Report on the investigation of the fatal injury of a crew member

and the serious injury of a second crew member

in heavy weather on board the UK registered container ship

Maersk Kithira

South China Sea

23 September 2008

Marine Accident Investigation Branch
Carlton House
Carlton Place
Southampton
United Kingdom
SO15 2DZ

Report No 9/2009
April 2009

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

ALRS	-	Admiralty List of Radio Signals
COSWP	-	Code of Safe Working Practices for Merchant Seamen
CPR	-	Cardio-pulmonary Resuscitation
ERRV	-	Emergency Response and Rescue Vessel
ETA	-	Estimated Time of Arrival
ITSO	-	Initial Training for Shipboard Operations
kW	-	Kilo Watt
m	-	metre
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note
OOW	-	Officer of the Watch
OPITO	-	Offshore Petroleum Industry Training Organisation
PPE	-	Personal Protective Equipment
SJA	-	Safe Job Analysis
SMS	-	Safety Management System
STCW	-	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 as amended
t	-	tonne
TEU	-	Twenty foot Equivalent Unit (container size)
UHF	-	Ultra High Frequency
UTC	-	Universal Time Co-ordinated
VOS	-	Voluntary Observing Ships

Times: All times used in this report are ship's time (UTC + 8 hours) unless otherwise stated

Maersk Kithira

Image courtesy of Jerzy Nowak

SYNOPSIS

On 23 September 2008, the chief officer and the chief engineer of the container vessel *Maersk Kithira* were seriously injured when they were struck by a wave as the vessel proceeded in heavy weather conditions in the South China Sea. The chief engineer subsequently died of his injuries.

The two officers went onto the forecastle deck to secure a leaking stores hatch and loose anchor securing chain following activation of a bilge alarm.

Although some measures were taken to reduce the risk to the men before they went onto the exposed forecastle deck, ship's staff did not fully appreciate the risk of large waves breaking over the decks in the prevailing conditions, and insufficient information was available on board the vessel to enable them to make a full risk assessment before embarking on the operation.

Subsequent to the accident, the ship's manager has provided its crews with enhanced training on risk assessment, improved its internal auditing procedures, and has amended its risk assessment relating to the movement of personnel on exposed decks in heavy weather.

A recommendation has been made to the Maritime and Coastguard Agency (MCA) which seeks to establish more comprehensive advice, including practical guidance on the likely incidence of large waves, that should be considered whenever seafarers need to access open decks in conditions of heavy weather.

The manager of *Maersk Kithira* has been recommended to make improvements to its safety management system relating to its procedures for maintaining watertight integrity.

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *MAERSK KITHIRA* AND ACCIDENT

Vessel details

Registered owner	:	Lombard Asset Leasing Ltd
Manager(s)	:	Maersk Ship Management B.V.
Port of registry	:	London
Flag	:	UK
Type	:	Container Ship (fully cellular) 6800 teu
Built	:	2001 – Hyundai Heavy Industries Ltd, Co South Korea
Previous Name	:	*P&O Nedlloyd Cook*
Classification society	:	Lloyd's Register
Construction	:	Steel
Length overall	:	299.9m
Gross tonnage	:	80,654
Engine power	:	65,880kW
Service speed	:	24.5 knots
Other relevant info	:	Single screw, single bow thruster

Accident details

Time and date	:	Approx 2035 ship's time 23 September 2008
Location of incident	:	22º 22' N 115º 28' E Approx 65 miles east of Hong Kong
Persons on board	:	24
Injuries/fatalities	:	1 fatality, 1 injury
Damage	:	Minor damage to deck fittings

1.2 BACKGROUND

Maersk Kithira was originally built as *P&O Nedlloyd Cook*, but was renamed on her transfer to the A.P. Møller – Maersk Group in 2007. She was built with a totally enclosed bridge, situated in the after third of the ship's length, and approximately 200m from the forecastle.

At the time of the accident, *Maersk Kithira* was manned with a crew of 24, consisting of UK officers, with the exception of a Ukrainian second engineer, and Filipino ratings. The ship had just started a new voyage loop, and was on the first rotation. The loop started at Yokohama, visited Chinese ports southbound, Singapore, Jebel Ali, the Chinese ports northbound, Taiwan, Los Angeles, and returned to Yokohama.

Operating a traditional three watch system, it was the routine for the master to stand a watch between 1600 and 1700, and between 0700 and 0800 to allow the chief officer to leave the bridge to complete paperwork, or carry out upper deck rounds as required.

1.2.1 The Company

Maersk Ship Management B.V. was formed when A.P. Møller – Maersk Group took over P&O Nedlloyd. The ships of the P&O Nedlloyd fleet were re-named, and the majority of ship and shore staff transferred to Maersk employment, requiring them to change from P&O's paper based Safety Management System (SMS) to the web based system used by A.P. Møller – Maersk Group. The change from one system to the other was managed by introducing the system to the shore staff well in advance of fleetwide implementation, and then organising introductory seminars for all ships' officers. During these 3-day seminars, the visions and values of the new company were explained and a 2-hour workshop was held to allow officers to familiarise themselves with the structure and content of the SMS, as well as instruction in how to navigate the computer software. The officers were then issued with usernames and passwords in order to continue the familiarisation process via the internet once the seminar had been completed.

1.2.2 Particular crew members

Master – was 55 years old and had gained his master's unlimited certificate of competency in 1981. He had served as master since 1995 and had been in command of *Maersk Kithira* for 3 years. He had served in container ships since 1980. The master worked a 10 week on, 10 week off work pattern, and was in his eighth week on board of this cycle at the time of the accident.

Chief engineer – Graham Ross, aged 52, had started his career at sea in 1973. He had gained his certificate of competency as chief engineer unlimited in 1983 and had been first promoted to the rank of chief engineer in 1999. He had served as chief engineer of *Maersk Kithira* for 3 years.

Chief officer – was 49 years old and had started his career at sea in 1976. He joined P&O Nedlloyd in 1996 and gained his master's unlimited certificate of competency in 2004. Promoted to chief officer in 2005, this was his third appointment to *Maersk Kithira*.

