



Australian Government
Australian Maritime Safety Authority

Fatigue Guidelines

Managing and reducing the
risk of fatigue at sea



Based on the International Maritime Organization,
Guidelines on Fatigue MSC.1/Circ. 1598.

This guide is aimed at regulated Australian
vessels and foreign flagged vessels

Published March 2020

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Source—Australian Maritime Safety Authority.

Published by:
Australian Maritime Safety Authority
GPO Box 2181 Canberra
ACT 2601.

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Foreword

In December 2018, the International Maritime Organization (IMO) Maritime Safety Committee at its 100th session approved the revised Guidelines on Fatigue (MSC.1/ Circ. 1598).

Australia has been a leading proponent of ensuring the adoption of comprehensive, science-based guidelines and contemporary approaches in the area of fatigue risk management, and has invested heavily in the development of the IMO guidelines on fatigue.

This guide is based on the International Maritime Organization Guidelines on Fatigue (MSC.1/Circ. 1598) and provides information in a simplified and useable format on the causes, consequences and management of fatigue.

This guide is primarily aimed at assisting those managing and operating regulated Australian vessels and foreign vessels. However, the principles outlined are equally applicable to other maritime operations, including domestic commercial vessels.

A high-angle photograph of a worker in an orange jumpsuit and white hard hat lying on a large coil of green rope. The worker is wearing a watch on their left wrist and has their arms crossed. The background is a dark, industrial setting.

Module **01**

Fatigue

Fatigue

Fatigue is a hazard that affects safety, health and wellbeing. It presents a considerable risk to seafarers' lives and health, property, security and the marine environment.

Fatigue is a hazard that affects safety, health and wellbeing.

Fatigue is a problem for all industries and transport modes which operate around the clock, and the maritime industry is no different. The demanding nature of shipping means that:

- » seafarers may be required to work long and irregular hours
- » seafarers may work and live away from home for weeks or months at a time, on a vessel subject to unpredictable and changing weather conditions
- » while they are serving on board, the vessel is both a seafarer's workplace and their home, so there may not be a clear separation between work and recreation. This can affect mental and emotional wellbeing.



Causes of fatigue

Table 1: Causes of fatigue

Factors	Causes
Lack of sleep	<ul style="list-style-type: none"> » staying awake for long periods » inadequate sleep opportunities » poor quality sleep and rest » fatigue accumulates when you do not get enough sleep and you do not make up for this loss of sleep.
Work and job design	<ul style="list-style-type: none"> » long work day » mentally or physically demanding tasks (prolonged mental and/or physical exertion) » unpredictable work schedules » time of day in which work takes place, particularly at night—humans are biologically programmed to be active during the day and sleep at night » few or no rest breaks » boring, repetitive work.
Environment	<ul style="list-style-type: none"> » weather (cold, hot or humid) » vessel design (light levels, vibration, location of sleeping and accommodation areas) » vessel motion » noise » operational factors such as time pressures, constant interruptions, high level of responsibility.
Individual attributes, lifestyle and home	<ul style="list-style-type: none"> » health and wellbeing (age, diet, fitness, illness) » stress » medication and substance use (alcohol, supplements, caffeine) » commuting to and from home » time with family and friends.

Sleep

Each individual has a body clock and this clock regulates the body's circadian rhythm. The body clock makes a person sleepy or alert on a regular schedule regardless of whether they are working or not. Our body clock programs us to be active during the day and to sleep at night.

In normal conditions, the sleep/wake cycle follows a 24-hour rhythm; however, the cycle is not the same for everyone.

The circadian cycle has two periods of sleepiness, known as the circadian trough and the circadian lull.

- » The circadian trough occurs typically between 0300 and 0600 (window of circadian low).
- » The circadian lull is a lesser circadian trough that typically occurs between 1500 and 1700 (the post-lunch dip).

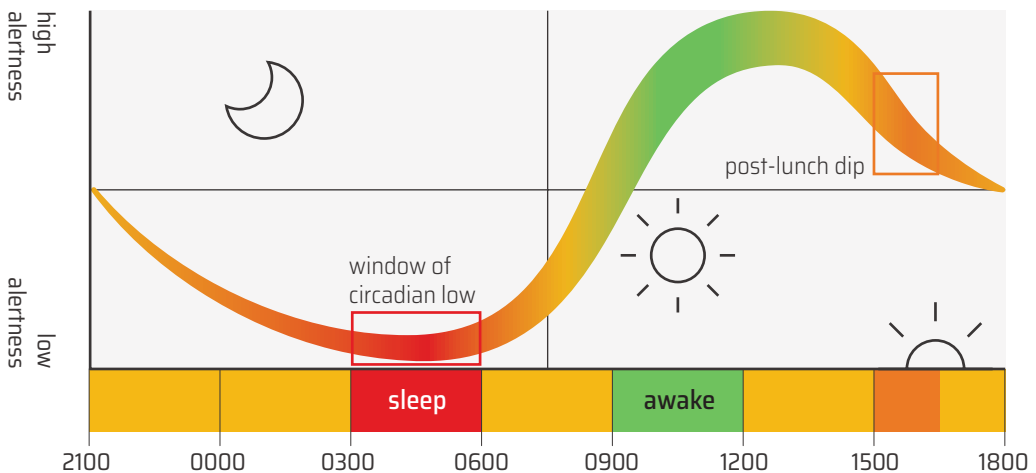
These are times we are least alert and more likely to make mistakes and fall asleep.

