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Fatigue



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Fatigue

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Introduction

Fatigue is a reduction in physical and/or mental capacity as the result of physical, mental, or emotional exertion which may impair nearly all physical and mental abilities including: strength, speed, reaction time, coordination, decision making or balance.

Fatigue is a significant contributory factor to many incidents in the shipping industry. Legislation designed to minimise fatigue, covering seafarers' hours of rest, has been in force for many years. Non-compliance is however, according to port state control (PSC) statistics, widespread. This loss prevention briefing is intended to:

Legislation

Safe Manning

The International Convention for the Safety of Life at Sea (SOLAS) Chapter V, regulation 14 requires that a ship engaged on international voyages shall be sufficiently and efficiently manned and have a safe manning document. The SOLAS regulations are guided by IMO Resolution A.1047 (27) 'Principles of Minimum Safe Manning'. The full text of the resolution is accessible on-line:



[www.imo.org/en/KnowledgeCentre/indexofimoresolutions/documents/a%20-%20assembly/1047\(27\).pdf](http://www.imo.org/en/KnowledgeCentre/indexofimoresolutions/documents/a%20-%20assembly/1047(27).pdf)

The objectives of the guidelines given in the resolution are:

"to ensure that a ship is sufficiently, effectively and efficiently manned to provide safety and security of the ship, safe navigation and operations at sea, safe operations in port, prevention of human injury or loss of life, the avoidance of damage to the marine environment and to property, and to ensure the welfare and health of seafarers through the avoidance of fatigue".

The guidance notes lists the operations that a ship might be expected to encounter; routine, non-routine and emergency and the consideration that should be given to assessing safe manning in each case. Owners and administrations, when determining safe manning levels, also need to consider:

"the number of qualified and other personnel required to meet peak workload situations and conditions, with due regard to the number of hours of shipboard duties and rest periods assigned to seafarers."

Hours of Work and Rest

Hours of work and rest guidelines on board ships trading internationally were first drafted by United Nations autonomous organisations:

- The International Maritime Organisation (IMO) in 1978 within the Standards of Training, Certification and Watchkeeping (STCW)
- The International Labour Organisation (ILO) in 1996 with ILO Convention 180 concerning seafarers' hours of work and the manning of ships, which was adopted by some, though not all, Flag States.

STCW 78 has been extensively updated, as described below. ILO 180 has been replaced by the 2006 Maritime Labour Convention (MLC 2006).

STCW 2010 Manila Amendments

Seafarers currently engaged in international trade generally have their hours of work and rest governed by the provisions of the STCW Convention 2010, Manila Amendments, as interpreted by the Flag State of the vessel on which they are serving.

Regulation A-VIII/1 'Fitness for duty' states:

- "1 Administrations shall take account of the danger posed by fatigue of seafarers, especially those whose duties involve the safe and secure operation of a ship.
- 2 All persons who are assigned duty as officer in charge of a watch or as a rating forming part of a watch and those whose duties involve designated safety, prevention of pollution and security duties shall be provided with a rest period of not less

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than:

1. A minimum of 10 hours of rest in any 24-hour period; and
 2. 77 hours in any 7-day period.
- 3 The hours of rest may be divided into no more than two periods, one of which shall be at least 6 hours in length, and the intervals between consecutive periods of rest shall not exceed 14 hours."

The main intent of the Manila Amendments, as they related to hours of work and rest, was to align STCW with MLC 2006.

The full text of MLC 2006 and further information related to the convention can be accessed through the ILO website:

www.ilo.org/global/standards/maritime-labour-convention/lang--en/index.htm.

Sole Watchkeeper

A UK government organisation, the Marine Accident Investigation Branch (MAIB) conducted a study into bridge watchkeeping safety in 2004. They examined the circumstances of marine accidents around the coast of the UK and on UK registered ships in other parts of the world. Many of the accidents investigated, mainly groundings but also collisions, occurred at night, where the sole watch-keeper on the bridge had been so fatigued that he had fallen asleep on watch. This had serious and sometimes catastrophic consequences.