Third officer – obtaining his Officer of the Watch Unlimited certificate of competency in 2006, the third officer's first appointment as a watchkeeping officer was on a North Sea rig emergency response and rescue vessel (ERRV). For this appointment he was required to successfully complete the Offshore Petroleum Industry Training Organisation's (OPITO) Initial Training for Shipboard Operations (ITSO) specifically requiring additional first-aid and emergency response training (see section 1.8.4). Joining Maersk in 2007, this was his second appointment to *Maersk Kithira*.

1.3 NARRATIVE

Maersk Kithira sailed from Yantian (Mirs Bay, Hong Kong) at 1430 on 23 September 2008, for Xiamen, where she was due to berth at 1000 the following morning. Weather reports about the approaching typhoon Hagupit had been received on board, and the "heavy weather checklist" from the company SMS had been completed by 1530. This included a requirement to check the anchor securing arrangements, ventilator closures on the forecastle and hatch cover locking devices. The chief officer was relieved by the second officer as officer of the watch (OOW) when full away on passage was rung at 1518. At 1530, the chief officer commenced rounds of the upper deck to visually confirm that the ship was secured for heavy weather, and at the same time the crew checked the cargo lashings.

At 1700 the chief officer relieved the master as OOW, and a weather report was sent (see section 1.4), indicating force 9 winds and 6m swell. At 1725 and for a few minutes after that, a series of alarms sounded on the ship's voyage management and monitoring system. This indicated that both the main and emergency starboard navigation lights had failed and that there was an earth on the circuit. This was correctly diagnosed as indicating that the sidelight unit had been hit by a wave, a fact substantiated during discharge the following day when a number of containers were noted to have been damaged in the vicinity of the starboard sidelights. However, no impact had been felt on the bridge, and speed was maintained. The master was informed, and he decided that no further action would be taken to remedy the situation due to the exposed position of the lights and the poor weather. It was agreed that approaching ships would be alerted to *Maersk Kithira's* presence by illuminating the deck if necessary.

By 1900 it was fully dark, and it was no longer possible to see the sea ahead of the ship. The wind direction remained steady at about 30 degrees on the port bow, causing a 2-3m sea. A large swell of about 6m was also evident coming from 20-30 degrees on the starboard bow. Under these influences, the ship was rolling to about 10º, but not pitching heavily. Engine speed was set for 20 knots,

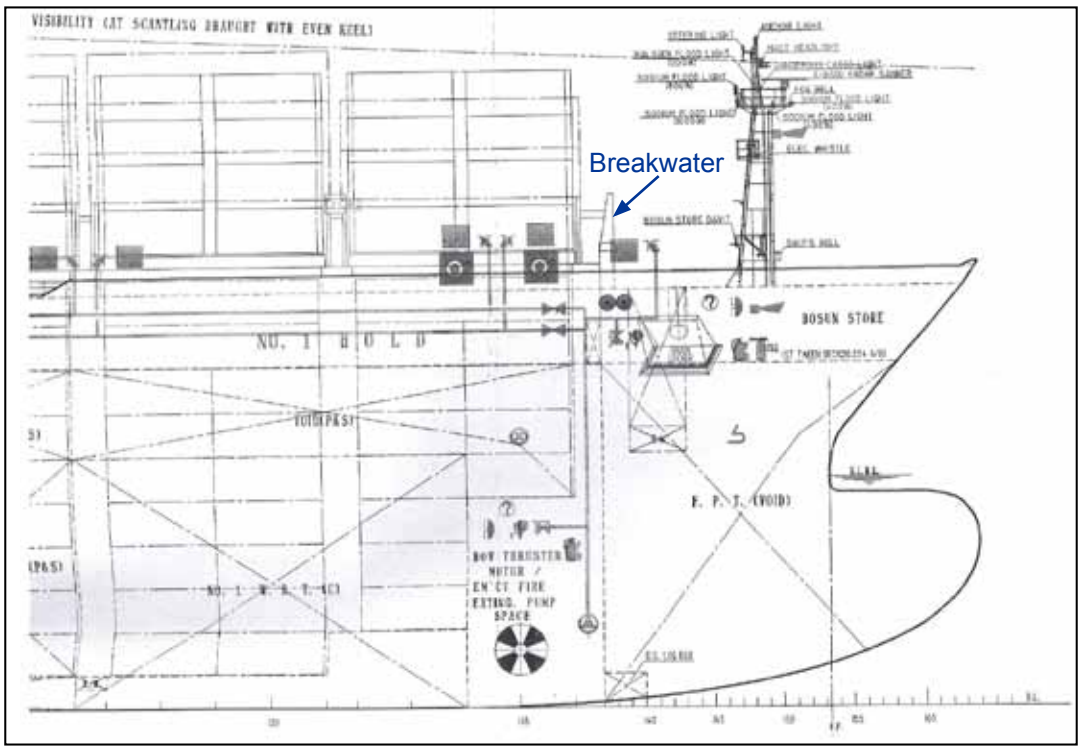
and the ship was making good a speed of 12 knots. This speed was considered to be sufficient for *Maersk Kithira* to make her scheduled arrival time at Xiamen the next morning as the master expected the overall voyage speed to increase as the vessel passed to the north of the typhoon's centre and proceeded further east into calmer waters.

At 1945, the bosun's store bilge alarm sounded indicating to the chief officer the possibility that a forecastle watertight closure had failed. Once he was relieved by the third officer at 1950, he went to discuss the problem with the master. Finding the master with the chief engineer, he informed the master of the alarm, and it was agreed that the chief officer would go forward to investigate the cause of it. The chief engineer volunteered to accompany the chief officer, so both men changed into working gear and prepared to make their way forward via the under-deck passageway on the starboard side. The master went to the bridge to oversee the operation, and took the con from the third officer.

The master reduced the speed of *Maersk Kithira* to 10 knots and altered her course to starboard to reduce the rolling by placing the swell directly ahead of the vessel.