Consequently, the time of day in which work takes place increases the risk of fatigue. Seafarers working through the night can be expected to be sleepy, especially between 0300 and 0500, and have to make additional effort to maintain alertness and performance.

For many seafarers, working patterns conflict with their body clock. If you have to be awake and work at night, or in the early morning, or work for extended periods, it can disrupt your body clock resulting in increased fatigue.

Seafarers crossing time zones are exposed to sudden change in the day and night cycle, which again disrupts the body clock. This leads to difficulty sleeping during normal sleep hours and can be made worse by shift work.

Figure 1: Circadian rhythm



Sleep must have two characteristics to be effective in satisfying the needs of the human body:

- » **quantity** (generally seven to nine hours per 24-hour period) and
- » **quality** (sleep needs to be uninterrupted to be restorative).

Quantity

Generally, people need between seven to nine hours sleep per night to perform adequately and effectively. Any less than this may increase the risk of fatigue and impair alertness and performance.

For example, if an individual needs eight hours of sleep and only obtains five hours, they have accumulated a sleep debt. Each successive night of inadequate sleep will add to this sleep debt. Long-term sleep debt has a significant impact on personal health.

The longer a seafarer remains awake, the stronger the drive for sleep, and the higher the levels of fatigue. Long work hours are associated with poor performance and poorer safety and health outcomes.

How far you have to commute to work is also important to consider. Seafarers may have to travel or drive long distances to the vessel and then have to work, affecting their quantity of sleep.

People need between 7-9 hours sleep per night, any less than this is a compromise.

Quality

What type of sleep you have is also important. To be effective, sleep needs to be uninterrupted. Many think that if they spend eight hours in bed, they are meeting their daily sleep and rest requirements. However,

this does not take into account the number of times they wake up during the night, or the time spent tossing and turning, both of which can affect sleep quantity and quality.

Stressors such as vibration, noise, intense mental and/or physical workload, excessive working hours, separation from family and isolation, can affect whether a seafarer obtains sufficient quality sleep. If they don't, this can lead to fatigue.

In recent years, family and work demands, as well as increased use of electronic devices such as smartphones, and time spent on social media have affected sleeping habits. Increasingly, our work commitments and lifestyle pressures can create a disconnect between our individual circadian rhythms and our environment, leading to more time awake.

Many are unaware that they are suffering from sleep deprivation.

Sleep disorders, such as sleep apnoea, affect the quality of sleep. Even when individuals spend enough time trying to sleep, sleep disorders can make restorative sleep impossible. Many of those who suffer from sleep disorders are not aware of the issue, and/or have not been diagnosed or treated for their disorder.

For seafarers, this poses a higher risk, as they are exposed to restricted sleep onboard.

Individual differences

Individuals respond to fatigue differently. Under the same circumstances, different people may become fatigued at different times and to different degrees of severity. Our ability to cope also depends on our lifestyle choices, our individual health and characteristics related to circadian rhythms. Some people are 'morning' types and others 'evening' types depending on the time of day when they perform at their best.

Effects of fatigue

When you are affected by fatigue, every aspect of your physical, cognitive and behavioural performance will also be affected—such as, your ability to make decisions, your response time, judgement, hand-eye coordination and other skills. When your fatigue impairment coincides with other risks in the environment, incidents can result.

People are poor judges of their own level of fatigue, performance and decision-making.

Particularly dangerous situations at sea arising from sleep debt are commonly known as microsleeps. These are brief, uncontrolled and spontaneous sleep episodes that occur while working.

While we are poor judges of our own levels of fatigue, there are a number of tools we can use to keep track of our sleep and time awake. You can find more information within these guidelines.

Table 2 outlines some of the effects of fatigue. However, the table is not inclusive and many of these symptoms may be subtle.