The full study can be viewed at: **Bridge watchkeeping safety study - Publications - GOV.UK**

STCW Chapter VIII, Standards regarding Watchkeeping, Part 3 – Watchkeeping at Sea, in the section headed 'Look-out' state that the officer in charge of the navigational watch may be the sole look-out in daylight, subject to certain provisions (weather, visibility, traffic density etc.). The implication here is that the officer in charge of the watch shall not be the sole look-out at night.

The UK Marine and Coastguard Agency (MCA), perhaps influenced by the MAIB study cited above, goes further and says, in their Marine Guidance Note MGN 315 (M), 'Keeping a Safe Navigational Watch on Merchant Vessels':

"...the MCA considers it dangerous and irresponsible for the OOW to act as sole look-out during periods of darkness..."

The full text can be accessed at:

www.gov.uk/government/publications/mgn-315-keeping-a-safe-navigational-watch-on-merchant-vessels

OPA 90

The huge oil spill resulting from the grounding of the 'Exxon Valdez' in Prince William Sound, Alaska in March 1989 gave rise to the Oil Pollution Act of 1990 (OPA 90) being passed by the United States Congress.

OPA 90 is a comprehensive prevention, response, liability, and

compensation regime to deal with oil spills in the navigable waters of the United States. Section 4114 'Tank Vessel Manning' includes provisions for hours of work on board tankers in US waters, whereby seafarers:

"...may not be permitted to work more than 15 hours in any 24-hour period, or more than 36 hours in any 72-hour period..."

The OPA 90 provisions are noteworthy because compliance with the STCW/MLC requirements may still result in non-conformance with the 'no more than 36 hours in any 72-hour period' proviso of OPA 90 (see 'Keeping the Record Straight' below).

Enforcement

The introduction of new legislation did not dispel the growing concern amongst Port State Control (PSC) bodies. They felt that the regulations were regularly being flouted, as evidenced by a number of incidents where watch-keeper fatigue was a contributory factor.

In 2014 a joint campaign was organised by PSC organisations to verify compliance with the STCW requirements on board inspected ships. The results of this Concentrated Inspection Campaign (CIC) were published by the secretariat of the Paris MoU (the organisation comprising 27 participating PSC administrations in the Europe/ North Atlantic area). The full report can be accessed via: **CIC results | Paris MoU**. The report concluded with the statement:

"It is concerning that during the CIC, which was publicised in advance, 912 deficiencies were recorded ... related specifically to STCW hours of rest and that 16 ships were detained ... The results show that there is generally a lack of overall compliance"

Paris MoU

The Tokyo MoU, The Asia-Pacific equivalent of the Paris MoU, conducted a similar campaign. The Tokyo MoU issued a statement at the conclusion of the campaign, reminding that the CIC had been conducted in part because:

"Investigations into a number of recent incidents have identified fatigue and insufficient rest of watch-keeping personnel as key contributing factors There has been a significant loss of human life and damage to the marine environment..."

The Tokyo MoU's headline conclusion from the CIC was that there was:

"Unsatisfactory compliance with hours of rest.... Main areas of concern are hours of rest not being recorded properly and watch-keeping personnel without sufficient rest"

Tokyo MoU

IMO Resolution A.1047 (27) is reasonably clear in the guidance that it gives to Administrations for determining safe manning levels. It might therefore be assumed that compliance with the provisions of the properly issued minimum safe manning document would be enough to ensure that the ship is never

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likely to contravene the STCW hours of rest requirements.

The results of the CIC conducted by Paris MoU do not however, support that assumption, as shown in the below table, taken directly from the Paris MoU report.