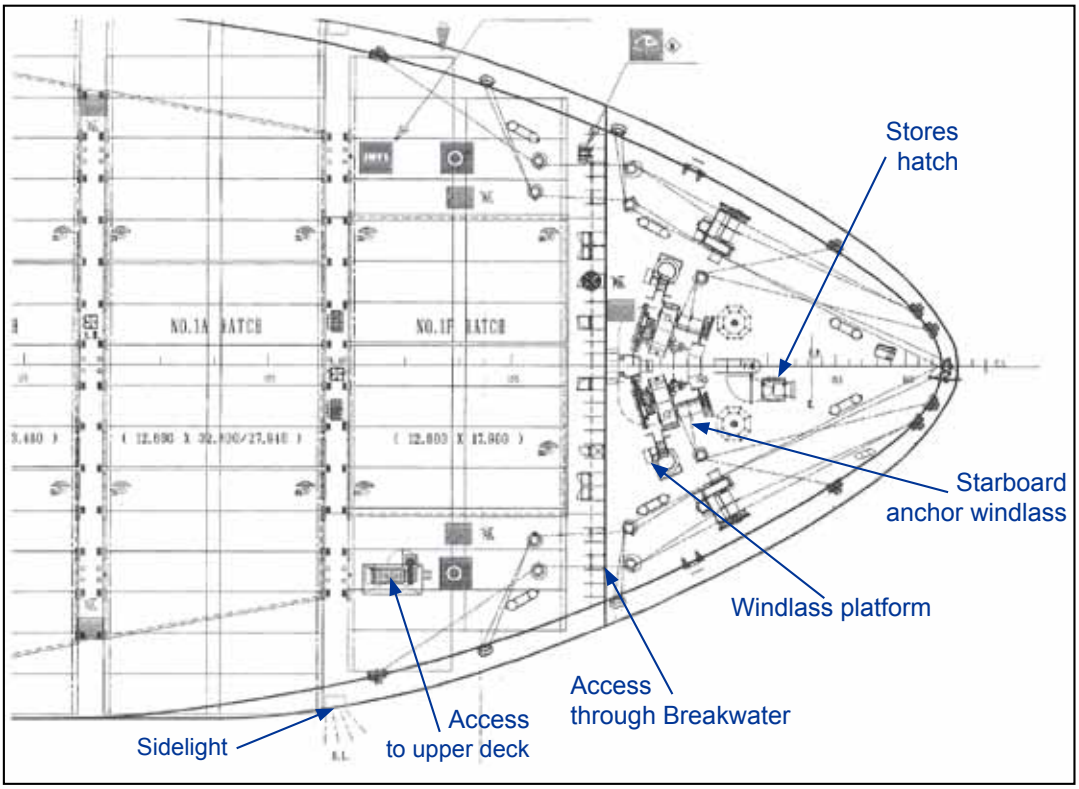
On arrival at the bosun's store **(Figure 1)**, the chief officer and chief engineer found that the deck was wet, and that water was entering through the forecastle deck stores hatch cover seal. Shortly afterwards, at 2007, they reported to the bridge by telephone what had been found.