Image | Kim Shiflett © NASA



Table 2: Effects of fatigue

Physical	
Performance impairment	Signs and symptoms
Involuntary need to sleep	<ul style="list-style-type: none"> » slow eyelid closures » droopy eyelids » itchy eyes » nodding off » inability to stay awake
Loss of control (bodily movements)	<ul style="list-style-type: none"> » affected speech » feeling of heaviness in arms and legs » clumsiness, tremors » difficulty with hand-eye coordination
Health issues	<ul style="list-style-type: none"> » headaches » giddiness » digestion problems » pain or cramps » insomnia » sudden sweating fits » heart palpitations/irregular heartbeat » loss of appetite



Cognitive

Performance impairment Signs and symptoms

Inability to concentrate	<ul style="list-style-type: none"> » unable to organise a series of activities » preoccupied with a single task » focuses on trivial issues, neglecting more important ones » reverts to ineffective habits » less vigilant than usual » decline in ability to solve complex problems » lapses of attention
Diminished decision-making ability	<ul style="list-style-type: none"> » misjudges distance, speed, time etc. » fails to appreciate the gravity of situations » overlooks items that should be included » selects risky options » greater indecisiveness
Poor memory	<ul style="list-style-type: none"> » fails to remember sequence of task, events or procedures » forgets to complete a task or part of a task » memory lapses
Slowing of cognitive process	<ul style="list-style-type: none"> » responds slowly (if at all) to normal, abnormal or emergency situations



Behavioural	
Performance impairment	Signs and symptoms
Mood change	<ul style="list-style-type: none">» quieter, less talkative than usual» unusually irritable» decreased tolerance and anti-social behaviour» depression
Attitude change	<ul style="list-style-type: none">» fails to anticipate danger» fails to observe and obey warning signs» seems unaware of own poor performance» more willing to take risks» displays a 'don't-care' attitude» less desire to socialise» increasing omissions» low motivation

Legislation

The following instruments contain related requirements on fatigue:

- » Principles of minimum safe manning (resolution A.1047[27])
- » Fatigue factors in manning and safety (resolution A.772[18])
- » *Guidelines on Fatigue* (MSC.1/Circ. 1598)



International Maritime Organization (IMO)

International Convention on Standards of Training Certification and Watchkeeping for Seafarers (STCW):

- » Regulation VIII/1 (Fitness for duty)
- » Regulation VIII/2 (Watchkeeping arrangements and principles observed)



International Safety Management (ISM) Code

- » Section 1.4 - Safety management system requirements



International Labour Organization (ILO)

Maritime Labour Convention (MLC), 2006

- » Regulation 2.3 Hours of work and rest
- » Regulation 2.4 Entitlement to leave
- » Regulation 2.7 Manning levels
- » Regulation 3.1 Accommodation and recreational facilities
- » Regulation 3.2 Food and catering



Module **02**

Fatigue and the company



Fatigue and the company

Module 2 contains guidance for the company in assessing, mitigating and managing the risk of fatigue in operational environments.

Fatigue and shipboard operations

Research has established a clear link between fatigue and accidents at sea. If companies address fatigue proactively, it will improve personnel safety. Managing fatigue effectively also has the potential to cut costs for the company by reducing injury and downtime because of accidents, as well as physical damage to high-value assets and the environment.

The company should provide adequate support for managing the risks of fatigue at both the organisational and operational levels.

Fatigue and company influence

While it is not possible for the company to regulate and oversee the sleeping habits of every seafarer on every vessel, it is within its capability to mitigate the risks of fatigue through vessel design, operational and crewing policies.

The *Principles of minimum safe manning (resolution A.1047[27])* provides for an assessment of the tasks, duties and responsibilities of the vessel's complement to ensure that crewing levels are adequate at all times to meet all conditions and requirements, including peak workload situations and emergency conditions.

Prescriptive formulas for hours of rest are set out in chapter VIII of the STCW. When applying these hours of rest, the company should take into account the effects of circadian rhythm and sleep debt because these are important for ensuring that rest and sleep periods are of high quality.

'Rest' periods mean just that—rest, not substituting a different form of work.

Appropriate crewing, resources, processes and policies should ensure that the management of fatigue risk supports safe, compliant and productive operations.

Importantly, fatigue risk control measures forming part of the company support should:

- » identify and assess fatigue risks
- » assess operational workload requirements in accordance with the *Principles of minimum safe manning (resolution A.1047[27])*
- » ensure that crewing and resources are adequate and available for assessed workload requirements to operate the vessel safely
- » ensure company-wide awareness of the risk of fatigue
- » ensure a healthy shipboard environment.

Table 3: Framework to mitigate the risk of fatigue

Hazard assessment	Risk mitigation
A. Is the company providing effective support for managing the risks of fatigue?	<ul style="list-style-type: none"> » fatigue awareness and training » adequate resources including crewing » healthy shipboard environment
B. Are seafarers provided with adequate sleep opportunity? (Quantity and quality)	<ul style="list-style-type: none"> » hours of work and rest requirements » duty scheduling and planning » workload management » work and living environment
C. Is the sleep seafarers obtain adequate? (Quantity and quality)	<ul style="list-style-type: none"> » company and seafarer responsibility
D. Are seafarers able to maintain adequate alertness and performance while on duty?	<ul style="list-style-type: none"> » self- and peer-fatigue monitoring ensuring 'fit for duty'
E. Are fatigue-related events (near misses and accidents) reported and analysed?	<ul style="list-style-type: none"> » fatigue reporting and analysis

Risk-based approach



Image | Iakov Filimonov

A. Company support for managing the risks of fatigue

The company should consider the following:



ISM Code requirements for clear, concise guidance on operational procedures on board.



