlying reasons for these failings.

2.4.3 Continuation of the turn to port

The third officer arrived on *ACX Hibiscus*'s bridge to take over the watch from the chief officer as the vessel started to turn. When he responded to the initial VHF radio call from *Hyundai Discovery*'s chief officer, potentially without appreciating the significance of the message, the third officer's response to the question *'why are you altering course to port?'* was that *ACX Hibiscus* was *'turning to the north'*. It is considered likely that in this response the third officer was relaying information passed to him by the chief officer.

It was reported that the third officer looked at the radar display and found that radar targets were not seen due to clutter, and that he informed the chief officer about the situation. Although it was not clear from the information provided to the MAIB, this conclusion could only have been drawn by the third officer if he had adjusted the clutter control and subsequently observed radar targets. These probably included *Hyundai Discovery*. However, the chief officer continued to turn *ACX Hibiscus* to port.

The VHF radio calls from *Hyundai Discovery* did not alert *ACX Hibiscus*'s chief officer to the imminent danger that he faced, and did not prompt him to consider the situation further or stop him from continuing his vessel's turn to port.

The reason why the information, and manner, of the report from the third officer and the VHF radio call from *Hyundai Discovery* did not convince *ACX Hibiscus*'s chief officer to reconsider his vessel's manoeuvre was not examined in the PMA's investigation report.

2.4.4 Response to seeing *Hyundai Discovery*

When *Hyundai Discovery* appeared out of the heavy rain at a range of around 2 cables, *ACX Hibiscus*'s chief officer recognised that there was an imminent risk of collision. The chief officer put *ACX Hibiscus*'s rudder hard to port, to increase the rate of turn, and stopped the propulsion in an attempt to avoid collision. These actions were too late to be effective.

The MAIB did not have access to *ACX Hibiscus'*s VDR, and it was therefore not possible to determine exactly when avoiding action was taken. The ship's turning circle data was not provided. Consequently, it was not possible to simulate alternative responses, such as steering to starboard and passing round *Hyundai Discovery*'s stern, which might have been more effective.

2.4.5 Passage planning

The plan for *ACX Hibiscus* to make passage from Singapore to Laem Chabang did not consider the likelihood of heavy rain restricting visibility, nor did the plan consider the risks of altering course to the north across the south-west bound traffic heading for the Singapore Strait TSS. The master had not signed the passage plan, so the planning process was incomplete, and it is considered very likely that it had not been discussed with the watchkeepers prior to departure from Singapore.

Had the passage planning process considered the possibility of heavy rain reducing visibility while the vessel was crossing a busy traffic lane, the master could have identified that additional resources were needed to mitigate the risks during the alteration of course to the north. The master could have remained on the bridge to assist the watch officers, or increased the watch manning.

The master's lack of oversight of the passage plan meant that appropriate bridge resources were not provided during an entirely foreseeable combination of hazardous circumstances.

2.4.6 Actions following collision

*ACX Hibiscus'*s master was alerted to the collision by the impact. His subsequent actions and those of the crew were not recorded or analysed in the PMA's investigation report.

2.4.7 Summary

From the limited information provided, it is considered most likely that the chief officer's performance was adversely affected by fatigue; that the standards of watchkeeping applied on *ACX Hibiscus* at the time of the accident were extremely poor; and that the master's oversight of both the passage plan and his officers' performance was ineffective.

It was not possible to draw any more detailed conclusions from the information provided by the PMA.

2.5 *HYUNDAI DISCOVERY*

2.5.1 Fatigue

There was no evidence that *Hyundai Discovery*'s chief officer was fatigued at the time of the accident, and fatigue is not considered to have had any effect on his actions.

2.5.2 Actions of *Hyundai Discovery*'s chief officer

The chief officer identified that *ACX Hibiscus* was turning to port within a minute of the turn starting; he then had around 4 minutes to react before the two vessels collided. The turn was executed quickly and was a significant alteration of course. There was no warning that *ACX Hibiscus* was about to alter course, and the chief officer had a very limited time to respond to what was a surprising and hazardous situation. This was compounded by the effect of the restricted visibility; that neither vessel was making sound signals; and that *Hyundai Discovery*'s chief officer had to rely on his radar and AIS to determine what was happening.