Figure 1a



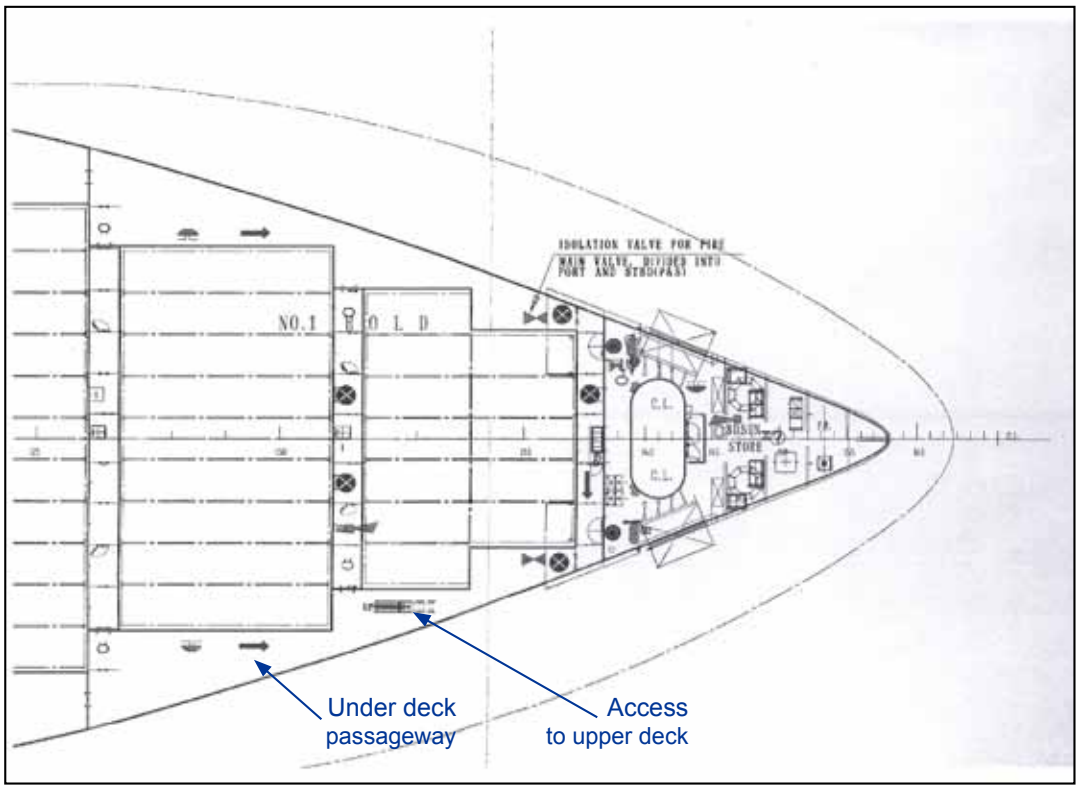
Profile of *Maersk Kithira*

Figure 1b



Plan of Forecastle - *Maersk Kithira*

Figure 1c



Plan of Bosun's Store - *Maersk Kithira*

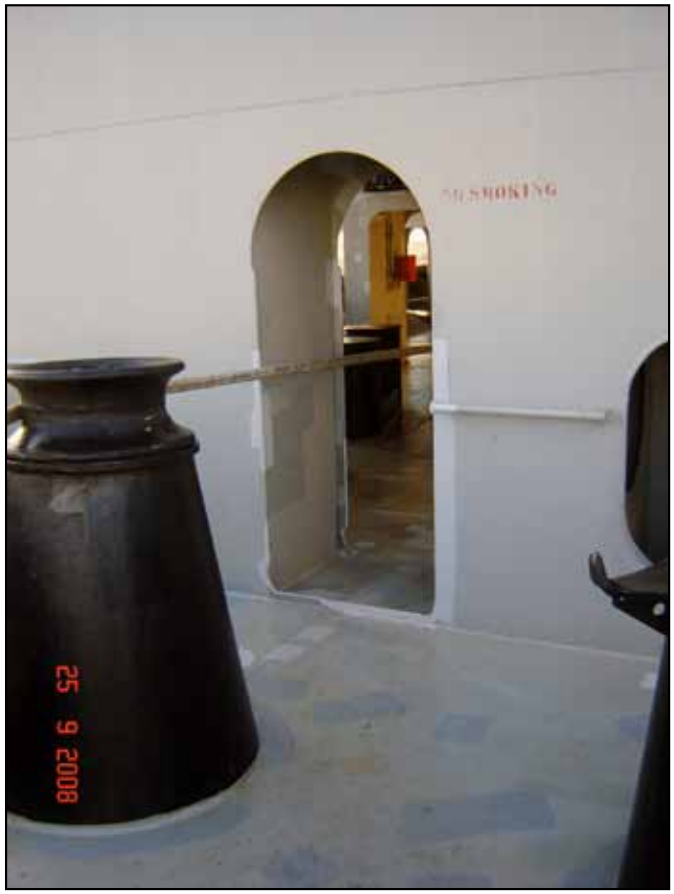
The master, chief engineer and chief officer jointly agreed that it would be necessary to tighten the dogs securing the forecastle stores hatch cover **(Figure 2)** to prevent further water from entering the space. The third officer switched on the foredeck floodlights, and the chief officer and chief engineer waited briefly at the top of the access to the upper deck for the master to give permission for them to proceed. At 2010, permission was given, and the two men went onto the upper deck. Ship movement was such that neither found it difficult to stand. They made their way initially to the access port in the breakwater **(Figure 3)**, and stood in the shelter of the breakwater to assess the motion of the ship, and gauge the amount of water being shipped on the deck. Noting that the only water coming onto the deck was spray coming up through the hawse pipe, they decided that it was safe to go onto the forecastle, and at 2011, informed the master by UHF radio of what they were doing.

Image courtesy of Maersk Ship Management BV

Figure 2

The forecastle stores hatch

Image courtesy of Maersk Ship Management BV Figure 3



The access through the forecastle breakwater

Communication between the forecastle and the bridge continued by UHF radio, with the chief officer commenting that both men were getting wet due to the spray coming on board. At 2018, having received no response from the forecastle team to repeated calls by UHF radio, the master ordered the third officer to go forward and investigate. The master reduced the speed of *Maersk Kithira* further to 5 knots.

At 2023, as the third officer was getting changed to go on deck, the master received a telephone call from the chief engineer, in the bosun's store, telling him that a large amount of spray had come on board and soaked the radios, rendering them inoperable. The chief engineer also confirmed that the stores hatch cover securing dogs had been tightened. However, the starboard anchor cable securing chain was noted to be slack, and he reported that he and the chief officer would take a couple of minutes to tighten it. The master then called the third officer back to the bridge, explaining that contact had been re-established.

The chief officer and chief engineer returned to the forecastle and set about tightening the anchor cable securing chain. This required one man to mount the windlass platform **(Figure 4)** to release the securing chain locking screw, while the other remained at deck level to adjust the securing chain through a link of the anchor cable. The chief engineer mounted the platform, and released the locking screw, allowing the chief officer to adjust the chain. As the chief engineer then re-tightened the locking screw, a wave broke over the forecastle and washed him off the platform. The wave also knocked the chief officer off his feet and propelled him into the windlass, rendering him unconscious. No wave impact was seen or felt by either the master or third officer on the bridge.

Image courtesy of Maersk Ship Management BV

Figure 4

The starboard anchor windlass

The chief officer woke up seconds later in about 30cm of water. Looking around, he saw the chief engineer forward of the windlass, lying stationary on the deck. The chief officer dragged the chief engineer behind the breakwater and put him into the recovery position. He then went to the bosun's store and telephoned the bridge.

At 2037 the general alarm was sounded, and the master made an announcement on the ship's public address system stating that there had been an accident and for personnel to muster in the ship's office. The ship's emergency organisation was such that the chief officer was the medical officer, with the third officer acting as his deputy. On mustering in the ship's office the third officer and the fourth engineer were sent by the master to find the casualties and make an initial assessment of their condition. Taking a first-aid kit, they made their way forward and found the chief officer holding the chief engineer in the recovery position aft of the breakwater. The third officer's initial assessment was that the chief engineer required a stretcher, while the chief officer could walk if assisted. The third officer then used the telephone in the bosun's store to discuss his findings with the master on the bridge and request that a stretcher party be sent forward. The stretcher party arrived shortly afterwards, and the chief engineer was carried aft to the ship's hospital. The fourth engineer escorted the chief officer aft to the ship's accommodation.

The third officer took charge of the attempt to provide the chief engineer with first-aid. Following the advice in *The Ship Captain's Medical Guide*[1] he cut away the chief engineer's clothing, and carried out an assessment of his condition. It was readily apparent that the chief engineer's injuries were very serious, so the master sought advice by telephone from the company's medical officer. He did not look for information concerning Radio Medical Advice since he considered that this would have delayed receipt of the advice he required. He did not have available to him an emergency contact list for medical emergencies, to which he could otherwise have referred for appropriate telephone numbers. Following reassurance from the company medical officer that the actions being taken were appropriate, the master began to assess options for evacuating the chief engineer to hospital ashore.

The chief officer was treated for bruising and for lacerations to his head and right knee. Since he had been knocked unconscious for a short period, one of the ship's officers remained with him throughout the night.