Ensure adequate resources, including crewing levels.



Promote a safety reporting culture—with open communication and no fear of reprisal.



Ensure joining seafarers are adequately rested before assuming duties.



Schedule time for proper handover on crew change.



Voyage length, time in port, length of service and leave ratios.



Multicultural issues—language barriers, and social, cultural and religious isolation.



Interpersonal relationships, stress, loneliness, boredom, social deprivation and increased workload because of small numbers of crew.



Provide shore leave and onboard recreation, family communication.



Watchkeeping arrangements.



Rotate jobs, if practicable.



Ensure adequate sleeping berths and accommodation.



Ensure adequate quality and quantity of food for proper nutrition.



Modification of present vessel design, or future designs, if necessary.

A.1 Fatigue awareness and training

It is essential that the company ensures all personnel receive appropriate fatigue awareness training. This should be initial training when they join the company, as well as ongoing recurrent training. This includes shore-based personnel (such as those involved in resource planning, crewing levels, and duty scheduling) whose decisions influence how fatigue is managed and fatigue-related processes. Importantly, their decisions have the potential to affect seafarers' fatigue levels and consequently shipboard safety.

The company should provide adequate resources to balance work and task demands

A.2 Adequate resources (including crewing levels)

Having sufficient resources, including crewing, is one of the primary determinants of seafarers' duty hours, workload, duty scheduling, average time off duty, and other key factors that can influence or elevate fatigue. To reduce the risk of fatigue across shipboard operations, the company should ensure that it provides adequate resources to balance work and task demands (or deal with an unexpected surge).

Not only should crewing levels match the operational workload on board the vessel, but this workload should also be managed efficiently. Effective operational planning is critical to ensuring adequate resources are available at all times, so that operational and other demands placed on the vessel and its crew can be managed safely and effectively. Operational workload is determined through an assessment by the company.

Although the master is responsible for managing the vessel and its crew, the company should provide adequate support and resources to the master to ensure they can manage shipboard duties and operations safely and effectively.

A.3 Healthy shipboard environment

Seafarers not only work, but also live on board a vessel. Ensuring a healthy shipboard environment is crucial to minimising the risks of fatigue, including:



SLEEP

The shipboard sleeping environment should provide for comfortable and good quality sleep (bedding, pillows, mattresses, adequate light management, etc).



STRESS

Adequate shipboard measures are in place to recognise and ensure appropriate support to seafarers suffering from stress.



EATING

Healthy nutritious food is available and served on board, and crew have unlimited access to drinking water.



EXERCISE

Provide adequate exercise facilities (such as well-designed and equipped training facilities and outside spaces) to ensure seafarers can maintain a healthy lifestyle on board.

B. Adequate sleep opportunity

Ensuring seafarers have adequate opportunities to sleep is key to managing fatigue effectively. It cannot be assumed that simply allocating a rest period from duty will provide an adequate level of sleep and recovery.

The length of the rest period is only one key factor. The relationship between the recovery value of off-duty periods and the actual amount of sleep people get onboard is increasingly complex.

B.1 Duty scheduling and planning

Duty scheduling and planning is critical in managing fatigue. The company should ensure its duty schedules provide adequate opportunity for sleep.

It is important to calculate, on average, whether a given duty schedule enables adequate sleep opportunity.

There are seven primary duty scheduling considerations:

01. Work hours (work periods)

As the length of a given period of work increases, the subsequent sleep opportunity decreases. Research has demonstrated that, apart from reducing performance, extended hours of work are also associated with reduced individual wellbeing and organisational commitment, as well as poor health outcomes. Administrative work, shipboard drills, training, vessel loading and unloading tasks may all affect seafarers' opportunities to gain adequate sleep. Research has also demonstrated a link between these factors and declining levels of productivity and safety.

02. Rest hours (rest periods) between work periods

This is the length of time off between work periods. Seafarers do not simply fall asleep as soon as they are off duty, and wake just before they go back on duty. Seafarers, like shore-based workers, have many activities and responsibilities to manage between work periods such as eating, showering, socialising, relaxing, studying and communicating with family and friends back home. Therefore, rest hours should provide for adequate sleep opportunity, time to complete those other tasks, be adaptable to the individual circadian rhythm and account for the effects of sleep inertia (grogginess and/or disorientation for up to 20 minutes after waking). The interval between two successive work periods should allow sufficient time to obtain adequate sleep, before the start of the next work period.

03. Night watches or work

Seafarers working during the night, specifically during the circadian low, can experience severe performance degradation. If the seafarer maintains a regular schedule, they may adapt over time. However, it is important to provide seafarers working at night with a good sleeping opportunity and environment during the day.