The chief officer's response to the situation was to use the VHF radio to alert *ACX Hibiscus'*s chief officer, question his actions, and ask him to reverse the turn to port and turn to starboard instead. However, the chief officer was unable to alert *ACX Hibiscus*'s chief officer to the danger he was in, or persuade him to change his actions.

After *Hyundai Discovery*'s chief officer's final VHF radio transmission to *ACX Hibiscus,* there was just over a minute left until the collision occurred. By this time, the actions of *Hyundai Discovery* alone were very unlikely to be sufficient to avoid collision (see Section 1.9). It was only during the final minute that *Hyundai Discovery*'s chief officer switched the helm control to manual steering and sounded the whistle. The helm was put hard to starboard just 20 seconds before the collision.

The chief officer's decision to use the VHF radio to try and persuade *ACX Hibiscus*'s chief officer to reverse his actions was an understandable reaction in the circumstances, as the most effective way of avoiding the collision was for *ACX Hibiscus* to alter course to starboard. If the bridge team on *ACX Hibiscus* had been more alert, it might have been successful. However, the VHF calls were contrary to the instructions in Zodiac's SMS, offered no guarantee of success, and wasted valuable time. Time can appear to pass very quickly in a stressful situation, and every minute is vital when manoeuvring a vessel the size of *Hyundai Discovery*.

This accident should be an important reminder to all bridge watchkeeping officers, as required by COLREGs Rule 8, that action to avoid collision should be substantial and taken in good time.

2.5.3 Actions available to the chief officer

Hyundai Discovery's chief officer was quick to notice *ACX Hibiscus*'s turn to port. He called *ACX Hibiscus* by VHF radio at 0753:15, and again at 0753:30, around 2 minutes 40 seconds before the collision. This time was considered to mark the point at which the chief officer had assessed the situation and decided what action to take.

Results obtained from the ship simulator trials were used to determine what actions would have been the most effective, and the latest time at which action could have been taken to avoid the collision. The emergency actions available to the chief officer were to turn hard to starboard, turn hard to port or initiate a crash stop. There were no navigational hazards to restrict the range of emergency options, and each could have been completed without causing a collision with a vessel other than *ACX Hibiscus*.

- Crash stop

  The simulator results showed that, due to the time lag built into the ship's engine control system, a crash stop would not have altered *Hyundai Discovery*'s speed significantly. This option would not have prevented the collision.

  Had the engine been ready to go astern immediately (if the engine was operating at a speed below which it could be quickly stopped or reversed without causing damage), it is possible that this option could have been more effective.

- Rudder hard to port

  It could be argued that an alteration to port by *Hyundai Discovery* would have been permissible under Rule 2 of the COLREGS. It was estimated from the simulation that if the chief officer placed the rudder hard to port at 0753:30 (2 minutes 40 seconds) before the collision, *Hyundai Discovery* would have passed 3.5 cables ahead of *ACX Hibiscus*. Delaying by another 30 seconds would have reduced the bow crossing range to 1.5 cables.

  This option would have been counter-intuitive to the chief officer as it would have been contrary to Rule 19 of the COLREGS and would possibly have placed the ship in greater danger if *ACX Hibiscus* had turned to starboard as *Hyundai Discovery*'s chief officer requested. Also, there was greater traffic density in this direction, which could have created additional risks.

- Rudder hard to starboard

  Turning *Hyundai Discovery* to starboard complied with all the applicable COLREGs, took the ship away from the majority of traffic, and separated it from any further actions taken by *ACX Hibiscus*. Had a hard turn to starboard been initiated 2 minutes and 40 seconds before the collision, it was estimated that *Hyundai Discovery* would have passed 4 cables ahead of *ACX Hibiscus*. A delay of a further 30 seconds would have halved this range to 2 cables.

  A turn to starboard was considered to be the most effective action to avoid the collision. It generated the greatest passing distance, ensured that *Hyundai Discovery* was not affected by the actions of *ACX Hibiscus,* and complied with the COLREGS.

