Report on the investigation of

the grounding of

mv Maersk Kendal

on Monggok Sebarok reef

in the Singapore Strait

on 16 September 2009

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Report No 2/2010
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Pursuant to Regulation 6 of Chapter XI-1 of the International Convention for the Safety of Life at Sea (SOLAS) and the Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code) (Resolution MSC.255(84)), the MAIB has investigated this accident with the co-operation and assistance of the Maritime and Port Authority of Singapore (MPA). The Coastal State's contribution to this investigation is acknowledged and gratefully appreciated.

Extract from

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2005 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2005 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 13(9) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2005, 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 AND ACRONYMS AND TERMS

AB	-	Able Bodied Seaman
AIS	-	Automatic Identification System
ARPA	-	Automatic Radar Plotting Aid
BRM	-	Bridge Resource Management
BTM	-	Bridge Team Management
COLREGS	-	International Regulations for Preventing Collisions at Sea 1972 (as amended)
CRM	-	Crew Resource Management
ECDIS	-	Electronic Chart Display and Information System
ICS	-	International Chamber of Shipping
IMO	-	International Maritime Organization
ISF	-	International Shipping Federation
ISM Code	-	International Management Code for the Safe Operation of Ships and for Pollution Prevention
kW	-	Kilowatt
m	-	metre(s)
MAIB	-	Marine Accident Investigation Branch
MCA	-	Maritime and Coastguard Agency
MPA	-	Maritime and Port Authority of Singapore
MTC	-	Maersk Training Centre
nm	-	Nautical mile
OCIMF	-	Oil Companies International Marine Forum
OOW	-	Officer of the Watch
PEC	-	Pilotage Exemption Certificate
rpm	-	Revolutions per minute

SIN	-	Safety Improvement Notice
SMS	-	Safety Management System
SOLAS	-	International Convention for the Safety of Life at Sea
STCW	-	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, as amended
TSS	-	Traffic Separation Scheme
UTC	-	Universal Co-ordinated Time
VDR	-	Voyage Data Recorder
VHF	-	Very High Frequency
VTIS	-	Vessel Traffic Information System
Advance	-	The distance gained in the original direction from the point at which full helm is applied until a ship steadies on her final course
One hour's notice	-	Notice given to the engine room to signify that the engine needs to be ready for manoeuvring at the end of 1 hour
Transfer	-	The distance gained at right angles to the original direction from the point at which full helm is applied until a ship steadies on her final course
Turning circle	-	The path followed by a ship's pivot point when executing a 360º turn

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

Courses: All courses are true unless otherwise stated

Maersk Kendal

SYNOPSIS

Maersk Kendal, a UK registered container ship, ran aground on Monggok Sebarok reef in the Singapore Strait on 16 September 2009. The vessel had altered her course to starboard to give way to three vessels exiting Jong Channel. This caused her to head towards the reef with the intention of altering course to port and resuming her original planned track after passing astern of the third vessel. Despite warnings from Singapore Vessel Traffic Information System (VTIS), the vessel did not reduce speed or alter course in sufficient time to prevent her from grounding. Substantial damage was sustained to the fore part of the vessel. However, there were no resulting injuries and no pollution.

The following decisions and actions taken by the bridge team contributed to the vessel running aground:

- The movement of the engine telegraph from full ahead manoeuvring to half ahead had no effect on the engine speed; neither the master nor the chief officer appreciated this at the time.
- The master's assessment of the situation and decision to alter course to starboard were based on his observation of true vectors and relative trails of the radar targets; no trial manoeuvres were carried out.
- The master and chief officer misinterpreted the information received from VTIS in respect of which three vessels it had referred to.
- The master and chief officer became irritated by the frequent interventions by VTIS, which resulted in important information from VTIS being missed.

The MAIB investigation identified a failure of bridge team work, which included a lack of comprehensive passage planning, poor position monitoring and ineffective interaction, underpinned by complacency.

Following the accident, A.P. Møller – Maersk A/S has taken steps to ensure that examination of VDR data will now form part of future navigational audits and that all bridge team officers will progressively undergo crew resource management training. The International Chamber of Shipping (ICS) has distributed a circular to its membership highlighting the lessons learned from recent accidents and strongly supporting the need for appropriate navigating officers to attend bridge team management training courses. The Maritime and Coastguard Agency (MCA) has undertaken to support proposed amendments to STCW requirements relating to leadership and management skills and competence in bridge resource management.

In view of the actions that have been taken, the MAIB has issued no safety recommendations.

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *MAERSK KENDAL* AND ACCIDENT

Vessel details

Registered owner	:	The Maersk Company Limited
Manager	:	A.P. Møller – Maersk A/S
Port of registry	:	London
Flag	:	United Kingdom
Type	:	Container ship
Built	:	2007 in South Korea
IMO number		9332999
Classification society	:	American Bureau of Shipping
Construction	:	Steel
Length overall	:	299.54 m
Gross tonnage	:	74642
Engine power	:	57200 kW
Service speed	:	25.6 knots
Other relevant info	:	Single bow thruster

Accident details

Time and date	:	0715 on 16 September 2009
Location of incident	:	Monggok Sebarok reef in the Singapore Strait
Persons on board	:	25
Damage	:	Substantial steel damage in way of fore peak, bow thruster room, No. 1 void and No. 1 centre ballast tank

1.2 NARRATIVE

1.2.1 Events leading up to the grounding

Maersk Kendal departed Laem Chabang (Thailand) with a cargo of 3100 containers on 14 September 2009. Her maximum draught was recorded in the logbook as 13.05 metres aft. She was bound for Tanjung Pelepas (Malaysia), a port about 20 miles west of Singapore, and her estimated time of arrival was 0830 on 16 September 2009. At Tanjung Pelepas she was scheduled to discharge and load containers before continuing on to Port Kelang and Colombo, en-route to north-west Europe.

At 0300 on 16 September, the master arrived on the bridge to assist the bridge team during the vessel's transit of the Singapore Strait. He assumed a monitoring and support role and provided advice to the second officer, who was the officer of the watch (OOW) and assisted by an able bodied seaman (AB). The steering was on automatic helm and engine was set on full sea speed at 88 revolutions per minute (rpm) giving a speed of about 21 knots.

The chief officer and the relief AB arrived on the bridge just before 0400 to take the watch. On taking charge, the chief officer monitored the vessel's position on the Electronic Chart Display and Information System (ECDIS), with intermittent position plotting on the paper chart, and used the Automatic Radar Plotting Aid (ARPA) for collision avoidance.

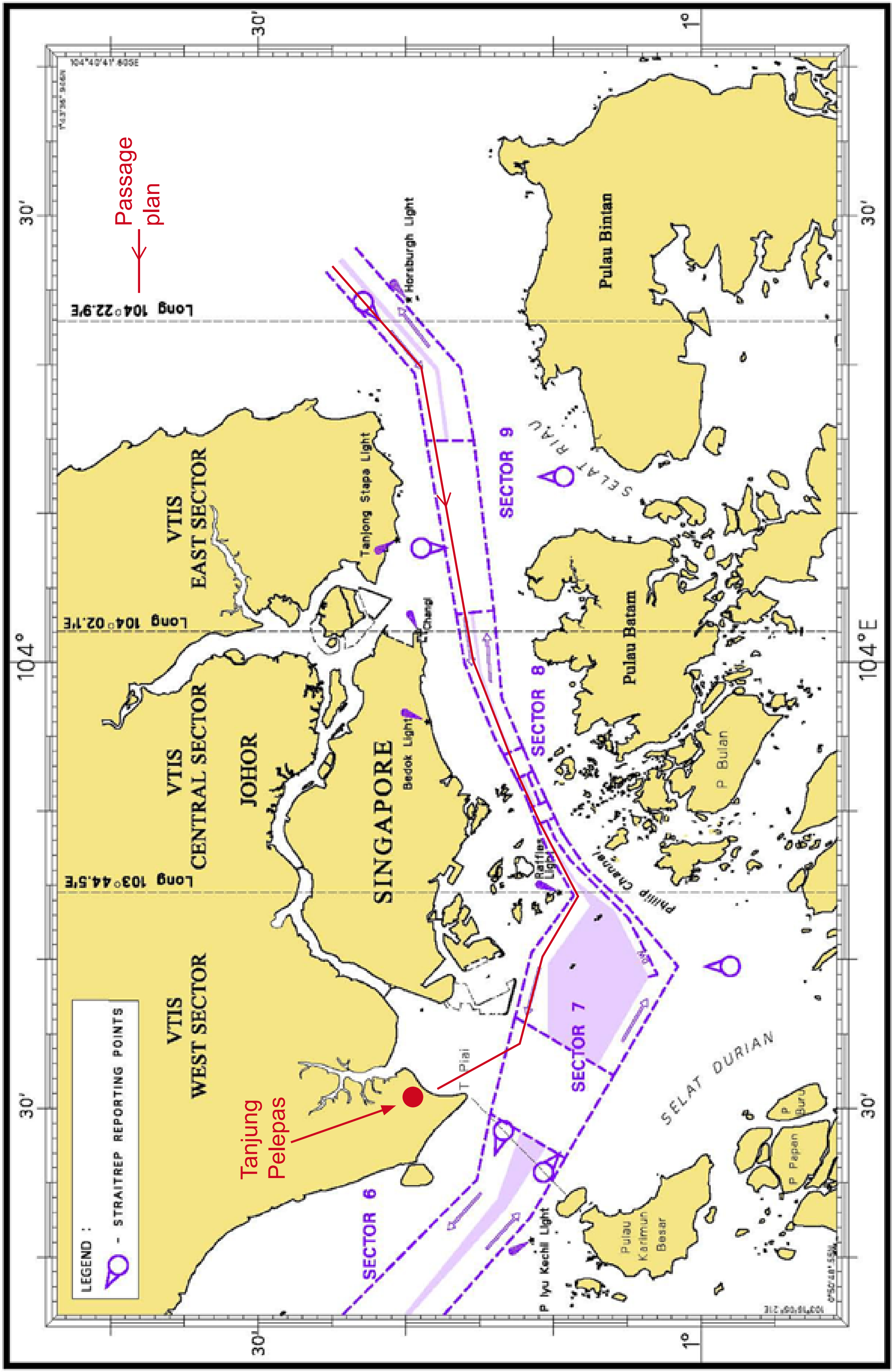
Maersk Kendal entered the eastern Singapore Strait Traffic Separation Scheme (TSS) at about 0515. As the vessel passed Horsburgh Light, at 0530, the chief officer reported in to Singapore Vessel Traffic Information System (VTIS) sector 9 **(Figure 1)** on VHF radio channel 14. This report was required by STRAITREP, a mandatory reporting scheme for vessels transiting the Malacca and Singapore Straits.

At 0615, the master informed the chief officer that he was taking over the con of the vessel. The chief officer now switched roles and provided support to the master by monitoring the position of the vessel, handling communications and advising the master on collision avoidance.

Maersk Kendal crossed from VTIS sector 9 to sector 8 at about 0630. At 0645, the chief officer called the duty engineer to advise him that 'one hour's notice' would be given at 0650. This was followed by another call to the engine control room at 0650 to advise the duty engineer that the telegraph had been set to full ahead manoeuvring (67 rpm).

An extract of the relevant telegraph orders given up to the grounding are at **Annex A**.