04. Short rest breaks within work periods

Short rest breaks benefit performance and help maintain alertness. One of the most important determinants of fatigue is 'time on task'. Frequent short breaks (when the timing of rest is at the discretion of the individual) result in better fatigue management. This may not always be feasible in a shipboard environment, but task rotations and substitutions can reduce the 'time-on-task' effect during the work period.

05. Naps

Naps are an effective countermeasure to fatigue, exhaustion from long work hours and restricted sleep. Whether before an anticipated short night's sleep or after, brief naps improve performance and alertness, and delay fatigue-induced performance degradation. Research has shown that the benefits of controlled napping outweigh the potential risks associated with sleep inertia.

If practicable, companies should consider napping and short-break policies to manage fatigue. Companies should also acknowledge impairment through sleep inertia (grogginess and/or disorientation for up to 20 minutes after waking) when planning tasks and activities, giving adequate time for seafarers to be alert before performing critical tasks.

06. Recovery sleep

Providing sufficient recovery time following periods of sleep debt is important. Minimum rest periods might not be sufficient for seafarers to recover from fatigue, particularly if the scheduled rest periods do not consider the body's circadian rhythm. To work safely across a given duty, and return to the next work period sufficiently recovered, means the seafarer must obtain an adequate quantity and quality of sleep between work periods. Sleep opportunities during the circadian low are preferable, because that's when we humans are supposed to be asleep, and sleep at this time is therefore more recuperative.

07. Reset breaks (long periods of rest or extended leave)

As the risk of fatigue increases over successive workdays of sleep debt, some 'recovery' must take place over spans of rest days. This is typically an issue at sea as seafarers are exposed to potentially arduous duty schedules for long periods of time (in excess of seven days, sometimes months on end) without having a reset break. This may be a factor to consider when determining crew rotation.

Tools to assess fatigue in scheduling

Planning duty schedules based on fatigue science and operational requirements allows for predictive identification of fatigue hazards. In turn, this assists in allocating adequate rest periods that provide sufficient opportunity for sleep.

Some useful tools for mitigating and controlling fatigue are:

- » Fatigue risk assessment tools, used to assess the risk level of a specific duty schedule via a fatigue risk score.
- » Fatigue predictive software tools. These use related software to predict fatigue levels for specific operations, and can be useful additional tools for managing fatigue risks.

Use these tools in conjunction with other operational data. Do not use them in isolation, or allow them to be the main driver in duty-scheduling decisions, as

they are not sufficient to determine the full extent of fatigue-related risk. Their main purpose should be limited to identifying potentially fatigue-inducing duty schedules or scheduling hot spots, allowing for better decision making in selecting duty schedules.

Seafarer fatigue is the result of the actual work, not the planned work.

There are numerous unforeseen circumstances that can cause changes to planned schedules; for example, weather conditions, unexpected technical problems, or seafarer illness. Another proactive approach for identifying fatigue hazards is to analyse actual operational duty schedules.

Table 4 below is a handy fatigue risk assessment tool that can be used to assess the risks associated with a particular duty schedule.

Table 4: Fatigue risk assessment

Risk factor	Lower risk	Significant risk	Higher risk
Total work hours per 7 days	<50	50-70	>70
Hours of work (per 24-hour period)	<9	10-12	>12
Hours of rest (between duty periods)	>12	7-12	<7
Number of consecutive night duties per 7 days (between 2100-0900)	0-1	2-3	>4
Number of short breaks around 15 minutes (within duty periods)	>3	1-2	0
Reset breaks in hours (continuous long break per 7 days)	>30	24-30	<24

Duty schedule design principles

The following research-based performance principles should underpin the design of duty schedules:



Plan duty (work) schedules based on the actual hours worked.



Use forward rotation such as day-afternoon-night shift changes.



Develop a working-hours policy on daily duty hours and maximum average weekly hours. If possible, a work week should not exceed 70 hours.



Use fatigue assessment tools and/or fatigue prediction software to verify new duty schedules are within safe limits.



Minimise occasions in which seafarers work more than 12 hours in a duty period per 24 hours.



When possible, eliminate the use of night time work for non-essential tasks or activities (i.e. between 0000-0600).



Limit the use of overtime, especially unscheduled overtime. Avoid working arrangements that provide incentives to work excessive hours.



When possible, schedule complex tasks for daytime (i.e. not between 0200-0600, or to a lesser degree, between 1500-1700).



Ensure that any period of extended work hours is compensated with a longer break before resuming the next duty period.



Avoid scheduling high-risk tasks on the first night of a night watch duty period. If unavoidable, when planning the task consider additional controls.



Account for 'covering' contingencies caused by sea sickness or illnesses.



Allow seafarers who work regular nights, periods of normal night's sleep to catch up on their sleep deficit.



Factor in sleeping, eating, washing and wind-down time in rest periods.



Ensure rest periods allow for a minimum of six hours uninterrupted sleep.