  If the chief officer had turned hard to starboard at the same time as he called *ACX Hibiscus* by VHF radio, it is likely that *Hyundai Discovery* would have passed around 4 cables ahead of *ACX Hibiscus*. *Hyundai Discovery* was not constrained by traffic or navigational hazards, and the chief officer could have continued to turn the vessel short round or, once ahead of *ACX Hibiscus,* turned to port and regained his original track.

2.5.4 Knowledge of emergency actions

Hyundai Discovery's turning circles at various speeds and loading conditions, along with a diagram showing the time taken to achieve a crash stop, were posted on the bridge.

Although the chief officer was fully aware of this information, he had not translated this knowledge into a practical understanding of when to apply it. In the circumstances of this accident, the chief officer needed to know the effect of putting the rudder hard over, and be confident in taking such bold action. There was no time to delay, and had the chief officer properly understood this, his decision making process might have been different.

The master's orders allowed officers to take emergency actions if required. However, unless officers feel confident about the likely outcome of making an emergency manoeuvre, they might be reticent to make such a manoeuvre. Similar emergency manoeuvres might also be required to avoid a grounding, or following a man overboard incident.

Zodiac's bridge officers would benefit from training and practice in how best to manoeuvre their ships in close quarter situations, to take action to avoid collision, or other emergency situations. This training could be achieved through simulator or familiarisation training. However, the simplest and most effective method could be to set aside training periods where OOWs can practise emergency manoeuvres with their vessels in controlled and supervised conditions while at sea.

2.5.5 Use of VHF for collision avoidance

Both Zodiac's and the master's instructions stated that VHF radio should not be used for collision avoidance. The instructions stated that VHF radio conversations can introduce confusion and that positive identification of the vessel is not guaranteed.

Although AIS had provided the chief officer with a positive identification of *ACX Hibiscus*, as discussed earlier in this report, the VHF radio call did not have the desired effect on *ACX Hibiscus'*s chief officer.

While it is likely that *ACX Hibiscus*'s chief officer was adversely affected by fatigue, there are many other potential reasons why an OOW may not respond to a VHF call. These might include: other, more pressing work; faulty equipment; not understanding the language used during transmission; or even that the bridge is not manned.

It is acknowledged that VHF radio calls are routinely used by OOWs to advise other vessels of their intentions and to request clarification of another vessel's movements. However, this method cannot be relied on for collision avoidance, and OOWs must not allow the use of VHF radio to delay them from taking action.

The lessons learnt from this accident should serve as a timely reminder of the risks of using VHF radio for collision avoidance, as highlighted in MGN 324 (M+F).

2.5.6 AIS information and presentation

The primary display of AIS information was on the unit located close to *Hyundai Discovery*'s chart table. This unit provided either a list of the vessels in the vicinity, or a visual representation of the traffic situation. The unit's screen was small, and

this made the information that was displayed on it hard to understand. Using the information was further complicated by the need to compare the targets displayed on the AIS unit with those on the radar screens, which were located in a different part of the bridge. It was not possible for *Hyundai Discovery*'s radars to display the AIS data on their screens due to their age and design.

AIS information was also displayed on an ECS display at the communications desk in the port aft part of the bridge. The ECS was not approved for navigation, and the master's and company's instructions stated that AIS should not be used for collision avoidance. The system was provided to help improve the watchkeepers' situational awareness, and it offered a clear visual representation of each vessel's name, course and speed. Zodiac's most recent navigation audit report on the vessel made no mention that the ECS was available, nor how the AIS data on it ought to be used. However, it was evident during the investigation that the AIS data that were presented on the ECS display were being used to good effect by the watchkeepers.

The advantage of AIS is that, provided the information from the target vessel is input correctly, it immediately indicates that a vessel is turning by showing regularly updated heading information. This is in contrast to ARPA target information, which can take several minutes to present reliable target data to the operator. In cases such as this one, where a target is continually turning, the target information may never be accurate as it is constantly being re-calculated.

Combining AIS data with an ECS, or radar, can enhance a bridge team's awareness of a situation by providing quick and obvious identification of a target's name, heading and immediate notification that it is turning. While it cannot be wholly relied on due to possible input errors, there are potential benefits for the cautious use of AIS data when evaluating the intentions of other vessels.