A total of 4,041 ships were inspected during the CIC, yet only 21

CIC-topic related deficiencies		Inspections	Detentions CIC-topic related
		(# of inspections with this deficiency) One inspection can have multiple deficiencies	(# of inspections with this deficiency recorded as ground for detention)
1209	Manning specified by the minimum safe manning doc (SOLAS 1999/2000 Amend / Chapter V Reg. 14)	21	5
1306	Shipboard working arrangements (STCW Section A- VIII/1 (5))	145	1
1307	Maximum hours of work or minimum hours of rest (STCW Section A- VIII/1 (2))	131	1
1308	Records of seafarers' daily hours of work or rest (STCW Section A-VIII/1 (7))	445	7
9235	Fitness for duty - work and rest hours (STCW RegII/4 or STCW Reg VIII/1.1.2)	95	5

(from the above table) had deficiencies related to non-compliance with the safe manning document; compared to 445 with record-keeping deficiencies.

Compliance with the provisions of a safe manning document does not mean that a ship will also satisfy STCW/MLC requirements.

Non-compliance

The Oil Companies International Marine Forum (OCIMF) published an information paper in 2012, "Recommendations Relating to the Application of Requirements Governing Seafarers Hours of Work and Rest". The full text can be accessed online: **OCIMF - Oil Companies International Marine Forum - Information Papers.**

The OCIMF paper highlights areas of concern with regard to different bodies (principally Flag and Port States) interpreting the STCW/MLC provisions in different ways with resultant discrepancies and misunderstandings. These discrepancies can, and have, led to non-conformances being raised by PSC inspectors. A brief summary of the OCIMF findings is follows.

Suggestions on how non-conformances arising from these discrepancies can be avoided are discussed later in this briefing, in the section 'Remedies'.

24 hours

- STCW/MLC refer to minimum rest periods in any 24 hours.
- Administrations have different views on how 24 hour period should be assessed.

Non-conformance

- Statutory record keeping aimed at identifying compliance with MLC/STCW.
- Regulations silent on how non-conformances should be addressed.

Drills

- STCW/MLC say drills to be conducted so that disturbance to rest periods minimised.
- Some administrations treat drills as 'work'.
- Others treat drills as non-interruptions to rest periods.

Applicability

- STCW applicable to watchkeepers.
- MLC applicable to all seafarers, including Master.

Compensatory rest

- Seafarers called out during normal rest period should have 'adequate' compensatory rest.
- Differing interpretations of 'adequate'.

Record keeping

- STCW/MLC require records to be kept.
- Silent on required period of retention of records.

Exceptions

- STCW permits 2 exceptions from required hours of rest.
- MLC permits exceptions through flag state regulations.

Superseded text

- Some administrations still refer to STCW78.
- Leads to discrepancies in Flag State/Port State interpretation.

Minimum Manning

The OCIMF paper mentioned in the previous section goes on to make recommendations regarding minimising 6 on / 6 off watch-keeping schedules. This includes providing additional crew and the role of shore management in providing proper guidance with respect to minimising fatigue. These recommendations will be discussed in the 'Remedies' section of this briefing.

However, there is still the question of how compliance with the requirements of the minimum safe manning document can lead to difficulties (often severe) complying with the hours of rest regulations. As stated earlier, the IMO guidelines give relatively straightforward guidance to administrations regarding the factors that need to be accounted for when issuing minimum safe manning documents.

In reality, under most Flag State regimes, it is the owners and managing operators who have the responsibility to ensure that ships are adequately manned. The owner / manager completes an application form and the Flag State then issues the

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minimum safe manning certificate based on the details provided on the form. Along with specific vessel details (tonnage, dimensions, machinery, equipment, automation etc.) there is usually an additional space for owners to add details of 'trading pattern' or 'special considerations' etc.; different Flag States use different terminologies.