When a minimum of 7-9 hours of sleep is not possible, compensate for any sleep loss with daily naps of up to 90 minutes in length (allowing 30 minutes between a nap and returning on duty for sleep inertia).



Provide for short breaks during duty periods (coffee, meals etc.). If possible, allow individuals to manage their own short breaks.



When possible, provide reset breaks of 25 consecutive hours every 7 days in which unrestricted sleep is possible.

In some cases, these design principles will not meet operational demands, so companies must ensure they manage any risks appropriately. For example, permanent night work arrangements may achieve the outcome of minimising night shifts for others.

Similarly, long cycle night shifts followed by long breaks, may be used to provide predictability in work scheduling.



Image | Chris Beerens © Commonwealth of Australia

B.2 Workload management

The mental and physical demands of work can contribute to a seafarer's fatigue impairment in a number of ways. Concentrating for extended periods, performing repetitious or monotonous work, and performing work that requires continued physical effort can increase the risk of fatigue.

Mental fatigue and physical fatigue are different; but a seafarer can experience them at the same time. It is important to be aware of a seafarer's optimal level of workload and stress, and to have realistic attitudes towards these.

Understanding that different people react differently to stressful situations is critical for adequate interventions. Communicating effectively with seafarers, and monitoring and observing any behaviour that may indicate a change to a seafarer's fatigue, as a result of workload, are important.

Typical techniques for managing workload while on duty include prioritising, delegating, rotating, and shedding tasks, as well as crew rotation. Some useful risk mitigation strategies to manage workload include:



Carefully considering task design according to the workload and the available resources, including crewing.



Reducing the time seafarers need to spend doing sustained physically and mentally demanding work (for example tank cleaning, navigation through congested waters).



Managing workload and work-pace change caused by machinery breakdowns, planned and unplanned sickness and illness.



Minimising routine and administrative tasks, or redesigning them to ensure seafarers can focus on core duties in their working time.



Minimising repetitive or monotonous tasks by rotating tasks.



Deferring non-urgent work to allow appropriate rest and recovery if necessary.

B.3 Work and living environment

The work and living environment is important for ensuring seafarers have an adequate opportunity for quality sleep.

Countermeasures the company can take to ensure seafarers have an adequate opportunity for quality sleep range from environmental, to procedural and operational changes; for example: addressing environmental aspects such as noise, during vessel design. However, there are control measures the company can implement to assist in reducing noise levels in the sleeping environment.

Environmental control measures may include, but are not limited to:



Adequate facilities for rest, sleep and meal breaks and other essential requirements, such as bathroom facilities and personal storage.



Making sleeping areas darker, quieter and more comfortable by:

- » supplying good quality and comfortable bedding such as mattresses and pillows.
- » providing a darkened sleeping atmosphere, by using blackout blinds for portholes or berths in sleeping spaces.
- » installing insulation baffles over cabin-door louvres.
- » improving air conditioning (ambient temperature) and air flow.



Making sleeping spaces, including their location, a priority in both retrofitting and new vessel construction.



Ensuring adequate personal storage space is available for seafarers' personal effects.

Procedural and operational control measures may include, but are not limited to:



Increasing access to healthier food choices by ensuring nutritious food is served on board.



Providing information and advice on healthy eating and physical wellbeing.



Making exercise equipment and facilities available to seafarers.



Providing and maintaining a quiet atmosphere for sleep, developing a 'do not disturb' policy for sleeping seafarers, with appropriate signage.



Where practicable, carrying out drills in a way that minimises rest periods' disturbance (as they can be extremely disruptive).



Including short breaks within duty periods, and implementing napping policies.



Ensuring vessel routines, especially meal times, align with seafarers' working schedules. This includes providing personnel working at night with appropriate meal choices.



Providing access to counselling services to assist in any issues arising from the disruption to individual, family or social patterns, and shipboard-related aspects. Implement a consistent stress management program.



Implement a policy to support seafarers experiencing high levels of workload.



If possible, avoid assigning seasick and ill seafarers work.



If possible, provide all seafarers with shipboard phone, internet and email access.



If possible, ensure that maintenance work does not disrupt sleeping personnel.

C. Adequate sleep obtained

Situations may arise where a seafarer has sufficient opportunity to sleep, but they may still not get adequate quality sleep. While an adequate sleep opportunity provides an indication of the likely quantity of sleep, it is important to know whether the seafarer has had enough sleep. Give seafarers the opportunity to report when they have not been able to get enough sleep, or feel at risk of making fatigue-related errors, without repercussions.

It is the seafarer's responsibility to ensure that they take the opportunity provided to get enough sleep, so they are alert and capable of doing their assigned work safely.

However, there are reasons why seafarers may not get adequate sleep.



A seafarer working during the night may have difficulty getting quality sleep.



On joining the vessel, a seafarer may experience difficulty adjusting to the sleep schedule.



Seafarers with a long commute to the vessel should not have to report to work until they have had enough rest.