Figure 1

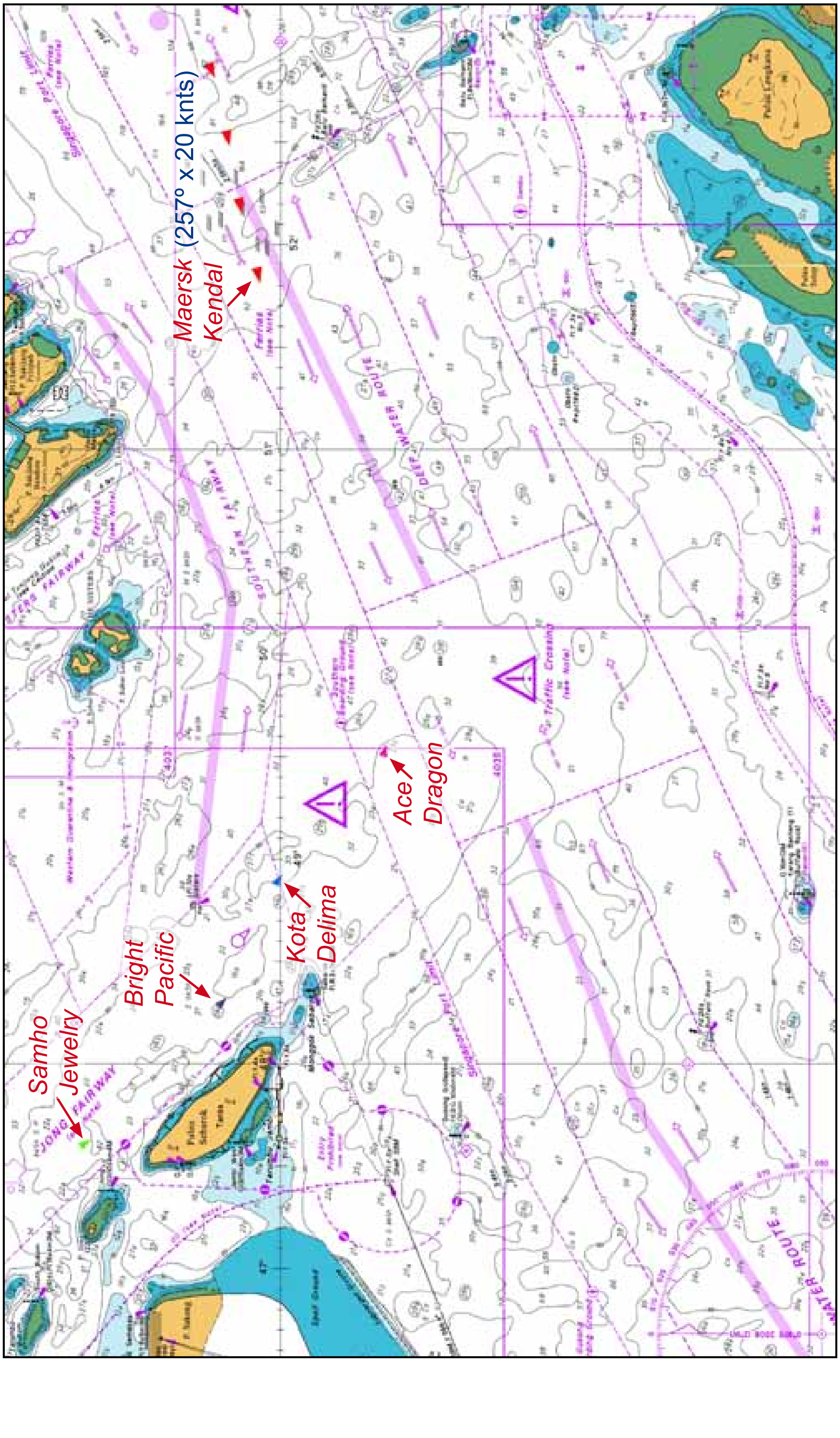


Singapore Strait - VTIS operational areas

At 0703 **(Figure 2)**, VTIS called *Maersk Kendal* and advised the vessel:

> *'Maersk Kendal, require you to slow down, require you to slow down. Three ships coming out of the Jong channel'*

Figure 2



Plot of vessels at 0703

VTIS also advised *Maersk Kendal* to exercise caution, which was acknowledged by the chief officer, and the master set the telegraph to half ahead. The vessel's course and speed over the ground were recorded as 257º and 20.7 knots respectively. The master then began to assess the traffic situation using the vessel's starboard automatic radar plotting aid (ARPA). The ARPA was set to display target true vectors with relative trails. He identified three vessels on the starboard bow: the *Kota Delima*, *Bright Pacific* and *Samho Jewelry,* which he concluded were the vessels referred to by VTIS. *Ace Dragon*, which was almost right ahead of *Maersk Kendal*, was discounted.

The master instructed the AB to place the helm in hand-steering and take the wheel. He then ordered the AB to make an alteration of course to starboard before steadying the vessel on about 265º with the intention of passing around the stern of *Kota Delima* and *Bright Pacific*. No use was made of the ARPA's trial manoeuvre function before the alteration was executed.

To assist collision avoidance, VTIS provided information between 0704 and 0708 to *Kota Delima*, *Bright Pacific* and *Maersk Kendal*.

At 0708 **(Figure 3)**, VTIS called *Maersk Kendal* and advised her to reduce speed as it was still high and the vessel was about to enter port limits. This message was acknowledged by the chief officer, and the master set the engine telegraph to slow ahead. Course and speed over the ground were recorded as 265º and 19.1 knots. The master then ordered a further alteration of course to starboard and steadied the vessel on a course of 273º.

At 0710 **(Figure 4)**, with *Maersk Kendal* proceeding on a course of 274º at 19 knots, VTIS called the vessel to confirm if the master was on the bridge, to advise him that the vessel had already entered Singapore port limits, and to request the vessel to slow down. The master responded by advising VTIS:

> '*Listen I am slowing down all the time, I have two ships out ahead and will pass astern of both of them, no problem'*

VTIS then immediately advised *Maersk Kendal*:

> '*Chemical tanker, chemical tanker, the name is Samho Jewelry Samho Jewelry is a, is a piloted tanker. She is not leaving Singapore she is not leaving Singapore' [sic]*

The chief officer responded:

> '*Got the name of the tanker – Samho Jewelry. Thank you'*

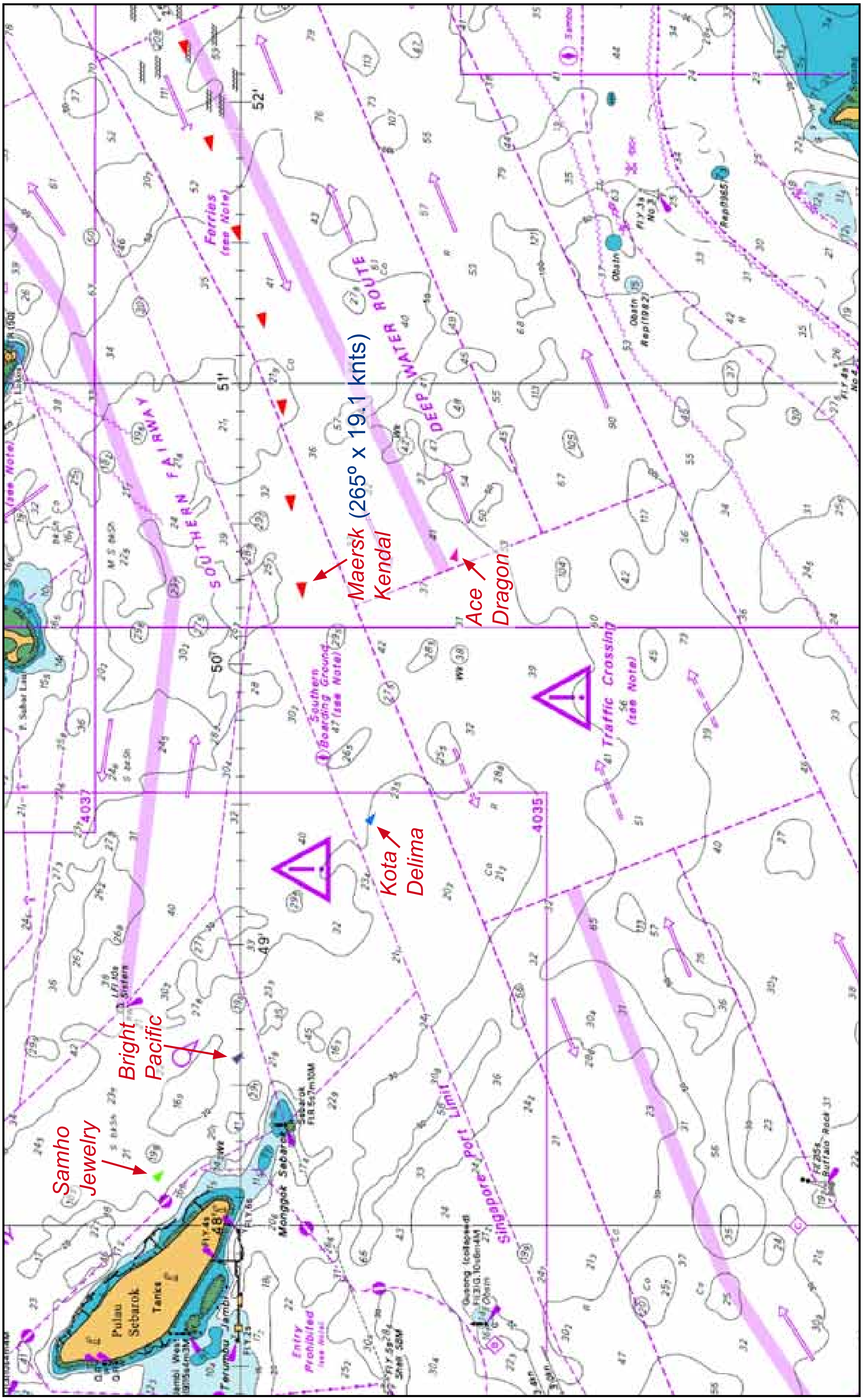
VTIS replied:

> *'Thank you, it appears that you are heading towards her. Over'*

and then made a further broadcast at about 0711:

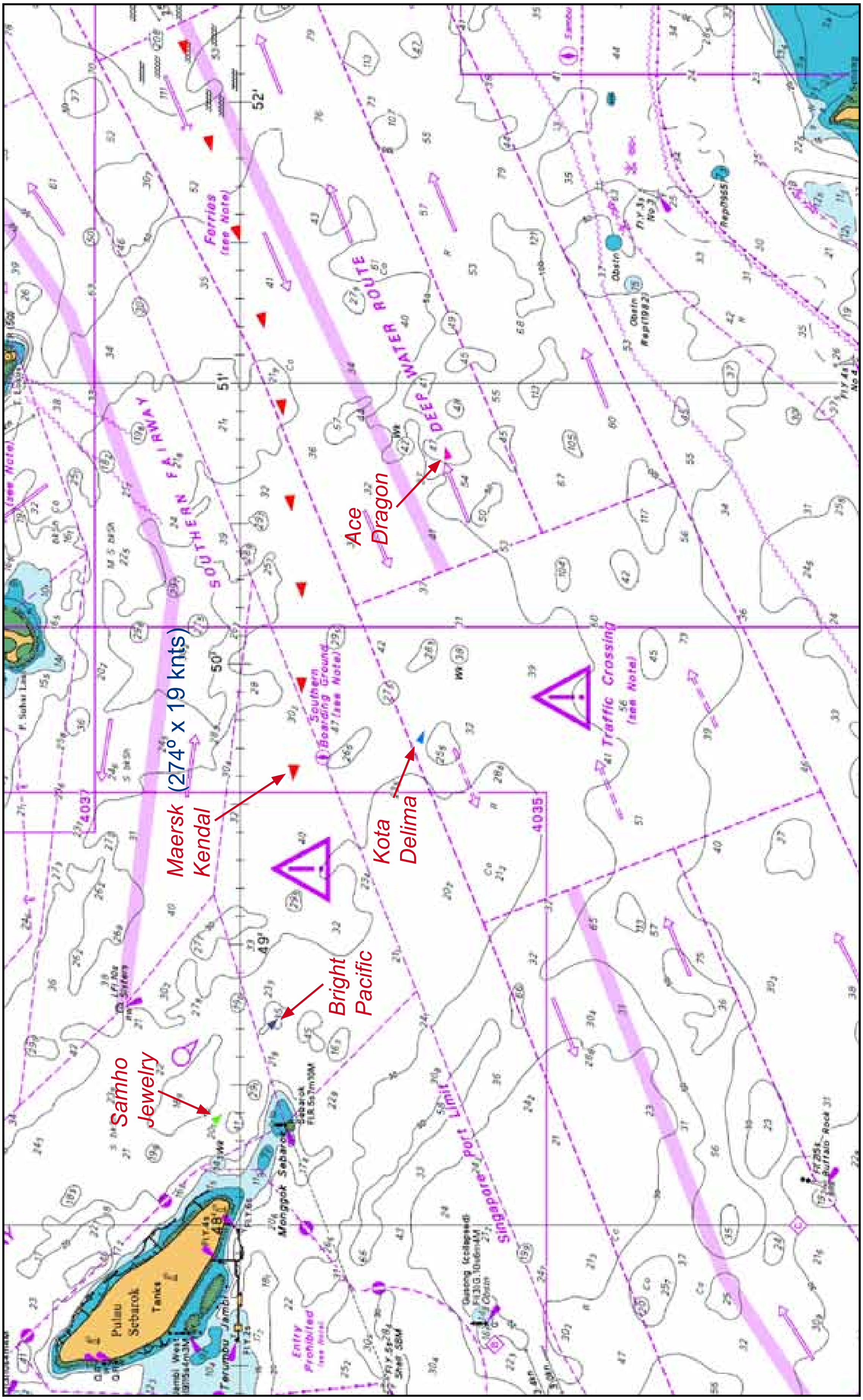
> '*All ships standby, all ships standby. Maersk Kendal warning to you. Ahead of you is Samho Jewelry, Samho Jewelry, What is your intention over?'*

Figure 3



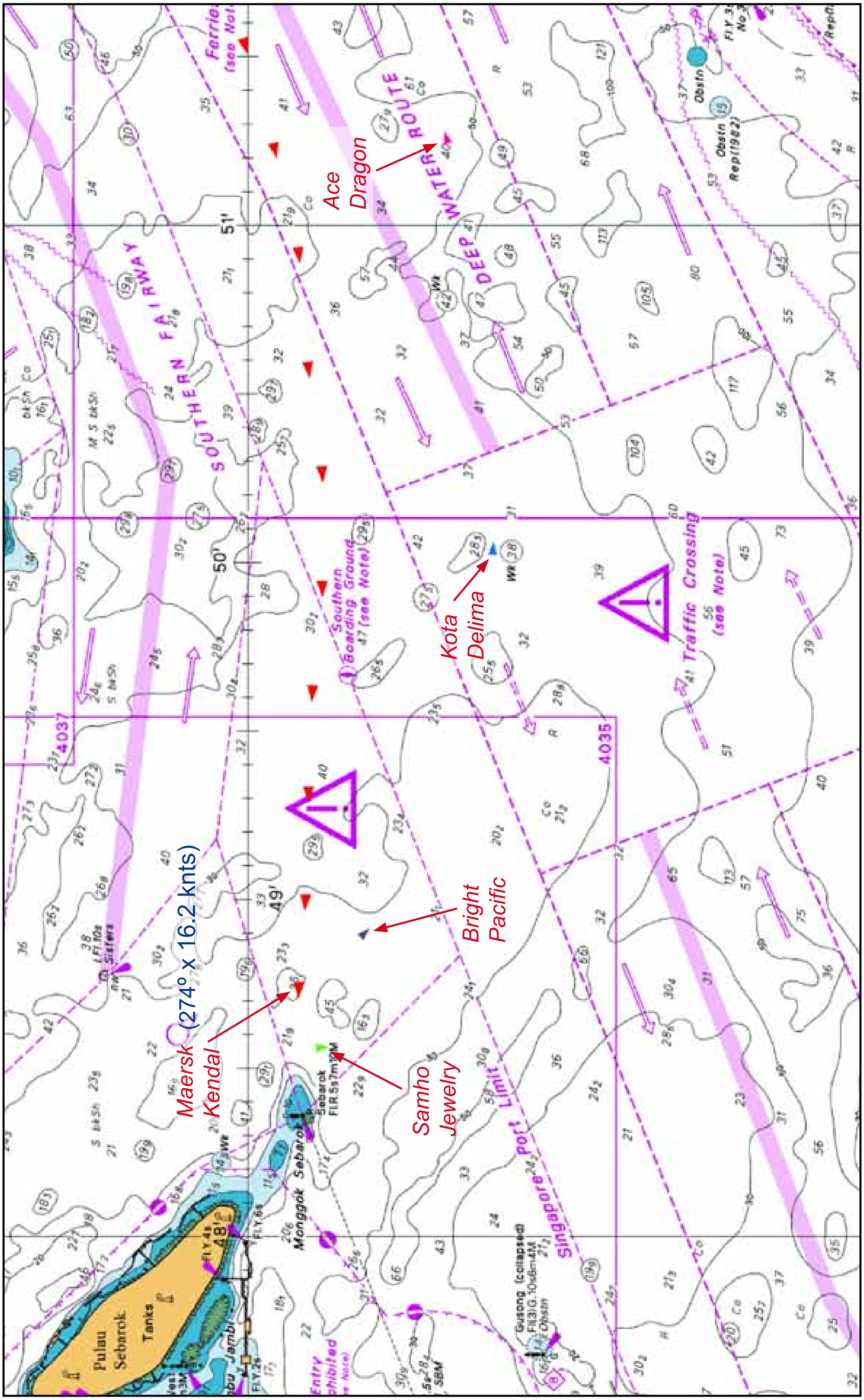
Plot of vessels at 0708

Figure 4



Plot of vessels at 0710

Figure 5



Plot of vessels at 0713

The chief officer replied that *Maersk Kendal* would be passing astern and would make an alteration to port after that.

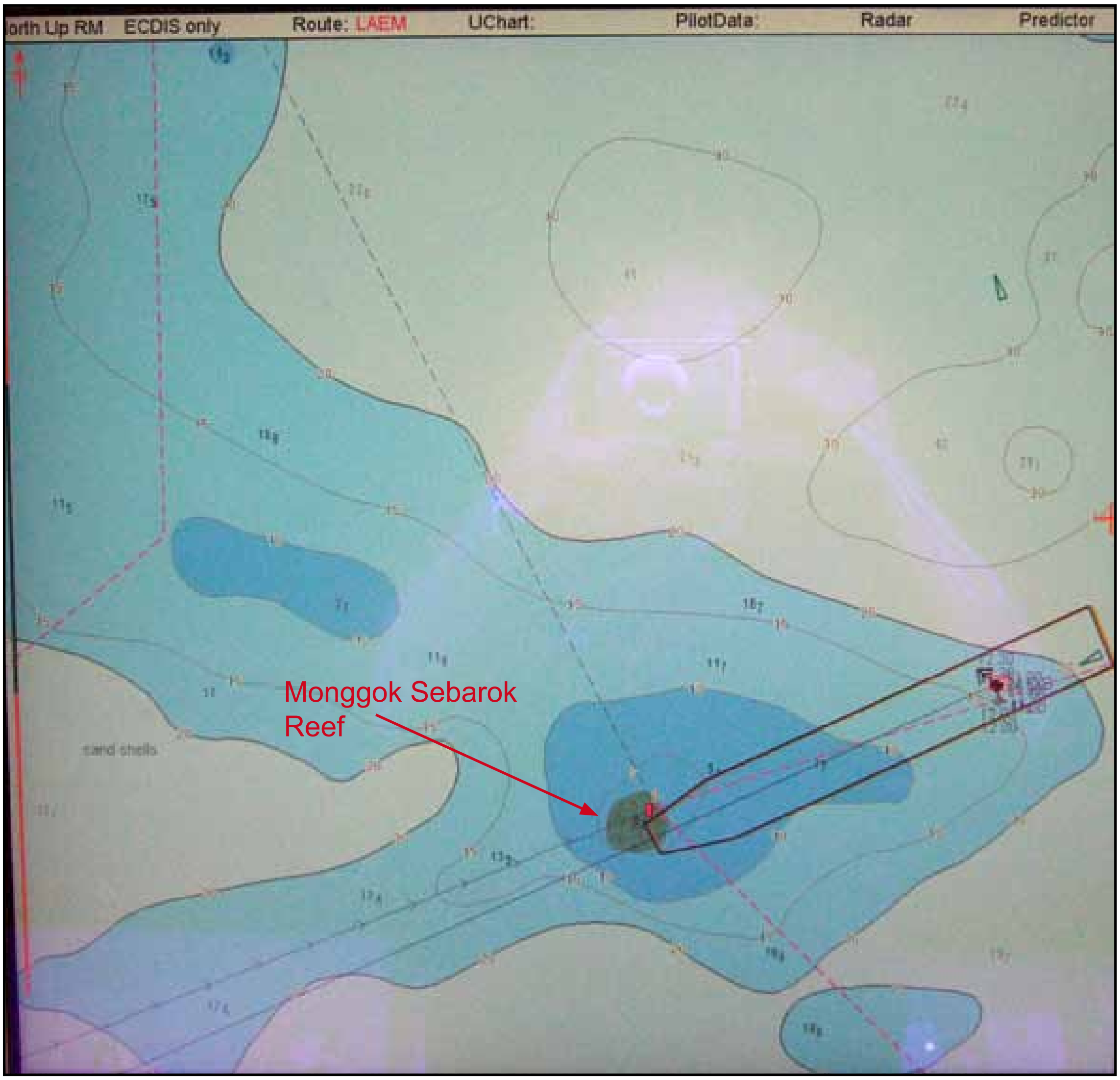
At 0713 **(Figure 5)**, with *Maersk Kendal* still on a course of 274º and now at a speed of 16.2 knots, VTIS advised:

> *'Maersk Kendal, shallow water ahead of you, shallow water ahead of you.'*

The chief officer replied "*OK sir*".

After *Samho Jewelry* had crossed the bow of *Maersk Kendal,* the master started following the stern of the other vessel to port. His initial helm order was 'port 10', followed by 'port 20' and then 'hard-a-port'. He then went onto the starboard bridge wing to assess whether the vessel would clear the beacon on Monggok Sebarok reef. As he returned to the wheelhouse, the vessel ran aground **(Figure 6)** on a heading of 246º and at a speed of about 14.2 knots.