The IMO provision that minimum safe manning documents need to consider "...the number of qualified and other personnel required to meet peak workload situations and conditions", is not generally addressed in any great depth on the application forms or accompanying guidance notes issued by flag states. At least one Flag State's guidance notes suggest that owners and operators should consult with seafarers and/or their union representatives before submitting their manning proposals. Another Flag State goes so far as to say that minimum safe manning is deemed to be the minimum manning to allow a vessel to travel safely from one port to another and does not necessarily state the operational manning that a vessel may require to conduct any specialised operations at sea or alongside.

Although flag states undoubtedly check, to the best of their ability, that manning levels are adequate, it is ultimately the owners and/or managers that decide on the manning requirements.

Under some administrations, ships under 3,000 GT are allowed to have manning reduced to such an extent that the master has to keep a regular navigational watch. There is also a provision made for ships engaged on 'limited' (e.g. coastal) voyages to sail with reduced manning. Ships less than 3,000 GT engaged on coastal trading are often employed on extremely work-intensive trading patterns. Some ships under 500 GT may be allowed to operate with only two officers and two ratings for bridge watchkeeping.

Intensive trading patterns, reduced manning, increased work-load, stress, noise, and vibration are all common-place on ships. Taking all of the above into consideration, it is therefore perhaps unsurprising that there are so many breaches of hours of rest regulations. Nor is it surprising that we still frequently hear of ships running aground because the sole watchkeeper is so fatigued that he has fallen asleep on watch.

Research Studies

As mentioned in the 'Sole Watchkeeper' section above, The MAIB conducted a study into bridge watchkeeping safety in 2004. The study found that watch keeper manning levels are one of the causal factors in collisions and groundings.

"All of the ships which grounded as a result of a sole watchkeeper falling asleep at night through fatigue were manned in accordance with their safe manning certificates; all had just two watchkeeping officers, a master and a chief officer. This....raises serious doubt on the justifications for operating vessels with just two bridge watchkeeping officers"

UK MAIB

The report went on to say this about safe manning guidelines:

"...it must be recognised that when determining safe manning levels, ship owners and managers cannot ignore the commercial pressures of manpower costs. In the same vein, Administrations cannot ignore the pressure owners and managers can bring to bear by threatening to move their ships to Administrations which might interpret the principles and guidelines more leniently".

In November 2006, Cardiff University's Centre for Occupational and Health Psychology (COHP), supported by several UK-based shipping bodies, undertook a study into seafarer fatigue, predominantly on UK flagged vessels. The full report can be downloaded from:

<http://orca.cf.ac.uk/48167/>

The findings of that study included:

Excessive hours

- Seafarers commonly worked excessive hours.
- Falsifying of records common.

Port calls

- Frequent port calls led to greater fatigue.
- Mini-bulkers suffered worst.

Multiple factors

- Poor sleep quality increased fatigue. As did:
- Negative environmental factors.
- High job demands.
- High Stress.

In 2012, 'Project Horizon' a European Commission part-funded multi-partner research initiative was set up to scientifically investigate seafaring watchkeeper fatigue.

The full report can be down-loaded at: **Horizon Project | Our Expertise | About us | Warsash Maritime Academy**. The results of the project confirmed several high-risk situations:

Night

- Watchkeepers most tired at night and, to lesser extent, in afternoon.

End of watch

- Worst time for sleepiness - especially at night.
- Slowest reaction times at end of night watches.

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6 on 6 off

- More tiring than 4 on 8 off.
- Markedly less sleep than 4 on 8 off.
- Onset of tiredness over shorter timeframe.
- Passages through difficult waters particularly high risk.

Disturbed off-watch

- 'Disturbed' off-watch periods produce significantly high levels of tiredness.

Following Project Horizon, Project MARTHA was set up in 2014 and the final report was published in February 2017. The research and surveys in Project MARTHA were carried out by a number of educational institutions from China, Denmark, Sweden and the UK and was supported by industry group InterManager.

It differentiated between sleepiness and the other effects of fatigue. A key conclusion was that the longer a seafarer is on board a vessel, the less motivated they become and levels of stress and fatigue increase. This might sound obvious but it is important to consider these effects when crew have been on board for several months and subject to a challenging itinerary. Merely ensuring that a crew member receives the minimum legal amount of rest under STCW and MLC is not a guarantee of avoiding fatigue.