Undiagnosed and untreated sleep disorders.



Emotional stress.



The sleeping environment (for example: comfort, noise, darkness, vessel motion, privacy, room location).



The type of food consumed.



Medication, or use of prescribed/over-the-counter/natural remedies.



Consumption of stimulants such as caffeine and amphetamines.



Using personal electronic devices before sleep, and the amount of 'screen time', which may make it hard to get to sleep, and affect the amount of sleep.

The factors mentioned above can all affect the quantity and quality of sleep obtained.

Regardless of what causes this insufficient or poor-quality sleep, it is important to recognise these factors as potential shipboard hazards.

D. Ensuring adequate alertness and performance while on duty

Ensuring seafarers are fit for duty and that they are able to maintain safe levels of alertness and performance is important. Even when seafarers have had sufficient opportunity for sleep, and 'sleep monitoring' shows they have had enough sleep, some seafarers may still show signs of fatigue.

This can occur when seafarers are working at night. The circadian drive dictates that during this time seafarers will experience the highest levels of fatigue.

Companies should use sleep monitoring in conjunction with the monitoring and evaluation of fatigue. They should also implement relevant fatigue management monitoring and evaluation procedures within the vessel's safety management system.

There are several tools for monitoring and assessing levels of fatigue. The company will have to strike a balance between gathering enough data to be confident they can make appropriate decisions on control measures, and the additional demands that data collection can place on seafarers. Examples of simple fatigue assessment tools such as self-monitoring, peer monitoring and fit-for-duty checklists are included in this guidance material for consideration.



Image | International Maritime Organization

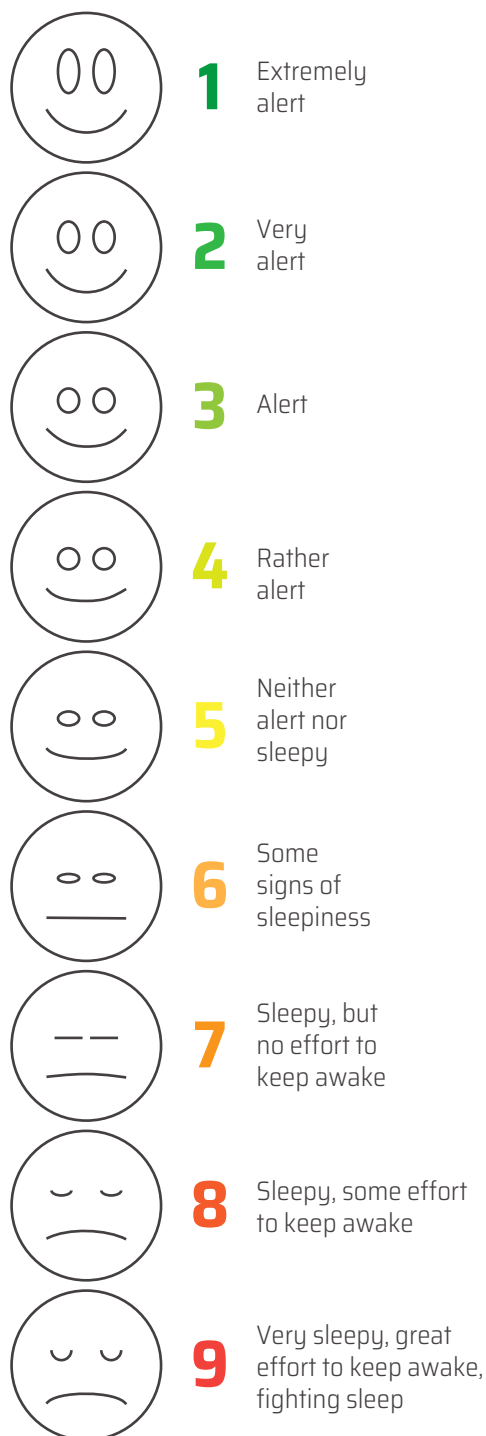
Examples of fatigue assessment tools

Self-monitoring through subjective fatigue and sleepiness ratings

Subjective sleepiness and fatigue ratings are particularly useful for gathering data quickly to decide whether additional fatigue risk management strategies are needed.

The Karolinska Sleepiness Scale (KSS) is the most widely used fatigue monitoring scale in maritime studies. It has been scientifically validated and is designed to be completed at multiple points within and across days. Using these standard scales enables comparison of fatigue and sleepiness levels between vessel operations within the same company. This can be helpful in deciding where controls and risk mitigation are most needed.

Figure 2: Karolinska Sleepiness Scale



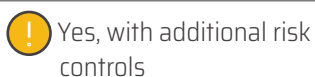


Fatigue self-assessment tool

This easy-to use fatigue assessment tool takes a minute to fill out. It supports the seafarer in identifying their fatigue, and provides an easily implemented risk assessment and control strategy. The tool can be used individually or during handover.