Figure 6

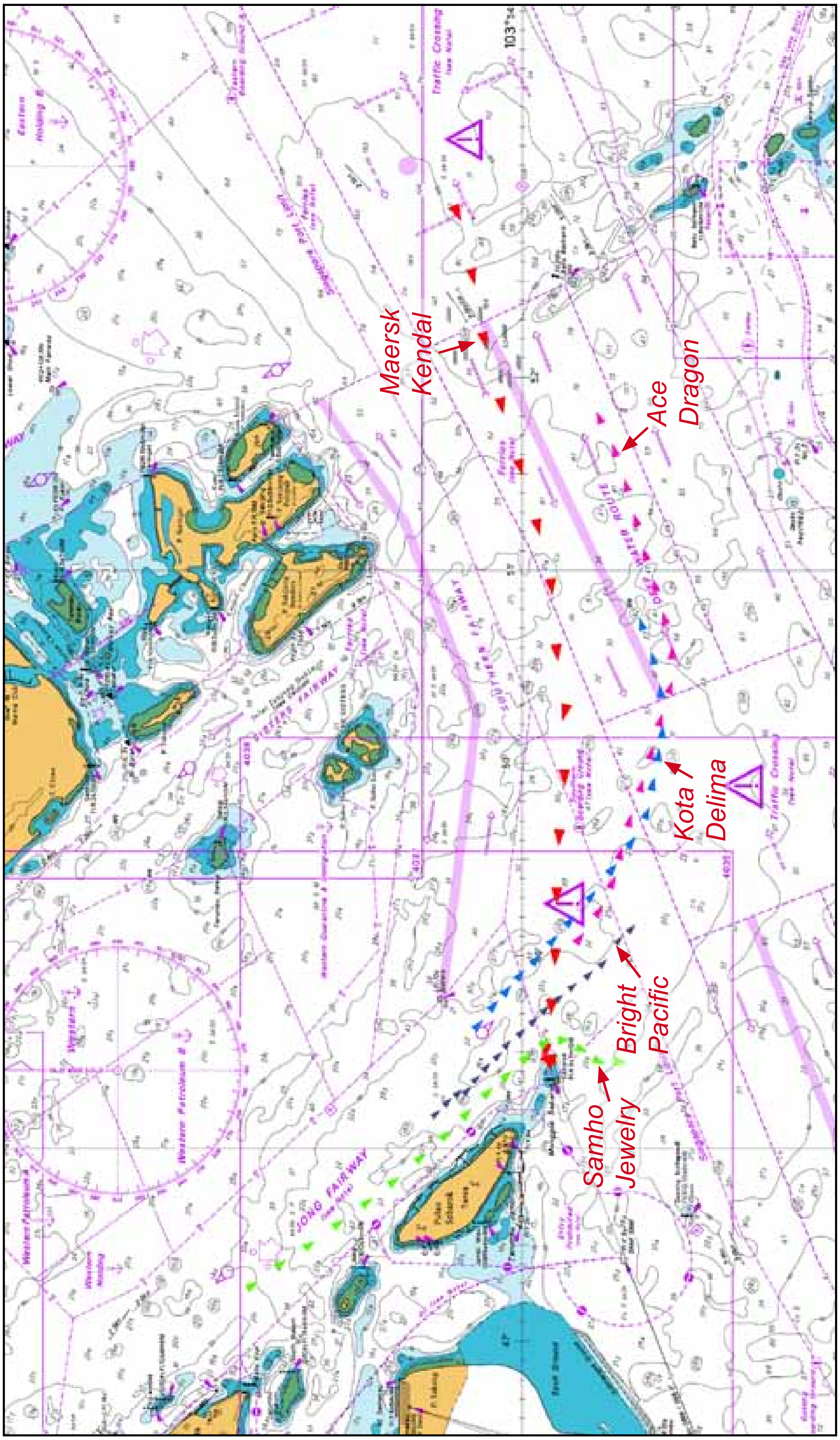


ECDIS display showing *Maersk Kendal* aground on Monggok Sebarok reef

VTIS made six attempts to contact the vessel before it finally received a reply at 0716 from the chief officer confirming that *Maersk Kendal* was aground.

The complete plot of all vessels from 0700 to 0716 is at **Figure 7**.

Figure 7



Overview of plot of all vessels between 0700 and 0716

A copy of the VHF radio transmissions recorded by Singapore VTIS was provided to the Marine Accident Investigation Branch (MAIB), courtesy of the Maritime and Port Authority of Singapore (MPA). A transcript of transmissions relevant to the accident was made by the MAIB, and is at **Annex B**.

1.2.2 Post grounding events

On grounding, the master set the telegraph to stop and went progressively to full astern. The chief officer called the third officer to relieve him so that he could go on deck to assess the damage. The chief engineer arrived on the bridge to find the engine at full astern. He advised the master of the possible consequences of overloading the engine and, at 0723, the telegraph was set to stop.

The master depressed the 'save' button **(Figure 8)** on the Voyage Data Recorder (VDR) and then notified the vessel's managers of the accident and that the VDR data had been saved. No general alarm was sounded, no crew muster was undertaken, and the checklist provided by the company for use in the case of grounding **(Annex C)** was not referred to.

Figure 8

VDR - Remote alarm panel showing 'save' button

Despite two attempts to manoeuvre the vessel off the reef with the assistance of two salvage tugs, *Maersk Kendal* remained aground. Salvage operations began on 19 September, whereby 365 containers and about 3000 tonnes of bunkers were discharged from the vessel. *Maersk Kendal* was finally refloated at 1243 on 23 September. She was later shifted to Tanjung Pelepas on 24 September, where all the remaining containers were discharged. The vessel entered Keppel Benoi dry dock at 1700 on 25 September where the hull was inspected and assessed for repairs.

1.3 DAMAGE

The extent of damage sustained as a result of the grounding was:

Fore peak - severe buckling of internal frames and hull plating extending from the tip of the bulbous bow for about 15 metres. The echo sounder and speed log compartments were also damaged.

Bow thruster room – damage to all electrical equipment including the bow thruster motor due to ingress of sea water and extensive buckling to the vessel's structure, mainly on the starboard side.

No. 1 void and No. 1 water ballast tank – extensive damage to the hull plating and internal frames **(Figure 9)**.

The damage was repaired in the dry dock. An estimated 120 tonnes of steel was renewed before the vessel resumed service on 12 November.

Figure 9

Survey of damage in dry dock

1.4 ENVIRONMENTAL CONDITIONS

At the time of the accident, the wind was light and the vessel was navigating in sheltered waters. The tidal stream was flooding in a direction of 300º at a rate of 0.8 knots. Sunrise was at 0656 and visibility was good.

1.5 *MAERSK KENDAL*

1.5.1 Vessel overview

Maersk Kendal was built in Hanjin Shipyard in South Korea and was designed to carry 6200 Twenty foot Equivalent Unit containers. She was the fifth of a series of eight vessels to be delivered in 2007 to Maersk Line. She was owned by The Maersk Company Limited based in London, and the technical management was delegated to A.P. Møller – Maersk A/S in Denmark.

The vessel operated a pendulum service between Bremerhaven, Rotterdam, Zeebrugge, Felixstowe and Port Tangier, via the Suez Canal to Colombo, Port Kelang, Tanjung Pelepas, Singapore and Laem Chabang. The accident occurred on the west-bound leg of her route.

1.5.2 Bridge equipment

Maersk Kendal was fitted with an integrated bridge system **(Figure 10)** manufactured by Furuno. This included two radars with ARPA facilities and two ECDIS units, all capable of overlaying Automatic Identification System (AIS) data on their respective screens. Position monitoring of the vessel was intended to be carried out on paper charts; ECDIS was intended for use only as an aid to navigation, and had therefore not received full ECDIS approval by the Maritime and Coastguard Agency (MCA).

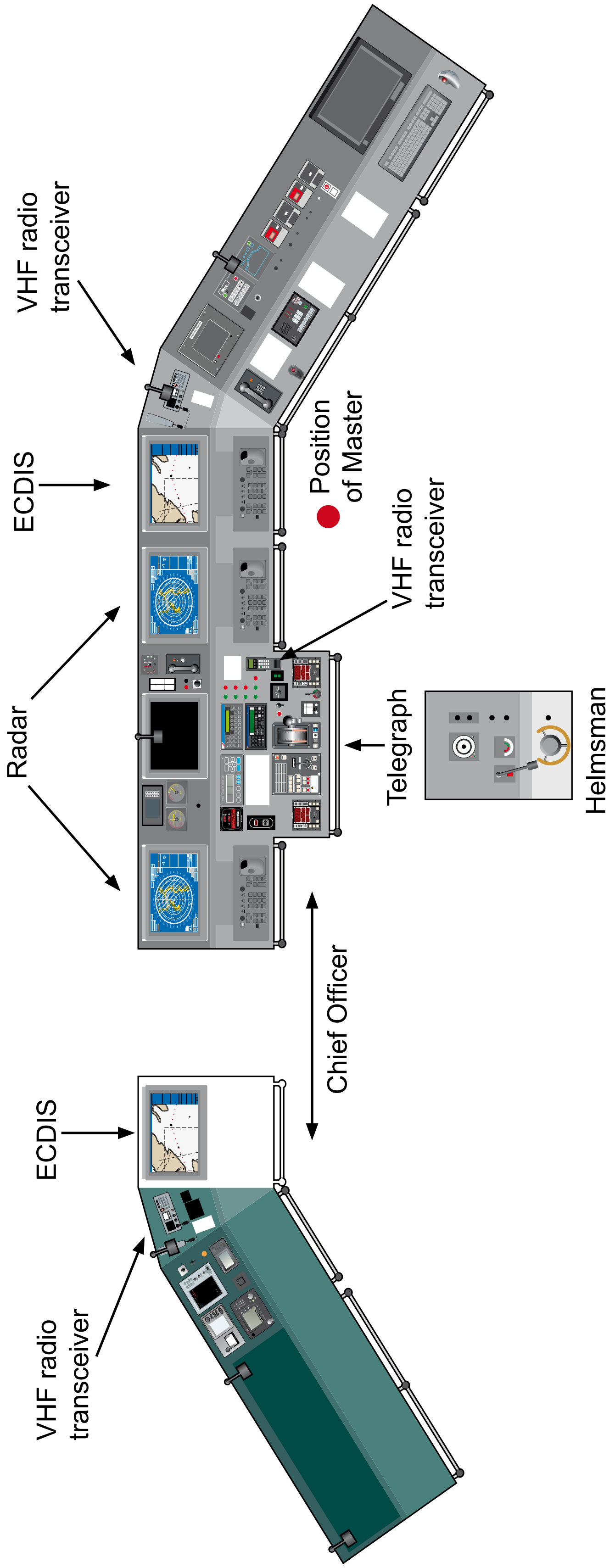
The vessel was also fitted with a Furuno VR-5000 VDR. The last annual performance verification of this equipment was carried out on 21 May 2009.

1.5.3 Engine and control

Maersk Kendal was fitted with a Doosan-Wartsila engine with a maximum output of 57200 kW at 102 rpm. The vessel's engine room was classed as an unmanned machinery space. The engine control system was provided by Lyngsø Marine and at the time of the accident was set to bridge control.