2.5.7 Failure to stop to offer assistance

Following the collision, *Hyundai Discovery*'s master reduced his vessel's speed and continued on his passage to Singapore. The master attempted to contact *ACX Hibiscus* by VHF radio more than once, but he did not receive a clear reply.

ACX Hibiscus was sufficiently badly damaged for its master to consider beaching the vessel. It was fortunate that the damage was not as serious as first thought and that no immediate assistance was required. It was conceivable, given the severity of the impact, that *ACX Hibiscus* was sinking and that the crew might need to abandon ship. *Hyundai Discovery* would have been the closest ship to offer immediate assistance as required by UNCLOS. Despite this obligation, the master continued on to his next port without confirming whether the crew of *ACX Hibiscus* needed assistance. *Hyundai Discovery*'s master later overheard *ACX Hibiscus'*s master inform the local coastguard that his vessel's condition had stabilised. *Hyundai Discovery*'s master was unable to explain why he did not offer assistance, despite his knowledge of this requirement and his own company's instructions.

Although *ACX Hibiscus* was in an apparently worse condition, its master also made little attempt to contact *Hyundai Discovery,* either to exchange details or to offer assistance.

This accident serves as a reminder of a master's obligation to offer assistance to any other vessels that his vessel is in collision with.

SECTION 3 - CONDUCT OF THE INVESTIGATION

3.1 AGREEMENT OF LEAD INVESTIGATING STATE

On 13 December 2011 the PMA agreed that the UK's MAIB would lead the investigation into the collision between *ACX Hibiscus* and *Hyundai Discovery.* The investigation was to be conducted in accordance with the IMO Code of International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code).

On 13 December 2012 the PMA appointed an investigator to attend the vessels involved and to work with the MAIB's inspectors.

3.2 FLAG STATE CO-OPERATION

The PMA investigator was delayed in travelling to Singapore at the beginning of the investigation, and the MAIB inspectors began their work on board the UK registered vessel *Hyundai Discovery*.

On 16 December 2011 the PMA investigator arrived in Singapore and the MAIB inspectors proposed that both parties should attend *ACX Hibiscus* in order that evidence could be gathered from the vessel and its crew. The intention was that the PMA investigator would then visit *Hyundai Discovery* with the MAIB inspectors so that all the evidence could be shared equally. However, the lawyer acting for *ACX Hibiscus*'s owners denied the MAIB inspectors access to the vessel because it was outside their jurisdiction. The investigation was temporarily suspended.

The PMA and MAIB agreed that the most practical way to proceed would be for the PMA investigator to attend *ACX Hibiscus* alone, and then to share the evidence that he had gathered with the MAIB. Accordingly, the MAIB prepared a list of questions, based on their knowledge of the case at that stage, to assist the PMA investigator.

The PMA investigator returned to *ACX Hibiscus* to continue the investigation on 17 December 2011. Later that day, the PMA investigator was instructed by the lawyer acting for *ACX Hibiscus*'s owners to sign a declaration stating that he would not pass any of the evidence that he had gathered to the MAIB. With approval from his manager in the PMA, the investigator signed the declaration.

MAIB inspectors were subsequently able to hold a brief meeting with the PMA investigator while he was waiting to board his flight home. However, no evidence was exchanged.

On 27 March 2012, MAIB staff met with the manager of the PMA's casualty investigation department to discuss the accident. During this meeting the MAIB presented its findings to date, and the PMA provided the MAIB with a copy of the *"Preliminary report of the ACX Hibiscus, IMO no.9159141 collision with Hyundai Discovery off Horsburgh light, Singapore, 11 December 2011".* The PMA manager apologised to the MAIB for the fact that he was unable to share with them any primary evidence because he was obliged to respect the instructions of *ACX Hibiscus'*s owners. This included the records of witness interviews and,

most importantly, *ACX Hibiscus'*s VDR. In contrast, the MAIB showed the PMA's representative a replay of the AIS data showing *ACX Hibiscus'*s track taken from *Hyundai Discovery*.

Regrettably, it must be concluded that the decision to deny the MAIB access to evidence from *ACX Hibiscus* has limited the safety issues that can be learned from this investigation.