The medical care provided for the chief engineer continued through the night, and followed the advice in *The Ship Captain's Medical Guide*. This included dressing his wounds, splinting his legs, and the administration of pain relief. The master realised that returning to Yantian for enhanced medical care would not be possible since the port had been closed owing to the effects of typhoon Hagupit. Helicopter evacuation or boat transfer in the prevailing weather conditions was impractical, therefore at 2230 course was resumed at best speed for Xiamen. The chief engineer's condition stabilised, and a continuous watch over him was maintained. However, from 0600 onwards on 24 September,

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[1] *Ship Captain's Medical Guide 22nd Edition* First published 1999 by TSO (The Stationery Office) ISBN 0 11 551658 1

the chief engineer became more agitated. At 0830, he stopped breathing, and Cardiopulmonary Resuscitation (CPR) was started by the third officer, assisted by the electrician and other crew members. The ship arrived alongside her berth at Xiamen at 1000, when paramedics boarded, and assessed the situation. CPR was stopped at 1042, and Mr Ross was pronounced dead.

1.4 WEATHER CONDITIONS

Maersk Kithira was being navigated approximately 20 miles off the southern coast of China, and at the northern edge of typhoon Hagupit. The wind was estimated to be blowing at a steady force 9, from the north east. The sea state was rough and confused. However, a wind driven sea from the north east at about 2m was identified, and a swell from the south east of between 6 and 10m was also noted.

Maersk Kithira was a 'Voluntary Observing Ship'[2], and sent the following weather reports near the time of the accident **(Table 1)**.

Date/Time GMT/Local	Lat	Long	Ship Speed	Wind from	Knots	Barometer	Wave height
23/09/08 0900/1700	22.3N	114.8 E	7.0	040	47	996.9	6.0m
23/09/08 1800/0200	22.8N	116.4E	10.8	050	40	1003.0	10.0m

Table 1 – Weather reported from *Maersk Kithira*

1.5 WAVE STATISTICS

The phenomenon of large waves at sea has been an expected part of sea-going for a very long time, traditionally being referred to as "abnormally large" waves. Observational techniques have improved in recent years and a number of statistical analyses have shown that large waves are not abnormal (meaning extraordinary), but better described as statistically unlikely to occur. However, this does mean that they will, from time-to-time occur.

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[2] The UK Meteorological Office maintains a fleet of around 350 Voluntary Observing Ships (VOS) on which the crew make weather observations. These observations are made in support of the International Maritime Organization's SOLAS (Safety of Life At Sea) Convention and are carried out under the WMO VOS programme. Within Europe VOS operations are co-ordinated through the EUCOS Surface Marine programme (E-Surfmar).
Observations from ships are usually made every three to six hours, while at sea. About 20% of the UK's ship observations are from the North Atlantic, with the rest further afield.

In his book *Seakeeping – Ship Behaviour in Rough Weather*[3]*,* ARJM Lloyd investigates the effect of waves on ships, and includes statistical analyses of recorded wave heights to help identify maximum conditions likely to be met. One of the problems he encountered in collating wave height evidence for the book was that many observations were from ships at sea, and were based on the observer's estimation of wave height. However, by comparing a large amount of data from recording instruments with weather reports from ships, he was able to conclude *"that observers' estimates of average wave height correspond reasonably closely to the significant wave height".* Significant wave height is defined as *the mean of the highest third of the heights recorded in a wave time history*. It is this figure which is used in the scientific, naval architecture, engineering and operational planning of wave parameters. Individual wave heights vary so that a statistical description, such as significant wave height is used to define wave heights over a period. For shipping, significant wave height is most commonly used in developing weather forecasts, and for weather routing of ships. This, however, does not identify the maximum wave height likely to be encountered. A rule of thumb suggests that the maximum wave height is approximately twice the significant wave height, but this rule does not follow for prolonged or intense storms, where maxima could be much greater. Further to this, in his book *Waves in Oceanic and Coastal Waters*[4]*,* Leo H Halthuijsen estimates that 1 in 1000 waves could be of this maximum height.

This area of science is still under investigation, and the formation of large waves is incompletely understood. However, in *Research Project 509*[5] for the Maritime and Coastguard Agency, the *Wolfson Unit for Marine Technology and Industrial Aerodynamics* at the University of Southampton states that *approximately 1 in 2000 waves will be twice the significant height.*

The approximate frequency of maximum wave height as a multiple of the significant wave height can be derived from *Probabilistic Theory of Ship Dynamics*[6], and is shown in **Table 2**.

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[3] Lloyd ARJM *Seakeeping – Ships Behaviour in Rough Weather*. First published by Ellis Horwood Ltd 1989 ISBN 0 9532634 0 1

[4] Halthuijsen LH *Waves in Oceanic and Coastal Waters* Cambridge University Press 2007 ISBN-13:9780521860284

[5] *Research Project 509*. HSC – Evaluation of Existing Criteria. A study of the intact and damage stability criteria in the 2000 High Speed Craft Code. March 2005

[6] Price W G and Bishop R E D. *Proababalistic Theory of Ship Dynamics*. Chapman & Hall Ltd 1974

Maximum / Significant Height	Occurrence
1.21	1 in 10
1.61	1 in 100
1.94	1 in 1,000
2.21	1 in 10,000
2.46	1 in 100,000

Table 2 – Maximum wave height as a multiple of the significant wave height and the probability of occurrence

The research indicates that somewhere between 1 in 1000 and 1 in 2000 waves will be twice the significant height. Thus, a vessel encountering waves with a modal period of about 10 seconds, might expect to encounter a wave of twice the significant height every 2¾ - 5½ hours, with the possibility that a wave of nearly 2.5 times the significant height being encountered once every 11.5 days.

1.6 COMPANY SAFETY MANAGEMENT SYSTEM

Although the ship's crew had been using the Maersk SMS for approximately 2 years, none of those interviewed felt fully familiar with the system. The web-based system was straightforward to use, but without in depth system knowledge users found it more difficult to search the full contents of the SMS than was the case when using the previous paper-based system employed by P&O Nedlloyd. This paper-based system had included an Emergency Response Manual for use on the bridge, providing ready reference to checklists and contact details for different types of incident, but this too had been replaced by a web-based system. The crew tended to use those parts of the SMS that they were familiar with, or to which they were directed, but rarely explored the system further.