To increase speed from full ahead manoeuvring to full sea speed, the telegraph was pushed forward. This activated a load up programme which took approximately 2 minutes per rpm to reach the desired setting. When reducing speed from full sea speed to full ahead manoeuvring, the telegraph was moved back to full ahead. This activated the load down programme, which took about 1 minute per rpm to reach the required setting. Regardless of any movement of the telegraph from full ahead manoeuvring to half ahead, the engine was designed to continue to reduce the rpm in accordance with the load down

Figure 10



Bridge equipment layout

programme. Any movement of the telegraph below half ahead had the effect of overriding the programme and reducing the rpm normally to the required setting. Alternatively the programme could be overridden at any time by pushing the 'limits cancel' switch on the control panel.

1.5.4 Manoeuvring data

Maersk Kendal was fitted with a conventional single fixed pitch, right hand propeller and rudder arrangement. The performance data supplied to the vessel recorded a turning circle of 0.48nm to port, with an advance of about 0.47nm at 20.1 knots. The stopping distances from full ahead and half ahead in a normal loaded condition were 1.81nm in 8.4 minutes and 1.56nm in 7.6 minutes respectively.

Further details of the vessel's performance data can be found at **Annex D**.

1.6 SAFETY MANAGEMENT

Maersk Kendal was required to comply with the International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code). She had a current safety management certificate issued by the MCA on 31 March 2009.

1.6.1 Safety management system

A.P. Møller – Maersk A/S operated a comprehensive safety management system known as the Global Ship Management System. This contained policies, relevant procedures and instructions for the safe management and operation of the variety of ship types controlled by the managers.

1.6.2 Vessel internal audits

Annual company internal audits were carried out by one of four fleet safety superintendents recruited from a pool of senior officers in the fleet. The superintendents had a wide range of vessel experience, and consisted of a chief engineer, a second engineer and two chief officers. In addition to conducting internal audits they provided training to the crew, and their total stay on board usually lasted up to 10 days.

The last internal audit completed on board *Maersk Kendal* was on 5 November 2008 and resulted in five system improvement notices (SIN) being issued. None of these SINs were related to navigational matters and had been addressed and closed out before 5 February 2009. Neither the master nor the chief officer who were involved in this accident, was on board *Maersk Kendal* during the last internal audit.

1.7 BRIDGE TEAM

Master

The master was a British national who had joined Maersk as a second officer in 2001. He was promoted to chief officer in February 2002. He obtained his unlimited master's certificate of competency in accordance with the requirements of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) in December 2005, and was promoted to the rank of master in March 2006.

Since joining Maersk, he had predominantly sailed on container ships. He took command of *Maersk Kendal* during September 2007 and had sailed on her, alternating with another permanent master, on a 2-month on/off basis. He had joined the vessel for his latest tour of duty in Rotterdam on 17 August 2009.

The master had attended ECDIS[1] and Crew Resource Management (CRM) courses in 2001 and 2004 respectively. He had previously transited the Singapore Strait several times, and it was his routine to be present on the bridge for the transit.

Chief officer

The chief officer was an Indian national and had been employed by Maersk since 2001, initially as a second officer. He was promoted to the rank of chief officer in June 2004. He had an unlimited chief officer's certificate of competency (STCW II/2) issued by the MCA and was in the process of gaining his master's unlimited qualification.

He had sailed on a variety of vessels since joining Maersk but more recently had been employed on container ships. He was assigned to *Maersk Kendal* on a permanent basis in August 2008. The appointment system allowed him to alternate a 2-month on/off rota with another chief officer and to sail for 1 month with each of the permanent masters. He had sailed with the current master on three previous occasions on *Maersk Kendal* and had also transited the Singapore Strait several times. He had joined the vessel for his latest tour of duty in Colombo on 4 September 2009.

The chief officer had attended an ECDIS course in September 2007 and had received company approval to attend a CRM course at the next opportunity.

Helmsman/lookout

The helmsman was a Filipino national. He was qualified to serve as a rating forming part of a navigational watch (STCW II/4). He had been on board since May 2009.

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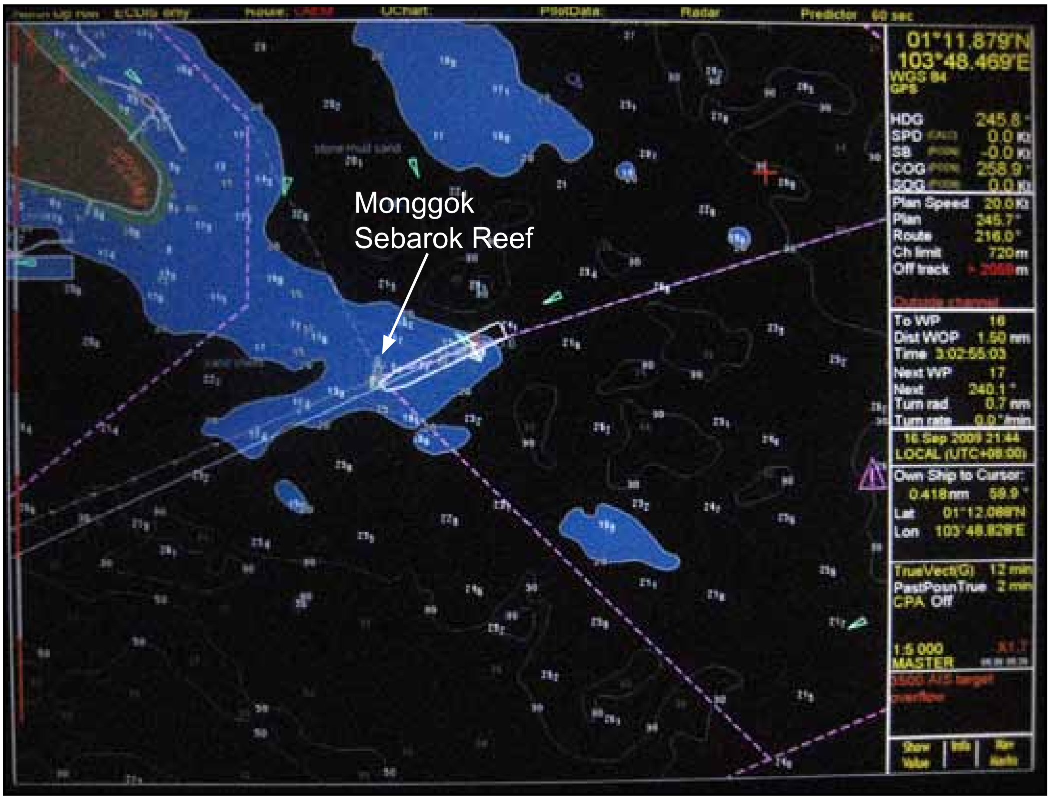
[1] Operational use of ECDIS, a 3-day course based on IMO model course 1.27 and intended for officers in charge of a navigational watch on ships where ECDIS is fitted.

1.8 BRIDGE RESOURCE ALLOCATION

The master was predominantly positioned at the starboard radar and ECDIS displays **(Figure 10)**. The engine telegraph was located on his inboard side. This was his usual position from which he had an unrestricted view of the conning display unit. At the time of grounding, the starboard ECDIS display was on a 1:5000 scale **(Figure 11)**.

Figure 11



ECDIS - night view at 1:5000 scale

As the OOW, the chief officer had full control of the vessel and was involved in plotting the vessel's position on paper charts, monitoring the vessel's progress on the port ECDIS display, radio communications and collision avoidance. After handing over the con of the vessel to the master at 0615, he continued these functions in a support and monitoring role. He was positioned mainly at the port radar and used the port ECDIS display to monitor the vessel's position. There were three VHF radio transceivers located on the bridge console; the chief officer used the one located outboard of the port ECDIS unit when communicating with Singapore VTIS.

The AB was initially assigned lookout duties but took position at the steering console when hand-steering was engaged at 0703.

1.9 BRIDGE DISCIPLINE

In accordance with the company's procedures, the vessel was required to maintain a master's orders book which contained the master's standing orders **(Annex E)** and daily orders. This was to provide a formal means for the master to supplement the company's navigational requirements with relevant specific instructions to navigating officers.

The master was required to hold a bridge discipline meeting in accordance with company procedure 2.1 Responsibility / Bridge discipline **(Annex F)** shortly after taking command or if new navigating officers joined the vessel, and to perform random audits on navigational procedures. The results of these meetings and audits were to be recorded in minutes. The last meeting was held by the previous master on 11 July 2009.

The master's standing orders directed the bridge team to question the master if in any doubt concerning his actions.

1.10 PASSAGE CONDUCT

1.10.1 General

The International Convention on Safety of Life at Sea (SOLAS), Chapter V, Regulation 34, requires a voyage to be planned in accordance with the International Maritime Organization (IMO) Guidelines for Voyage Planning - Resolution A.893(21) **(Annex G)**. The objective of the plan is the safety and efficiency of navigation and protection of the environment.

The MCA provides guidance on the regulations contained in Chapter V of SOLAS **(Annex H)**.

1.10.2 Transiting the Straits of Malacca and Singapore

The IMO formally adopted 'Amended rules for vessels navigating through the Straits of Malacca and Singapore' **(Annex I)** through its safety of navigation circular 198 on 26 May 1998. These rules form part of the sailing directions contained in British Admiralty Sailing Directions, Nautical Publication 44, Malacca Strait and West Coast of Sumatera Pilot. Relevant to this accident is Rule 8.

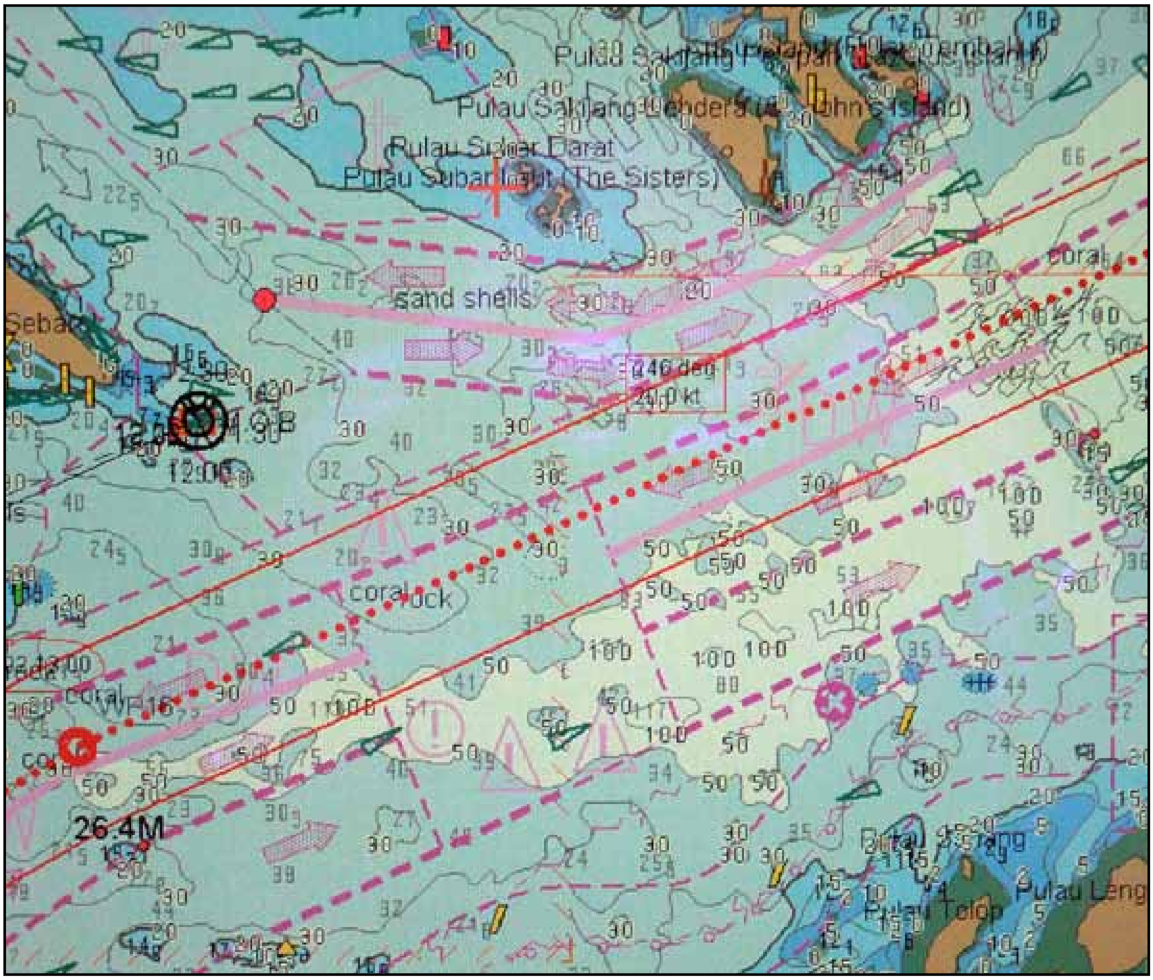
> '*All vessels navigating in the routeing system of the Straits of Malacca and Singapore shall maintain at all times a safe speed consistent with safe navigation, shall proceed with caution, and shall be in maximum state of manoeuvring readiness'.*