Further details can be found here:

www.warsashacademy.co.uk/about/our-expertise/maritime-research-centre/martha/home.aspx

Remedies

Fatigue has been recognised to be a serious issue affecting maritime safety.

There are systems that can be employed to minimise the risks of fatigue. These include addressing fatigue from a regulatory (record-keeping) point of view and the adoption of fatigue risk management. Taking a practical stand-point can reduce the chances of watch-keepers falling asleep and running their ships aground.

Regulatory Compliance

OCIMF, in their 2012 paper on hours of rest requirements (see 'Non-compliance' section above) made several recommendations regarding avoiding problems with port state and other inspectors engaged in reviewing ship compliance with STCW/MLC and OPA 90 requirements.

The below table summarises the OCIMF recommendations:

Any 24 hours

- Should be applied literally.
- Not linked to calendar days.
- Not linked to a fixed time.

Non-conformance

- 'Technical' non-conformances occurring in rest hours unlikely to contribute to fatigue.
- Non-conformance during work hours likely to contribute to fatigue.

Drills

- Held so as to minimise disruption to rest periods.
- Recorded as work periods.

Applicability

- Requirements apply to all on board, not just watchkeepers.

Compensatory Rest

- For crew who respond to calls in rest period.
- Added to rest period to achieve the required rest hours.
- Record time responding to alarms, etc even if a non-conformance occurs.

Record Keeping

- Retained on board in required format, signed by Master and seafarer, for entire time on board or 12 months.

Exceptions

- Only permitted per MLC provisions.
- examples include by collective agreement or arbitration.

Superseded text

- Onboard controls on hours of rest to reflect STCW 2010 amendments.

Practical Advice

Comprehensive guidance on the management of fatigue has been published by the UK Marine & Coastguard Agency (MCA) in their Marine Guidance Note MGN 505 (M), 'Human Element Guidance – Part 1, Fatigue and Fitness for Duty: Statutory Duties, Causes of Fatigue and Guidance on Good Practice', the full contents of which can be downloaded from: **MGN 505 Human element guidance-fatigue and fitness for duty - Publications - GOV.UK.**

Additionally, TNO an independent research agency in The Netherlands, together with the STC Group, Rotterdam produced a report in 2008 for the Dutch Ministry of Transport, Public Works and Water Management (now part of the Ministry of Infrastructure and the Environment) entitled 'Preventing and Managing Fatigue in the Shipping Industry'. The full **TNO report can be downloaded from: TNO Preventing and managing fatigue in the shipping industry.**

Also, in 2008 the United States Coastguard (USCG) introduced The Crew Endurance Management System (CEMS), a system of tools and practices that ship owners and operators can integrate into their safety management systems that are designed to manage risk factors affecting seafarer endurance.

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Full details of the USCG programme can be accessed at: **USCG Human Element & Ship Design Division (CG-ENG-1)**

Fatigue Management Plan

A common feature of each of the above studies into fatigue in the shipping industry is the setting up of a 'Fatigue Management Plan' (UK and Dutch terminology) or 'Crew Endurance Management System' (US terminology).

Terms such as 'Fatigue Management Tool', 'Fatigue Risk Management Tool', 'Fatigue Risk Management System', or 'Fatigue Management System' are also sometimes used to describe the same thing.

The process involved in implementing a Fatigue Management Plan for a specific vessel is, very briefly, summarised in the table below.



It is important to understand that the integration of a Fatigue Management Plan into a ship's Safety Management System should not simply consist of the addition of yet another document to the system. It should actually be a process that shifts the on-board methodology away from compliance with a prescriptive set of rules toward an integrated risk management system.