1.6.1 Safe Job Analysis (SJA)

Generic risk assessments had been provided within the SMS, and these were referred to as 'safe job analyses'. They covered the risks associated with common tasks on board, but were not ship specific.

An SJA entitled "Movement on Deck in Heavy Weather" was included in the system, but had not been referred to before the chief officer and chief engineer went onto the deck. It identified three hazards: slips trips and falls, falling overboard, and moving/falling objects. Risk control measures for these scenarios included the provision of adequate lighting, the use of correct personal protective equipment (PPE) and good communications. The risk of being struck by a wave when going onto the deck in heavy weather had not been identified.

The SMS required the ship's staff to develop ship specific SJAs, utilising the generic SJAs as a template. The SMS also required that the SJAs be audited by the company as part of the company's annual internal audit regime, in part to ensure that the generic SJAs were being tailored by ship's staff to reflect the operational requirements of individual vessels.

1.6.2 Checklists

The SMS provided a series of generic checklists suitable for all ships in the fleet. Again, the SMS required each ship to develop its own specific checklists, which were also subject to the company's internal audit procedure. A copy of the generic heavy weather checklist and the checklist used at the time are at **Annex A**.

At the top of the checklist is a sentence describing the use of the document:

> *A vessel specific heavy weather checklist shall be available onboard all vessels to facilitate an efficient "making ready for sea" check on departure from port, bound for an ocean passage, when expecting adverse weather between coastal ports, or when weather deteriorates while on route the inclusion of items below shall be considered and the shipboard management shall, thoroughly and well in advance, compose their own checklist with all appropriate check items.*(Sic)

The checklist with two additions: "(anchors and bow thruster vents closed after sailing Yantian", and "C/O rounds of decks after sailing" [sic]) was completed on board shortly after sailing from Yantian, and its completion was recorded in the deck logbook.

1.7 INSTRUCTION AND TRAINING FOR HEAVY WEATHER

1.7.1 Ship preparations

Instruction in heavy weather seamanship techniques is part of the syllabus of all grades of deck officer certification. The scope is limited to the actions necessary to minimise damage to the ship, and the additional securing necessary. Most text books will offer a list of factors to take into account when preparing for heavy weather, and in general this includes the advice to restrict access to the upper deck, and to rig lifelines in advance of its onset to enable personnel to cross exposed decks if necessary.

The International Chamber of Shipping's Bridge Procedures Guide includes advice and checklists for securing ships for sea, including the requirement to restrict access to the upper deck in heavy weather (Checklist B10). However, there is no advice concerning the process to be followed when access to the open deck is required.

1.7.2 Code of Safe Working Practices for Merchant Seamen (COSWP)

The COSWP provides advice to seafarers on UK merchant ships covering common tasks carried out on board ship, and also demonstrates and instructs in the formation of effective risk assessments. It is a requirement of The Merchant Shipping (Code of Safe Working Practices for Merchant Seamen) Regulations 1998 (SI 1998 No 1838), that a current printed edition of the Code be carried on all UK ships except fishing vessels and pleasure craft.

The Code is divided into four sections. These cover the regulatory framework that underpins the advice in the Code; the introduction of new recruits to safety procedures on board and what can be done to improve personal health and safety; working practices common to all ships; and working practices for specialist ship operations.

Advice concerning the factors to consider before undertaking specific tasks on board ships, both at sea and in port, to ensure that the operation is carried out safely, is included in the Code. The advice on safe movement is given in chapter 13. However, specific advice concerning accessing the open decks in heavy weather is limited to advising that lifelines should be securely rigged across open spaces when rough weather is expected.

1.8 MEDICAL CARE

The mandatory requirements for training and proficiency in medical first-aid, and for persons in charge of medical care on board ship, and the standards of competence to be achieved, are set out in Regulation VI/4 of the Annex to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 as amended (STCW), and Section A-VI/4 of the STCW Code. These requirements are applied to the UK fleet by The Merchant Shipping (Training and Certification) Regulations 1997, and provided in three stages as follows.

1.8.1 Elementary First-Aid

The Elementary First-Aid qualification is a 1 day course, and forms part of the four elements of basic training required for all seafarers assigned designated safety or pollution prevention duties in the operation of the ship. It provides sufficient instruction to enable the application of immediate first-aid.

1.8.2 Medical First-Aid

The objectives of this training are that on successful completion of the course, the candidate will be able to apply immediate first-aid, and have knowledge of reference materials and first-aid and medical equipment on board, and understand their use in the management of accidents and medical emergencies. All candidates for a certificate of competency must have successfully completed an approved training programme. The third officer held this qualification.

1.8.3 Medical care

Following successful completion of this training, the candidate will have sufficient knowledge of the types of ships' medical equipment and stores and their use to diagnose medical problems, provide medical care to the sick and injured while they remain on board, and participate in co-ordinated schemes for medical assistance to ships. All candidates for master and chief mate certification must have completed this training in addition to the Medical First-Aid training. Both the master and chief officer held this qualification.

In addition to the STCW required training, service on an ERRV requires additional training as follows.

1.8.4 Offshore Petroleum Industry Training Organisation (OPITO) training

For service on an ERRV, the OPITO has determined that all the crew will have completed an ERRV Crew Initial Training for Shipboard Operations (ITSO) programme and, as required, a proportion of each crew will have received training as Advanced Medical Aiders. This training course is part of the industry recognition that a major objective is to prevent incidents occurring and, if they do, to control and minimise their effect. Thus, part of the ITSO course deals with the problems associated with treating large numbers of casualties, and includes triage techniques, casualty movement, and record keeping. The work of the ERRV involves maintaining the readiness state of the team such that response to an emergency is immediate and accurate. ERRV crews therefore spend much of their time training and practising drills. The third officer held this qualification following previous service on board an ERRV, so he was more familiar with the tasks of casualty evacuation, casualty assessment, and dealing with multiple casualties than any other member of the crew of *Maersk Kithira.*

1.9 SHIP CAPTAIN'S MEDICAL GUIDE AND RADIO MEDICAL ADVICE

The Ship Captain's Medical Guide is intended for use on ships where no doctor is carried and it is necessary to assess and treat injuries and to diagnose and treat ill health. It contains a wide range of authoritative advice, and is designed such that the recommended measures for prevention and treatment can be safely carried out by an intelligent layman. It is complemented by the medical stores required to be carried by UK registered ships under The Merchant Shipping and Fishing Vessels (Medical Stores) Regulations 1995 (SI 1995/1802), as amended, and detailed in Merchant Shipping Notice MSN 1768 (M+F). Throughout the guide it is recognised by the authors that the absence of expert medical attention for those on board ship means that the trained ship's officer will have to give types of treatment beyond that accepted as normal first-aid. It is also recognised that it may be some time before the casualty can be seen by a trained doctor, and so the reader of the guide is prompted to seek Radio Medical Advice.