3.3 CONSEQUENCES TO THE INVESTIGATION

The most important question to answer in this investigation was why *ACX Hibiscus*'s chief officer chose to alter course to port across a traffic route in such hazardous circumstances. Although the report from the PMA provided many factual details, it did not fully answer this question. The conclusion that the chief officer's decision was due to fatigue, was not substantiated beyond stating his most recent hours of work and rest. There were other factors that needed to be considered:

- The chief officer's watchkeeping competence, knowledge of the COLREGS and attitude to collision avoidance.
- The reason why the chief officer did not adjust the radar clutter control.
- The reason why the chief officer continued to turn *ACX Hibiscus* despite calls on VHF radio and being alerted to radar targets ahead of his vessel.
- The effectiveness of the master's management and oversight of his officers.
- The effectiveness of *ACX Hibiscus*'s safety management system, including navigational procedures and passage planning.
- The effectiveness of any procedures that were in place to check the competence of watchkeeping officers.
- The vessel's managers' attitude to safety.

As a consequence, this report has been obliged to focus on the actions that should be taken to avoid rogue vessels, rather than deal with the underlying causes of the accident. This is contrary to the aims of the MAIB and the IMO's Casualty Investigation Code.

3.4 EFFECTIVENESS OF THE IMO CASUALTY INVESTIGATION CODE

The IMO Casualty Investigation Code **(Annex A)** requires that all substantially interested states should co-operate fully in carrying out a Safety Investigation, unless this is limited by national laws. The PMA agreed that the MAIB would lead the joint investigation into the accident. However, despite repeated requests, VDR data, interview records and other evidence were not provided to the lead investigating state. The MAIB's inspectors were provided with only a partial account of the accident 3 months after it had occurred.

Evidence was denied to this investigation due to pressure brought to bear on the PMA by *ACX Hibiscus*'s owners. This lack of co-operation is contrary to the requirements of Part II Mandatory Standards Chapter 10 of the Casualty Investigation Code, which states that:

> *'All substantially interested states shall co-operate to the extent practicable'.*

And Chapter 11, which states:

> *'Marine safety investigating state(s) shall ensure that investigator(s) carrying out a marine safety investigation are impartial and objective. The marine safety investigation shall be able to report on the results of a marine safety investigation without* ***direction or interference*** *from any persons or organisations who may be affected by its outcome'.*

That *ACX Hibiscus*'s owners were able to apply pressure to PMA, which resulted in much key evidence being withheld from the lead investigating state, has highlighted a fundamental weakness in that administration's application of the IMO Casualty Investigation Code.

SECTION 4 - CONCLUSIONS

4.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT WHICH HAVE RESULTED IN RECOMMENDATIONS

1. *ACX Hibiscus*'s chief officer altered course to port, in restricted visibility, into *Hyundai Discovery*'s path. Despite warnings from his own third officer and the VHF radio, the chief officer on *ACX Hibiscus* continued to turn his vessel. [2.2]

2. *Hyundai Discovery*'s chief officer noticed that *ACX Hibiscus* began to turn about 4 minutes before the collision occurred. This gave him little opportunity to assimilate this unexpected manoeuvre and take avoiding action. [2.2]

3. Neither vessel's bridge teams complied fully with the applicable COLREGS for restricted visibility. Both vessels' bridge teams would have been much better prepared to respond to the traffic situation which they faced had they taken effective action to comply with the COLREGS. [2.3]

4. *ACX Hibiscus'*s chief officer had worked for 19 of the 24 hours before the accident. The PMA's investigation report concluded that the chief officer's performance was adversely affected by fatigue, and that this was causal to the accident. [2.4.1]

5. Neither *ACX Hibiscus'*s master nor the chief officer recognised that the effects of fatigue made the chief officer unsuited to keeping a watch in an area affected by high traffic density and restricted visibility. The watchkeeping routine on *ACX Hibiscus* should have been adapted to avoid taking such a risk. [2.4.1]

6. Notwithstanding *ACX Hibiscus*'s chief officer's potential fatigue, the standard of watchkeeping on the vessel at the time of the accident was far below that which should be expected of a qualified watchkeeper. [2.4.2]

7. The reasons why *ACX Hibiscus*'s chief officer started to turn his vessel to port without checking that it was safe to turn across the opposite traffic route, and continued to turn despite warnings, were not examined in the PMA's investigation report. [2.4.2, 2.4.3, 3.3]