1.10.3 *Maersk Kendal*'s passage plan

In accordance with the above regulation and company procedures 3.1 and 3.2.3 **(Annex J)**, the vessel had prepared a voyage plan **(Annex K)** and had completed a checklist. At the time of the accident the vessel was navigating on British Admiralty chart 4041 which had been received on board on 17 August 2009. The planned course lines had been drawn on the chart, but no-go areas, parallel index lines and specific hazards had not been marked, although the checklist had been completed to indicate that they had. The passage plan and checklist were signed as completed by the second officer and signed off as approved by the master.

The planned course lines were also entered in the ECDIS. Inspection of the ECDIS after the accident revealed that only a safety contour of 20m and a cross track error of 1 cable had been configured. No safety depth, danger areas, look ahead or predicted movement indicator had been set up **(Figure 12)**.

Figure 12



ECDIS passage plan

In accordance with IMO Resolution A.893 (21), section 3.2.2.1, a vessel is required to take into account:

'safe speed, having regard to the proximity of navigational hazards along the intended route or track, the manoeuvring characteristics of the vessel and its draught in relation to the available water depth'

and section 3.2.2.9 requires the vessel to consider:

'contingency plans for alternative action to place the vessel in deep water'

No reduction of speed was made for the passage through the Singapore Strait other than to prepare for arrival at Tanjung Pelepas. Company instruction, 4.8 Navigation in Confined Waters **(Annex L)** required a sufficient number of generators to be employed to ensure that a generator failure did not create a general blackout. No additional generators had been started for the passage through the Singapore Strait. Guidance on the vessel's speed was also provided to the master through company procedure 3.7 Speed **(Annex M)**.

1.10.4 Passage monitoring

The MCA guidance on voyage planning while monitoring the vessel's position states:

'*the vessel's position is fixed and marked on the chart in use, the estimated position at a convenient interval of time in advance should be projected and plotted. With ECDIS and RCDS[2] care should be taken to ensure that the display shows sufficient "look-ahead" distance and the next chart can be readily assessed.'*

When navigating in confined waters, the company's procedures **(Annex L)** required:

'*the vessel's position shall always be plotted on the chart at such frequent intervals as will immediately call attention to deviation from the planned track.'*

The estimated position after the predetermined position fixing interval was required to be calculated and projected ahead so as to confirm that the position fixing interval was appropriate and that forthcoming hazards were reviewed.

Page 2 of the relevant voyage plan **(Annex K)** required the OOW to plot a position at:

'an interval that is half the time it takes vessel to run into the nearest danger.' [sic]

The last position plotted on the chart was at 0650, 25 minutes before the grounding.

2 Raster charts display system

1.11 BRIDGE PROCEDURES GUIDE

The fourth edition of the International Chamber of Shipping (ICS) Bridge Procedures Guide is intended to reflect best navigational practices on merchant vessels, with the aim of improving navigational safety and protection of the marine environment. It is acknowledged as the principal industry guide on the subject, and a reference copy can be found on many ships worldwide.

Extracts on bridge team management and passage planning that are relevant to this accident are at **Annex N**.

1.12 CREW RESOURCE MANAGEMENT

Crew Resource Management (CRM) was developed in response to the number of high profile aircraft accidents that occurred in the 1980s. Information gathered during investigation suggested that many accidents resulted from an inability of crews to respond appropriately to the situation, rather than a technical problem or failure of airmanship.

CRM can be defined as a management system which makes optimum use of all available resources – equipment, procedures and people – to promote safety and enhance the efficiency of operations. CRM focuses not so much on technical knowledge and skills but rather on the cognitive and interpersonal skills required to manage an operation. Cognitive skills are mental processes used for gaining and maintaining situational awareness, for problem solving and taking decisions. Interpersonal skills are communications and a range of behavioural activities associated with team work.

Bridge Resource Management (BRM) as adopted by the maritime industry can be described as:

> *'The use and co-ordination of all the skills, knowledge, experience and resources available to the ship's team, to accomplish or achieve the established goals of safety and efficiency of the passage*[3]*.'*

A number of organisations in the UK provide CRM training which has been adapted to the marine industry. This training is non-mandatory and is usually a combination of classroom and computer-based training.

1.13 BRIDGE TEAM MANAGEMENT

Bridge Team Management (BTM) can be defined as the management of the bridge team to ensure the safe and timely arrival of a ship. It introduces the concept of a 'navigation team' so that competent navigation is achieved through planning, clarity of purpose, effective organisation and management principles.

BTM training normally consists of intensive bridge simulator exercises conducted over a period of 5 days, and includes modules of exercise planning, execution and a debrief session at the end of each exercise. In the UK, BTM

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3 SAS-BRM student's work book

training is based on criteria developed by the Merchant Navy Training Board in consultation with the MCA. BTM training is not mandatory and is intended to either extend the scope and understanding of topics covered by mandatory training or to meet specific training needs.

Internationally, most BTM training is based on the criteria developed by the IMO model course 1.22, Ship Simulator and Bridge Team work.

The tanker industry, through the Oil Companies International Marine Forum (OCIMF), has taken a lead in providing its officers with BTM training. Now it is almost an implied requirement for senior deck officers on tankers to have attended a BTM course which is verified through OCIMF's Ship Inspection Report Programme inspections and recorded on the Vessel Inspection Questionnaire.

1.14 STCW REQUIREMENTS

1.14.1 Current requirements

The STCW Code contains no requirements for demonstrating competencies in BRM or BTM. It only requires candidates aspiring to obtain operational or management level certification to have knowledge, understanding and proficiency of effective bridge team work procedures (Table A-II/1 and A-II/2 of the STCW Code). This can be demonstrated by undertaking approved simulator training. In the UK, this is achieved by attending an appropriate level course on Navigation, Radar and ARPA Simulator training developed by the Merchant Navy Training Board. In addition to other criteria, a candidate must demonstrate application of the principles of effective team work and react effectively during emergency situations.

1.14.2 International developments

In its 37th session in January 2006, the IMO sub-committee on Standards of Training and Watchkeeping agreed to a comprehensive review of the STCW Convention and the STCW Code.

Significant progress on the review of the Convention and Code was made during the 40th meeting in February 2009. Proposed draft amendments, among other things, will require candidates at operational level certification to have the knowledge, understanding and proficiency of bridge resource management. Additionally, candidates for management level certification will require competence in leadership and management skills **(Annex O)**.

The International Chamber of Shipping (ICS) and the International Shipping Federation (ISF) submitted a proposal **(Annex P)** for consideration at the sub-committee's 41st session in January 2010. The proposal would require competence in leadership and management skills at an operational as well as management level. They contend that irrespective of an officer's managerial or operational function, he/she will require these skills when communicating with junior officers, ratings, third parties, passengers and senior officers.

It is anticipated that the outcome of the review of the Convention and the Code will be adopted at a diplomatic conference of STCW parties in the Philippines in June 2010.

1.15 MAERSK TRAINING CENTRE

The Maersk Training Centre (MTC) is part of the A.P. Møller – Maersk Group. It was established in 1978 in Svendborg and now has training centres in Newcastle upon Tyne, Chennai (India) and Wuhan (China).

MTC provides an in-house CRM course for its fleet officers. The course, unlike others, imparts 3 days of theoretical training in the classroom, where principles of CRM are taught. This is followed by 2 days of practical simulator exercises. The course is open to both engineers and navigating officers.

1.16 STRAITREP

Singapore VTIS was established by MPA as the competent authority to monitor vessel traffic in the TSS of the Singapore Strait. Sectors 7, 8 and 9 are controlled by Singapore VTIS **(Figure 1)**.They provide information to ships about specific and critical situations which could cause conflicting traffic movements and other information concerning the safety of navigation.

The IMO adopted the mandatory ship reporting system STRAITREP in 1998 for vessels transiting the Malacca and Singapore Straits. The reporting system generally requires vessels of greater than 300 gross tonnage and 50m in length to report in to VTIS at designated positions.

1.17 THE COLLISION REGULATIONS

The following rules, which are taken from the International Regulations for Preventing Collisions at Sea 1972 (as amended) (COLREGS), are relevant to this accident and are reproduced at **Annex Q**.

- Rule 2 - Responsibility
- Rule 5 – Lookout
- Rule 6 – Safe speed
- Rule 7 – Risk of collision
- Rule 8 – Action to avoid collision
- Rule 15 – Crossing situation
- Rule 16 – Action by give-way vessel
- Rule 17 – Action by stand-on vessel

1.18 SIMILAR ACCIDENTS

The MAIB database of accidents for the period covering 2002 to 2008, records 725 collisions, contacts and grounding accidents to merchant ships of 500gt or more. Of the 126 accidents to which inspectors were deployed, the contributing factors of 94 were linked to bridge team management.

Among the accidents which have been investigated and found to have similar safety issues to those of this investigation are:

In June 2004, the chemical tanker *Attilio Levoli* ran aground on Lymington Banks in the west Solent. She suffered bottom plate indentation and was fortunate not to sustain hull penetration. Poor bridge team management on board the vessel resulted in a lack of awareness of the vessel's position. This, and an inappropriate division of tasks within the bridge team were identified as contributing factors.

In December 2005, *CP Valour* ran aground in Baia da Praia do Norte in the Azores as she was entering the bay to effect engine repairs. The vessel was subsequently declared a constructive total loss. The investigation identified that the passage plan into the bay had not been discussed, and the master had not briefed his bridge team on what was required of them. This led to the master not receiving any support from the OOW and, consequently, he failed to recognise that the engine had been inadvertently left running at half ahead.