In respect of the identifiable injuries sustained by Mr Ross, the advice from the medical guide was to obtain Radio Medical Advice, and to carry out the specified medical care, noting that head wounds and fractures should be seen by a doctor as soon as possible.

Marine Guidance Note MGN 225 (M+F) provides information on how to obtain radio medical advice when a medical incident or emergency arises at sea. There are two centres in the UK designated to provide such advice. These are at Queen Alexandra Hospital, Portsmouth, and at Aberdeen Royal Infirmary. However, provision of radio medical advice is not limited to the UK and is available through coast radio stations worldwide as detailed in the Admiralty List of Radio Signals (ALRS), a copy of which was held on board *Maersk Kithira*. Although this information was available to the master, he felt it would take too long to find the telephone numbers he required. Furthermore, he had the telephone number of the company medical officer readily available at the communication desk on the bridge, so he used that option to gain prompt medical advice.

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 SIMILAR ACCIDENTS

The MAIB accident database records show that in the 10 years before this accident, 17 accidents had occurred where crewmen had been either killed or injured as a result of working on deck in rough weather when a wave washed inboard. The largest proportion of these had occurred on container ships, as the following table shows **(Table 3)**.

Ship Type	Accidents	Injuries	Fatalities
Tanker	3	5	2
Passenger Ship	2	2	0
Ro-Ro	1	1	0
General Cargo	2	3	0
Other	4	5	0
Container Ship	5	6	2
Total	**17**	**22**	**4**

Table 3 – MAIB accident database records 1998 to 2007.
Injuries and fatalities to crew working on deck in heavy weather, when a wave washed inboard. (Figures are for merchant vessels of 500gt or more of UK flag or in UK waters.)

The full list of these accidents is included at **Annex B**.

2.3 BARRIERS

In this accident there were three separate and distinct stages where intervention might have prevented the final outcome, namely effective securing for sea, proper assessment of the risk presented by the flooding, and proper assessment of the precautions to be taken against the risk of being struck by a wave when going onto the open deck in heavy weather.

2.3.1 Securing for sea

The ship's staff were well aware of the approaching typhoon, and of the probability of encountering very heavy weather. A copy of the company's heavy weather checklist had been completed shortly after *Maersk Kithira* sailed from Yantian. The chief officer had carried out upper deck rounds once the ship was clear of the port, to confirm that she was properly secured, and this included the forward area.

The checklist was a generic form designed to be used as a template for all ships in the fleet. It had not been modified to include details specific to *Maersk Kithira*, even though there was a company requirement for this to be done. Careful completion of a comprehensive checklist covering safety critical tasks provides the person completing the form with an invaluable aide memoire. In the case of securing a vessel prior to entering heavy weather, the diligent use of an appropriate checklist will confirm that, tasks required to ensure the seaworthiness and safety of the vessel, are approached in a uniform and methodical way that does not rely upon the memory or thoroughness of the person completing the task.

The chief officer relied solely on a cursory visual check to confirm that the forecastle was secure. Had an effective system been in place on *Maersk Kithira* to confirm that the upper deck was secure, then barring any failure of a closing device or other unforeseen event, there would have been no need for any person to access the upper deck during heavy weather.

2.3.2 Assessment of the risk of flooding

When the bilge alarm for the bosun's store sounded, there was no way for the master or the chief officer to determine just how serious a problem the water ingress was without sending someone forward to investigate. From the bridge, it was not possible to see the forecastle deck itself, and therefore no way of determining from this position the amount, frequency, or size of the waves or spray breaking over the forecastle. It was therefore entirely appropriate for someone to go forward and assess the situation, since this could be achieved in relative safety by using the under-deck passageway.

Once forward, it would have been possible to assess the rate of water ingress as either trivial, requiring no action; excessive, requiring immediate remedial action; or somewhere between these two extremes requiring the situation to be monitored. In any event, the water could have been pumped out to reduce the extent of flooding.

In this case, the rate of water ingress was not excessive, neither was it trivial. The ship was due in her next port in 14 hours time, and while of concern, the water ingress posed no immediate risk to the ship, and the voyage could have continued with no requirement for anyone to go onto the open deck.

It is of note that the bilge alarm labelled “bosun’s store” also included the chain locker, and following activation on the evening of 23 September, the system remained in the alarm state for a further 6 days, until the chain locker was opened and the strum box on the bilge suction cleared of an accumulation of mud. Since the level of water in the bosun’s store was only enough to wet the deck, it is likely that the alarm condition was caused by the chain locker filling with water rather than water ingress through the forecastle stores hatch. The chief officer had considered it unnecessary to plug and cement the spurling pipes since the voyage from Yantian to Xiamen was expected to take less than 20 hours, and the company’s heavy weather checklist did not specify this was to be done.

2.3.3 Access to the upper deck – Assessment and precautionary measures

Maersk Kithira had been designed and built with a high and totally enclosed bridge. While an enclosed bridge improves the comfort of bridge watchkeepers, and allows the bridge electronics to be maintained at a near constant temperature, it puts a barrier between the bridge watchkeeper and the weather, and removes any feel for the prevailing conditions and the effect they may be having on the ship’s structure, cargo and anyone working on the open deck, particularly in way of the foredeck.

In an effort to reduce the rolling motion and reduce the risk of shipping seas forward, the master adjusted the ship’s course, and also reduced speed. Unable to see the foredeck or the approaching waves in the darkness, he was unable to confirm the efficacy of this action and relied on the chief officer and chief engineer to tell him if the action had not had the desired effect.