Fatigue Management Systems have been implemented in the aviation (see **IATA - Fatigue Risk Management Guide (FRMS)**) and road transport industries (particularly in Australia – see **Fatigue Management - Department of Transport - NT Government - Australia** and **Driver fatigue management**), where it has been realised that fatigue is a hazard that can be effectively managed like any other risk.

Keeping the Record Straight

Deliberate falsification of hours of work/rest records can never be condoned. There are however, many cases where non-conformances have been raised because ships' crews have made errors in their record-keeping through simple forgetfulness. There have also been cases where the software employed for on-board recording and checking of hours of work/rest has been flawed. For example in the OPA 90 anomaly cited earlier, where STCW/MLC requirements are met, but OPA 90 requirements are not, some software programs does not recognise the different requirements.

To ensure record-keeping is flawless, Members are encouraged to:

- Purchase reliable and trusted software.
- Train staff in its use.
- Have a system where each crew-member is responsible (and accountable) for accurately recording their own hours of work/rest.
- Ensure records are contemporaneous and not completed days or weeks after the event.
- Have a system of on-board checking by department heads.
- Have a system of further verification by shore-staff during audits, or by electronic transfer of records to shore office.
- Be aware that non-conformances with regulatory requirements will sometimes arise. These should be accurately recorded and fully explained.
- Ensure that records are never falsified.

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Avoiding Catastrophe

Additional measures should be implemented to ensure watchkeepers remain awake and alert:

Look-out at night

- Avoid single-handed watches in hours of darkness.

BNWAS

- Keep BNWAS, dead-man alarms etc. switched on

Stand up

- Avoid sitting on bridge chairs when on watch

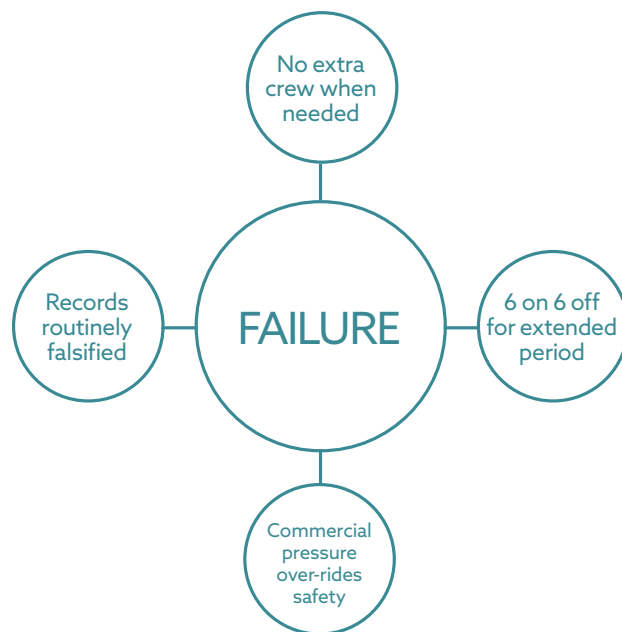
Busy periods

- Properly manage hours of work/rest during and after periods of intense activity, e.g. in-port cargo operations and dry-docking

Commitment

The implementation of a Fatigue Management Plan will only be effective if there is commitment shown by all stakeholders, from senior shore management downwards throughout the organisation. If not, then the plan will fail. Failure can be expected if:

- Rest hour regulations cannot be met, yet schedules remain unchanged and additional crew are not provided.
- Anticipated spells of heavy work-load (intensive port calls etc.) are not compensated by providing temporary additional crew for that period.
- Working 6 on 6 off for an extended period.
- Working 6 on 6 off unnecessarily (e.g. ship in port for several days with light workload).
- The master is not empowered and supported by shore management to actively enforce hours of rest regulations, including stopping the ship if necessary.
- Records are regularly falsified in order to appear to be in compliance.
- The over-riding culture is one which embraces the traditional, now obsolete maritime "can-do" attitude, which ignores the fact that fatigue is dangerous to personnel, ships, cargo and company.



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