8. *ACX Hibiscus*'s chief officer took action to avoid collision only when *Hyundai Discovery* became visible. By that time, it was too late to avoid a collision. [2.4.4]

9. *ACX Hibiscus'*s master's lack of oversight of the passage plan meant that appropriate bridge resources were not provided during an entirely foreseeable combination of hazardous circumstances. [2.4.5]

10. This accident demonstrates that using VHF radio calls to try and avoid a collision offers no guarantee of success, and can waste valuable time. Action to avoid collision should be substantial and made in good time. [2.5.2]

4.2 OTHER SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION ALSO LEADING TO RECOMMENDATIONS

1. That *ACX Hibiscus*'s owners were able to apply pressure to PMA, which resulted in much key evidence being withheld from the lead investigating state, has highlighted a fundamental weakness in that administration's application of the IMO Casualty Investigation Code. [3.4]

4.3 SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION WHICH HAVE BEEN ADDRESSED OR HAVE NOT RESULTED IN RECOMMENDATIONS

1. Simulations undertaken by the MAIB showed that, when *ACX Hibiscus* turned to port, the most effective action that *Hyundai Discovery*'s chief officer could have taken was to turn his vessel to starboard. Had he done this at around the same time as he called *ACX Hibiscus* by VHF radio, it is likely that *Hyundai Discovery* would have passed around 4 cables ahead of the other vessel. [2.5.3]

2. Zodiac's bridge officers would benefit from training and practice in how best to manoeuvre their ships in close quarter situations to take action to avoid collision, or other emergency situations. [2.5.4]

3. The lessons learnt from this accident should serve as a timely reminder of the risks of using VHF radio for collision avoidance. [2.5.5]

4. Following the accident, neither vessels' master took appropriate action to offer assistance to the other vessel as required by UNCLOS. This accident serves as a reminder of a master's obligation to offer assistance to any other vessels that his vessel is in collision with. [2.5.7]

5. The PMA, despite agreeing that the UK would act as the lead investigating state, allowed the owners of *ACX Hibiscus* to deny the MAIB access to critical evidence. [3.2]

6. Due to a lack of access to critical evidence, this report has been obliged to focus on the actions that should be taken to avoid rogue vessels, rather than deal with the underlying causes of the accident. [3.3]

SECTION 5 - ACTION TAKEN

5.1 ACTIONS TAKEN BY OTHER ORGANISATIONS

Zodiac Maritime Agencies Limited has:

Carried out an internal investigation and produced a report which identified the safety lessons to be learnt from this accident. Zodiac's managers have developed a presentation highlighting these lessons, and at the time of the investigation were disseminating these lessons to their fleet during ship visits by auditors and superintendents, and company seminars.

Zodiac's managers have subsequently:

- Used the lessons learnt from this accident in a company case study and in training material. The topics covered include:
    - The actions that could have been taken to avoid collision.
    - The obligation to reduce speed in restricted visibility.
    - The availability of main engines for manoeuvring when required.
    - The use of VHF radio for collision avoidance.
- Included the lessons learnt from this incident for discussion during onboard navigational audits.

Onward Marine Service Company Limited

It is not known what, if any, actions the Onward Marine Service Company Limited, the managers of *ACX Hibiscus,* have taken as a result of this accident.

SECTION 6 - RECOMMENDATIONS

The **Panama Maritime Authority** is recommended to:

2013/125 Take such measures as are necessary to ensure it is fully compliant with the IMO Casualty Investigation Code Mandatory sections, specifically Chapter 11.

2013/126 Take appropriate action with *ACX Hibiscus'*s owners to address the underlying causes of this accident.

Zodiac Maritime Agencies Ltd. is recommended to:

2013/127 Develop its Safety Management System, training and audit programme to enhance its masters' and watchkeeping officers' understanding of:

- The precautions to be taken in restricted visibility.
- Emergency manoeuvring actions.
- The obligation to offer assistance to any other vessels that their vessel might collide with.

Marine Accident Investigation Branch
June 2013

Safety recommendations shall in no case create a presumption of blame or liability

Marine Accident Report