The foredeck floodlights had been switched on, and these provided a sufficient level of illumination. Both men were wearing suitable footwear and clothing; however neither was wearing a lifejacket contrary to the SJA developed for movement on deck in heavy weather.

The chief officer and chief engineer each carried hand-held radios, and initially both were able to talk directly to the master on the bridge. However, this communication link failed when both radios were soaked with spray when the officers moved on to the forecastle deck. The master would then have been uncertain if any break in communication was due to the men’s concentration on the task in hand or as a result of their being incapacitated. A continuous link could have been maintained by having a third person stationed near the breakwater in a safe and sheltered position to provide the master with a running commentary on the progress of the operation and the prevailing conditions. In this manner, the men would have been able to attend to the task, and the master would have been able to maintain a full overview of the situation.

Not all measures listed in the relevant SJA were taken, and the SJA itself did not consider the additional risk of personnel being struck by a wave. In the absence of a formal risk assessment, the master, chief officer and chief engineer all underestimated the risk in this regard.

2.4 FORMAL ADVICE

The lack of formal advice to masters, with respect to sending crew on deck in heavy weather, is of concern. Without such advice, a master is left relying on his own knowledge and experience to ensure that the task is carried out safely. Access to the upper deck in heavy weather is discouraged in seamanship manuals and current MCA advice, yet there may be occasions when there is an immediate risk to the ship, necessitating such access. A master under these conditions has need of a reference to guide him in properly assessing the risks to personnel accessing the upper deck and, in particular, the measures that need to be taken to reduce to an acceptable level the risk of his crew being struck by a wave. Key to this is knowledge of the height and frequency of significantly larger waves that may be encountered in the prevailing circumstances. Such knowledge was lacking in this case and contributed to the master, chief officer and chief engineer underestimating the risk of being struck by a wave.

2.5 COMPANY AUDITING

The company's SMS procedures required the ship's staff to review the content of the generic SJAs and checklists to ensure their suitability for the particular trade and ship type. The company's internal auditors were then expected to include a review of the modified ship specific SJAs and checklists in their audits. *Maersk Kithira's* SJA for movement on deck in heavy weather had not been modified, but the company's auditing process had not identified this.

2.6 MEDICAL CARE

The medical care provided on board *Maersk Kithira* followed the advice contained in *The Ship Captain's Medical Guide*, and followed the required training in first-aid. The advice provided by the company's medical officer confirmed that the medical care provided by the ship's staff involved was entirely appropriate. The third officer's familiarity with first-aid procedures owing to the advanced training he had received and drills he had practised during his service on an ERRV, rendered him more comfortable in assuming a leading role in administering medical care than would otherwise have been the case.

No specific checklist was immediately available to the master in respect of seeking radio medical advice, which had the potential to delay receipt of such advice.

2.7 FATIGUE

The working hours of the crew involved in this accident were not onerous. There is no evidence to suggest that fatigue played any part in this accident.

SECTION 3 - CONCLUSIONS

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

1. No formal advice is currently promulgated with respect to assessing the need to go on deck in heavy weather in view of the height and frequency of significantly larger waves that may be encountered in the circumstances, or the control measures that need to be taken, to reduce to an acceptable level, the risk to personnel of being struck by a wave. [2.3.2, 2.4]

2. Contrary to company instructions, the heavy weather checklist had not been modified to include details specific to *Maersk Kithira*. Therefore, there was no detailed aide memoire for the ship's officers to which to refer ensuring that the ship was effectively secured for sea. [2.3.1]

3. The master underestimated the prevailing weather conditions owing to his inability to see the approaching waves in darkness. [2.3.3]

4. The master, chief officer and chief engineer underestimated the risk of personnel being struck by a wave when going onto the open deck in the prevailing weather conditions, owing to a lack of knowledge of the height and frequency of significantly higher waves that may be encountered in the circumstances, and a lack of a formal risk assessment of the hazard to which to refer. [2.3.3, 2.5]

3.2 SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION WHICH HAVE NOT RESULTED IN RECOMMENDATIONS BUT HAVE BEEN ADDRESSED

1. The company's auditing process had not identified that shipboard risk assessments had not been developed, contrary to the company's SMS procedures. [2.5]

2. No specific checklist or prompt was immediately available to the master in respect of seeking radio medical advice. [2.6]

SECTION 4 - ACTION TAKEN

4.1 The **Maritime and Coastguard Agency** is consulting industry bodies on draft guidance on:

- Issues to be considered prior to authorising work on open deck in heavy weather; and
- Control measures that should be adopted when sending personnel to work on deck in such conditions, for inclusion in the next revision of the Code of Safe Working Practices for Merchant Seamen.

4.2. **Maersk Ship Management B.V.** has taken the following actions:

- Amended its SJA entitled “Movement on Deck in Heavy Weather” **(Annex C)**.
- Reiterated the purpose and use of its SJA system and further explained the importance of amending its generic forms to fit the particular requirements of each ship within the fleet.
- Instructed its internal auditors to focus on the use of SJAs during audits and provide ship’s staff with training when required.
- Re-introduced the Emergency Response Manual to the ships of the fleet.
- Issued a Safety Flash **(Annex D)**.

SECTION 5 - RECOMMENDATIONS

The **Maritime and Coastguard Agency** is recommended to:

2009/122 Develop and promulgate formal advice to mariners on the specific risks to be considered when assessing the need to go onto the open deck in heavy weather. Such advice should:

- Provide guidance on the height and frequency of significantly larger waves that may be encountered.
- Urge particular caution when assessing the need to go onto the open deck during darkness in view of the difficulties that may be experienced in assessing the magnitude/direction of approaching waves.
- List control measures that should be adopted when sending personnel onto the open deck in heavy weather.

The above formal advice should underpin the draft guidance currently being developed and be incorporated into the next revision of the Code of Safe Working Practices for Merchant Seamen.

Maersk Ship Management B.V. is recommended to:

2009/123 Amend its safety management system to include:

- Additional heavy weather checklist measures to ensure watertight integrity.

Marine Accident Investigation Branch
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