In November 2007, *Ursine*, a roll-on roll-off ferry, made contact with the passenger ferry *Pride of Bruges* as she was manoeuvred towards her berth in King George dock in Hull. The bridge was manned by the master, the chief officer and a pilotage exemption certificate (PEC) holder. A detailed berthing plan was not discussed. Consequently, the master and PEC holder each assumed that the other would conduct the berthing manoeuvre resulting in no one person imposing overall control on the operation.

In 2009, *King Everest,* a loaded tanker, made contact with a buoy and subsequently snagged the buoy's anchor chain around her rudder horn as she entered a river estuary on a flood tide. Although the damage was slight, the vessel was fast on the chain for 2 days before she could be released. A last minute and unconveyed change in the passage plan, poor position monitoring and a lack of intervention by the second officer when the master became distracted by a VHF radio call resulted in the vessel drifting onto the buoy.

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 FATIGUE

There is no evidence that any of the bridge team were suffering from fatigue. Fatigue is therefore not considered to be a contributing factor in this accident.

2.3 THE GROUNDING

The following events were significant leading up to *Maersk Kendal* running aground. Underpinning them were issues linked to the management of the bridge team, which will be discussed in subsequent sections of this report.

- The master had started slowing the vessel's speed at 0650 in preparation for arrival at Tanjung Pelepas pilot station. Telegraph movements to half ahead and slow ahead appear to follow VTIS requests made at 0703 and 0708 for *Maersk Kendal* to slow down **(Annex A)**. Movement of the telegraph from full ahead manoeuvring to half ahead had no effect on engine speed and neither the master nor the chief officer appreciated this at the time.

- The bridge team started plotting the traffic exiting Jong Channel after receiving information from VTIS at 0703 **(Figure 2)**. The master's assessment of the situation and decisions to alter course to starboard were based on his observation of true vectors and relative trails of the radar targets. The bridge team made no attempt to utilise the trial manoeuvre function of the ARPA before course alterations were made.

- The master and chief officer misinterpreted the information received from VTIS and believed that *Samho Jewelry* was one of the three vessels VTIS had referred to **(Figure 2)**.

- VTIS advised *Maersk Kendal* at 0711 that *Samho Jewelry* was a piloted vessel and was not leaving the port limits. No consideration was made by the master or chief officer to alter course until *Samho Jewelry* had crossed *Maersk Kendal*'s bow.

2.4 EXCESSIVE SPEED

Vessels are required to maintain a safe speed in accordance with the prevailing circumstances and conditions. This is reiterated in the IMO guidelines on voyage planning, in Rule 6 of the COLREGS and in the company's own guidance on safe speed **(Annex M)**.

Although the master started to slow the vessel's speed at 0650 to full ahead manoeuvring, this was in preparation for arrival at Tanjung Pelepas pilot station rather than to slow down for navigational and collision avoidance considerations. The timing of telegraph movements to half ahead and then slow ahead **(Annex A)**, suggest that he was prompted by VTIS to slow down rather than as a result of his own assessment of the situation. The telegraph movement to half ahead had no effect, and the vessel's speed over the ground was recorded as 19 knots at 0710 **(Figure 4)**. It was only when the telegraph was brought back from half ahead to slow ahead that the load down programme was overridden and the engine speed started to reduce significantly. Furthermore, neither he nor the chief officer monitored the vessel's speed, although this could have been easily obtained from the ECDIS, ARPA, AIS or the conning unit display **(Figure 10)**.

The master had not considered the effect of the vessel's speed, her turning circle, stopping distance and the proximity of navigation hazards when planning his manoeuvre to starboard to avoid the three vessels.

Throughout the period leading up to the grounding, the master and chief officer remained confident that *Maersk Kendal*'s speed would not affect the master's ability to navigate her safely. This misplaced confidence was built on complacency, and seriously restricted the manoeuvring options available to the bridge team.

2.5 ACTION TO AVOID COLLISION

The radar targets of *Kota Delima*, *Bright Pacific* and *Samho Jewelry* were acquired by ARPA when they were at 3.0, 3.5 and 4.5nm respectively. In accordance with Rule 7 of the COLREGS, the master determined that there was a risk of collision. His assessment of the situation and decision to alter course to starboard were based on his observation of true vectors and relative trails of the targets and not a trial manoeuvre.

A trial manoeuvre would have given the master a number of options for an appropriate course alteration and/or reduction of speed. These would have assisted him in choosing the most appropriate option given the prevailing navigational constraints and a desire to return to the planned track as soon as practicable in accordance with best practice.

Rule 16 of the COLREGS requires a give-way vessel to, so far as is possible, take early and substantial action to keep well clear. Rule 8(c) advocates an alteration of course alone as the most effective action, but only when a vessel has sufficient sea room. In this case, the combination of an early and substantial reduction in speed together with an appropriate alteration of course would have satisfied these requirements and would have caused *Maersk Kendal* to clear all vessels safely. It would also have avoided the need for *Maersk Kendal* to enter the port of Singapore, which contravened local regulations and compromised the maintenance of good order within the port.

Notwithstanding that *Samho Jewelry* was not leaving Singapore port, the master correctly assessed that there was a risk of collision, that she was a crossing vessel, and that *Maersk Kendal* was the give-way vessel in accordance with Rule 15 of the COLREGS. While Rule 15 requires a give-way vessel to avoid crossing ahead of the other, the success of the master's plan to pass around the stern of *Samho Jewelry* relied on that vessel maintaining her course and speed in accordance with Rule 17(a)(i). However, *Samho Jewelry* slowed down, which delayed her crossing ahead of *Maersk Kendal*. Although contrary to the spirit of Rule 15, the master could have opted instead to alter course to port once *Bright Pacific* had crossed ahead. Such an action would have been in accordance with Rule 2(b), which allows a departure from the Rules necessary to avoid immediate navigational danger.

Analysis of the plot at 0713 **(Figure 5)**, by which time *Samho Jewelry* had crossed ahead, indicates that Monggok Sebarok reef was almost right ahead of *Maersk Kendal* at a range of 4 cables. *Maersk Kendal*'s performance data **(Annex D)** indicates that neither stopping the vessel at 0713 nor turning her to port would have prevented her from running aground. The only alternative and safe option would have been a decisive alteration of course to starboard.

The master's reluctance to reassess his collision avoidance strategy by significantly reducing speed at the initial stages, or by making a substantial alteration of course towards the latter stage of collision avoidance, demonstrates a lack of precautionary thought.

Rule 5 of the COLREGS requires every vessel to maintain a proper lookout so as to make a full appraisal of the situation and of the risk of collision. A proper lookout was maintained on board *Maersk Kendal* in terms of risk of collision. However, during the latter stages leading up to the grounding, both the master and the chief officer lost situational awareness[4] in terms of the vessel's increasingly close proximity to the reef.

2.6 PASSAGE PLANNING

During the course of a voyage, a vessel may need to leave her planned route temporarily at short notice. The marking of critical areas on the chart is a good practice that will assist the bridge team when they have to decide quickly, to what extent the vessel can deviate without jeopardising safety. No-go areas, parallel index lines and specific hazards had not been marked on the paper chart in use at the time, even though the passage plan checklist indicated that this had been done. Although the bridge team were aware of the reef, a complete passage plan would have reinforced - to the chief officer - the dangers of entering no-go areas had he continued to plot positions on the chart.

[4] An incorrect understanding of the current situation which can lead to a faulty hypothesis regarding a future situation, or an understanding which is based on incorrect beliefs, leading to compounded errors that can substantially increase the risk to the ship. (IMO Resolution A.884(21) Annex 3).

The ECDIS was meant to be used as a secondary aid to navigation. However, the passage plan entered in it was incomplete **(Figure 12)** and did not utilise in-built safety features such as danger areas, safety depths, look ahead and predicted vessel movement. Both the master and chief officer had attended an ECDIS course and should have been aware of the advantage of using these features; they should have checked to see that the equipment was correctly set up.

The passage plan made reference to the maximum speed the vessel was required to transit each leg, but it failed to take into account confined water transits and contingency planning such as areas of expected increased traffic volume where speed may have to be reduced and other precautionary measures taken. For the passage through the Singapore Strait consideration should have been given to:

- Having the engine on a higher state of readiness after passing Horsburgh Light
- Clearing the anchors for immediate deployment
- Having an additional generator running in accordance with the company's instructions
- Having both steering gear pump motors running, and
- Posting additional personnel on the bridge.

The passage plan through the Singapore Strait was incomplete and not in accordance with the best practices of seamanship, the Rules for vessels Navigating through the Straits of Malacca and Singapore, the ICS Bridge Procedures Guide and the company's own requirements. The master and chief officer were complacent in not valuing the benefits of comprehensive passage planning.

2.7 POSITION MONITORING

Both the master and chief officer were aware that the vessel was heading towards the reef, but had no sense of the vessel's rate of approach and could not recall how far off the reef was when *Maersk Kendal* attempted to round the stern of *Samho Jewelry*.

From 0650 to the time of grounding, the bridge team monitored the vessel's progress on ECDIS only. However, the ECDIS was inappropriately set up. The master used a scale of 1:5000 **(Figure 11)**. While there are good reasons for using a large scale, in this case it probably contributed to the master losing positional awareness as the beacon would not have appeared on the display until shortly before the vessel grounded. In addition, no danger areas were marked and the look ahead feature, which would have alerted the master and chief officer of the impending danger, was not set up.

Both officers had attended a generic course in the use of ECDIS, and had signed the bridge equipment familiarisation sheet to confirm that they were familiar with the equipment. While they relied on the ECDIS as the primary means of navigation, they did not utilise it to its full potential in monitoring the vessel's position in relation to the planned track and surrounding hazards.

Neither the master nor the chief officer monitored the vessel's position as required by the passage plan, company's procedures and ICS Bridge Procedures Guide. They were complacent in not valuing the benefit of close position monitoring.

2.8 COMMUNICATIONS WITH VTIS

Singapore VTIS, in accordance with its role, provided *Maersk Kendal* with advice and information during the period leading up to the grounding. On two particular occasions, had the master or chief officer sought clarification from VTIS, they would have had an opportunity to reassess the situation and change their planned actions.

The first occasion occurred at 0703 when VTIS advised *Maersk Kendal* of the three vessels exiting Jong Channel. Although VTIS provided *Maersk Kendal* with the ranges and bearings of *Kota Delima* and *Bright Pacific,* and facilitated safe passing with these two vessels, the bridge team did not seek further clarification on the name of the third vessel. As a result, the master automatically discounted *Ace Dragon* as one of the three vessels, as she posed no threat to *Maersk Kendal,* and focused his attention on avoiding *Samho Jewelry*.

The second occasion was when VTIS advised *Maersk Kendal,* at about 0711, that *Samho Jewelry* was a piloted vessel and was not leaving Singapore port limits. In fact, VTIS was so concerned by *Maersk Kendal*'s actions that it requested all ships to stand-by while it warned *Maersk Kendal* again that she appeared to be heading towards *Samho Jewelry.* The master had personally responded to VTIS at 0710, and it is apparent that he and the chief officer had become irritated by VTIS's interventions. This resulted in the chief officer automatically acknowledging all subsequent radio communications without fully appreciating their significance. Had the chief officer requested clarification at that time, the need for *Maersk Kendal* to abort her planned action, and instead return to her original track once clear of *Bright Pacific* **(Figure 5)**, would have become readily apparent.

The master and chief officer were complacent in not recognising the assistance that VTIS was able to provide.

2.9 BRIDGE TEAM MANAGEMENT

The cornerstone of effective bridge team management is enshrined in the following extract from the ICS Bridge Procedures Guide:

> *"A bridge team which has a plan that is understood and is well briefed, with all members supporting each other, will have good situational awareness. Its members will then be able to anticipate dangerous situations arising and recognise the development of a chain of errors, thus enabling them to take action to break the sequence."*

The master and chief officer, although aware that *Maersk Kendal* was heading towards the reef, did not effectively monitor the vessel's speed or her relative position, and did not appreciate the significance of the communications from VTIS at 0711. They collectively made a series of errors which neither of them recognised or broke, and which otherwise would have prevented the grounding.

The master was confident in his planned manoeuvre to return to the original track after clearing *Samho Jewelry*'s stern, right up to the point at which *Maersk Kendal* was about to run aground. To make his plan succeed, he inadvertently channelled all of his attention on collision avoidance to the extent that he blocked out other information that was available to him. The master did not recollect any advice given by VTIS at 0711 or any information relayed to him by the chief officer as to the intentions of *Samho Jewelry*. With no navigational alerts from the chief officer or from the ECDIS, the master lost situational awareness in terms of the vessel's increasingly close proximity to the reef.

An effective bridge team will work to eliminate the risk of an error by one person developing into a dangerous situation. The master and chief officer had sailed together on *Maersk Kendal* on three previous occasions and had established a mutual respect and rapport with each other. Based on previous transits of the Dover and Singapore Straits, the chief officer was comfortable and confident in the master's decisions and navigational capabilities.

Although the master was approachable, he liked to get involved and to do things himself. This type of leadership carries the risk of working in isolation and, when not properly supported by the bridge team, can result in an error going undetected and unchallenged. Although the master, through his standing orders, had made it clear that the OOW should question the master's actions when in doubt, this did not infer that the master would first discuss his intentions with the OOW. The master had not convened a bridge discipline meeting since joining the vessel on 17 August 2009 to clarify and reiterate his requirements, and it is evident that the chief officer considered it unnecessary to question the master's intentions or actions on this occasion.

Different societies vary in the way inequalities in status and power are handled. In societies organised on relatively authoritarian or paternalistic lines, consultation between superiors and subordinates is not expected (by either party). The probability of a subordinate challenging or contradicting a superior's decision is low. A respected superior is treated as more or less infallible. In a less authoritarian society, the emotional distance between leaders and those led is smaller and thus the barriers to consultation and co-operative decision making are less formidable.

Hofstede and Hofstede (2005) have measured the strength of these attitudes and expectations in many countries in the form of a Power Distance Index. Countries in the Indian sub-continent tend to have a higher Power Distance Index than countries in northern Europe. In a worldwide study of 74 countries, India scored 77, while the United Kingdom scored 35 on the Index, which suggests markedly different approaches to power and status[5].

The chief officer did not challenge the master's intentions or actions because:

- His previous experience with the master gave him no reason to do so
- He did not appreciate the impending danger
- The master did not engage the chief officer in terms of the navigational support he required
- The master appeared to be in control and comfortable with the situation
- The chief officer was culturally reluctant to challenge the master
- The master had signalled an irritation to interventions in his response to VTIS
- The chief officer had received no crew resource management or bridge team management training.

The chief officer would have benefited from attending a crew resource management course. This would have encouraged him to overcome cultural barriers and to challenge the master when the situation so required.

In light of the number of similar incidents where the main contributing factors are related to deficiencies in bridge team management, this accident provides an object lesson and identifies a need for:

1. Increased competence in leadership and management skills
2. Knowledge and understanding of bridge resource management
3. Training in bridge team management.

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[5] Reference : Hofstede, G and Hofstede, G J. Cultures and Organizations: Software of the Mind. New York: McGraw-Hill USA, 2005, ISBN 0-07-143959-5.

While 1 and 2 are currently being addressed in the forthcoming amendments to the STCW Code, there is still a need for companies to consider providing training in bridge team management.

The tanker industry, and most of the passenger ship industry, now require their officers to have undertaken training in either bridge resource or bridge team management, or both. It is also considered good practice to provide officers with refresher training every 5 years to reiterate the principles of bridge management and eliminate bad practices that might have developed in the interim. As navigational bridges become increasingly sophisticated and expensive, it seems logical that ship owners should increasingly invest in officers' training with the aim of protecting their assets.

2.10 NAVIGATIONAL AUDITS

Although the company had provided comprehensive guidance and procedures for the vessel to follow e.g. maintaining a safe speed, passage planning and monitoring and navigating in confined waters, these were not followed. This was probably due to the number of times the master and chief officer had previously transited the Strait without incident; they had become over-confident in their ability and complacent[6] in their attitude.

The presence of an internal or external auditor on board will encourage the crew to comply with laid-down procedures and work routines. However, evaluations of VDR data taken from vessels following accidents have provided the MAIB with invaluable evidence on how vessels normally operate away from the scrutiny of company officials. Reluctance to follow procedures, and complacent attitudes, can be identified and addressed by monitoring the activities of ship staff during random audits of VDR data.

EU directive 2009/18/EC[7] not only encourages the use of VDR data for accident investigation but also as a preventative tool. The directive advocates the routine examination of VDR data by ship managers to gain experience of the circumstances capable of leading to accidents or incidents. Such examination will provide them with incontrovertible information on watchkeeping standards under normal operating conditions.

2.11 EMERGENCY PREPAREDNESS

Following the accident, the master did not utilise the grounding checklist **(Annex C)** as required by the company procedures. This would have required him to stop the engine, sound the general alarm and conduct a muster which, in turn, would have alerted and prepared the crew to deal with any subsequent emergencies such as injuries, pollution or even fire.

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6 The human consequence resulting from familiarity of task or operation

7 Directive 2009/18/EC, establishing the fundamental principles governing the investigation of accidents in the maritime transport sector and amending Council Directive 1999/35/EC and Directive 2002/59/EC of the European Parliament and the Council, paragraph 21.

It is likely that the master went into a state of shock and reacted instinctively by putting the engine to full astern. While this may be understandable in the circumstances, an effective bridge team would have ensured that the master was prompted to use the grounding checklist. Fortunately, there were no resulting effects, but this action had the potential to cause further damage to the vessel, with very serious consequences.

Checklists are specifically designed to assist personnel in times of emergencies by prompting them to take the right actions.

2.12 PRESERVING VOYAGE DATA RECORDER DATA

On 17 September, a shore technician was contracted to extract the VDR data recordings on board. He found that the data had not been saved.

Subsequently it was established that the yellow light had not illuminated **(Figure 8)** when the save button had been initially pressed. It seems that the unit had an inherent fault, although its performance had been recently verified.

The master was not familiar with the working of a VDR and had never saved data on it before. He initially reported to the company that the VDR data had been saved. However, when it was established some time later that the yellow light, which was designed to remain lit to indicate that the data had been saved, had not illuminated, he should have sought advice from the company. He could have either stopped power to the VDR unit or simply removed the hard drive to prevent it from being overwritten.

Following a previous accident[8] on board one of the company's vessels, Maersk has since issued Technical Flash 12/2009 highlighting the importance of preserving VDR data.

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[8] Report on the investigation of heavy weather damage 50 miles west of Guernsey and a fire alongside Algeciras, Spain on board *Maersk Newport*. MAIB Report 13/2009 www.maib.gov.uk

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT WHICH HAVE BEEN ADDRESSED

1. Throughout the period leading up to the grounding, the master and chief officer remained confident that *Maersk Kendal*'s speed would not affect the master's ability to navigate her safely. This misplaced confidence was built on complacency, and seriously restricted the manoeuvring options available to the bridge team. [2.4, 2.10]

2. A trial manoeuvre would have given the master a number of options for an appropriate course alteration and/or reduction of speed. These would have assisted him in choosing the most appropriate option given the prevailing navigational constraints and a desire to return to the planned track as soon as practicable in accordance with best practice. [2.5]

3. The combination of an early and substantial reduction of speed, together with an appropriate alteration of course would have avoided the need for *Maersk Kendal* to enter the port of Singapore. [2.5]

4. The master's reluctance to reassess his collision avoidance strategy by significantly reducing speed at the initial stages or by making a substantial alteration of course towards the latter stages of collision avoidance demonstrates a lack of precautionary thought. [2.5]

5. During the latter stages leading up to the grounding, both the master and the chief officer lost situational awareness in terms of the vessel's increasingly close proximity to the reef. [2.5, 2.9]

6. The master and chief officer were complacent in not:
   - Valuing the benefits of comprehensive passage planning
   - Valuing the benefit of close position monitoring
   - Recognising the assistance that VTIS was able to provide. [2.6, 2.7, 2.8, 2.10]

7. The chief officer did not challenge the master's intentions or actions because:
   - His previous experience with the master gave him no reason to do so
   - He did not appreciate the impending danger
   - The master did not engage the chief officer in terms of the navigational support he required
   - The master appeared to be in control and comfortable with the situation

- The chief officer was culturally reluctant to challenge the master
- The master had signalled an irritation to interventions in his response to VTIS
- The chief officer had received no crew resource management or bridge team management training. [2.9]

8. In light of the number of similar incidents where the main contributing factors are related to deficiencies in bridge team management, this accident provides an object lesson and identifies a need for:
   - Increased competence in leadership and management skills
   - Knowledge and understanding of bridge resource management
   - Training in bridge team management. [2.9]

3.2 OTHER SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION WHICH HAVE BEEN ADDRESSED

1. Reluctance to follow procedures and complacent attitudes can be identified and addressed by monitoring the activities of ship staff during random audits of VDR data. [2.9]

2. The master was not familiar with the working of a VDR and had never saved data on it before. When it was established that the yellow light, which was designed to remain lit to indicate that the data had been saved, had not illuminated, he should have sought advice from the company. [2.12]

3.3 OTHER SAFETY ISSUES

1. It is likely that the master went into a state of shock immediately following the grounding and reacted instinctively by putting the engine to full astern. This action had the potential to cause further damage to the vessel, with very serious consequences. An effective bridge team would have ensured that the master was prompted to use the grounding checklist [2.11]

SECTION 4 - ACTION TAKEN

4.1 A.P. MØLLER – MAERSK A/S

Carried out a review of its procedures and intends to improve the safe operation of its vessels by:

- Ensuring that future navigational audits include the examination of VDR data so as to verify compliance with its procedures and so that training imparted ashore is effectively implemented on board.
- Progressively providing all bridge team officers with training in crew resource management.

4.2 THE MARITIME AND COASTGUARD AGENCY

Has undertaken to support proposed amendments to STCW requirements relating to leadership and management skills and competence in bridge resource management.

4.3 THE INTERNATIONAL CHAMBER OF SHIPPING

Has distributed a circular to its members, highlighting a number of recent accidents where a main contributing factor identified by the MAIB has been the breakdown of bridge team management, and strongly supporting the need for appropriate navigating officers to attend bridge team management training courses **(Annex R)**.

SECTION 5 - RECOMMENDATIONS

In view of the actions already taken as a result of this accident, the MAIB has issued no safety recommendations.

Marine Accident Investigation Branch
March 2010