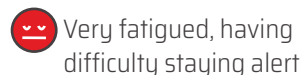
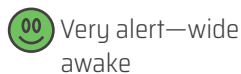
Fitness for duty

Do you believe you are fit for duty?



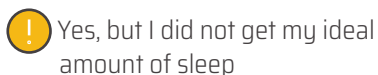
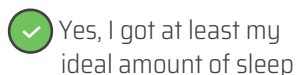
Current fatigue state

How do you feel right now?



Sleep quantity

Did you sleep in the last 24 hours?



Sleep quality

How would you rate the quality of that sleep?



Signs of fatigue

Have you experienced any physical signs of fatigue immediately before or during this duty period (i.e. microsleeps)?






Have you experienced any mental signs of fatigue immediately before, or during, this duty period (i.e. difficulty concentrating)?



How to use this tool

With respect to the previous questions, the colour of the answers indicates the fatigue category and the action(s) required in the next table.

- » If your answers are **Green**, your fatigue category is Green
- » If **one or more answer is Amber**, your fatigue category is Amber
- » If **one or more answer is Red**, your fatigue category is Red

Fatigue category	Action required
 Red	As soon as it is safe to do so, suspend any safety critical tasks that have been started. Report now to your immediate supervisor or master.
 Amber	Before commencing your duty period or assigned tasks, or before continuing work on a task that has been started, report to your immediate supervisor or master, and implement fatigue risk controls as required.
 Green	Monitor for signs of fatigue, no additional risk controls required.

D.1 Peer monitoring

Seafarers can use the fatigue signs and symptoms table in Module 1 as a peer monitoring tool to assess if any fatigue signs and symptoms are observed in their peers. Alternatively, seafarers can monitor their peers using the ‘fatigue self-assessment’ tool discussed above. For example, during duty handover, the outgoing officer-of-the-watch can ask the incoming officer-of-the-watch whether they have had adequate sleep and they are fit for duty, using the ‘self-assessment’ tool as a checklist.

E. Reporting of fatigue-related events

A company's fatigue risk management approach should include systems to promote reporting of fatigue related events. This identifies instances where fatigue related events (such as accidents and incidents) have occurred and feeds any lessons learned back to strengthen higher level controls and decision making.

Feedback on reports about fatigue related events can assist the company in improving fatigue management onboard. It is vital to keep all seafarers and the company informed about fatigue hazards in day-to-day operations. A series of similar fatigue reports can trigger further investigation.

Part A, Section 9.1 of the ISM Code includes reporting provisions within the vessel's safety management system '*ensuring that non-conformities, accidents and hazardous situations are reported to the company, investigated and analysed with the objective of improving safety and pollution prevention*'. Section 9.2 of the ISM Code also includes the following provision: '*the company should establish procedures for the implementation of corrective action, including measures intended to prevent recurrence*'.



Image | Chris Beerens © Commonwealth of Australia

Implement reporting of fatigue-related events through relevant safety management system procedures, and encourage seafarers to report events:



Through a voluntary reporting system, when something in the operating environment is likely to impact their, or other seafarers', alertness to such an extent that safety margins could be reduced to unsatisfactory levels.



Through the vessel's reporting system, when there has been an incident or accident where fatigue may have been a contributory factor. To facilitate this, have a fatigue reporting facility or prompt on the company's incident reporting forms.

Companies' responses and attitudes towards reporting of fatigue-related events affect crew motivation to report fatigue, and the subsequent effectiveness of hazard identification processes. Hence, the promotion of a safety reporting culture is important.

An effective reporting culture is one which makes it easy to report, is free from retribution and gives timely feedback about the reports submitted. Companies are recommended to:



use forms that are easy to access, and quick to complete and submit.



have clearly understood rules about confidentiality of reported information.



have clearly understood voluntary reporting protection limits.



include regular analysis of reports.



provide regular feedback about decisions or actions taken based on the reports and lessons learnt.

Lessons learnt from incidents and events play a vital role in helping to develop fatigue risk management strategies for the workplace. They are useful in reinforcing awareness of fatigue among seafarers. Some of these reports and incidents, together with lessons learnt, could be circulated on a ship-by-ship basis. Distributing these lessons learnt will allow administrations, companies and seafarers to demonstrate their commitment to the awareness and prevention of fatigue.

Example of a fatigue event report form

This example provides recommended information that can be included in fatigue event reporting. Companies may decide to incorporate this information within their current incident reporting system.

Fatigue event report	
Name	
When did it happen? (time of event)	
What happened? (describe the event)	
Describe how you felt, (or what you observed)	
Please circle how you felt when the event occurred	1. Extremely alert 2. Very alert 3. Alert 4. Rather alert 5. Neither alert nor sleepy 6. Some signs of sleepiness 7. Sleepy, but no effort to keep awake 8. Sleepy, some effort to keep awake 9. Very sleepy, great effort to keep awake, fighting sleep
Fatigue before duty?	<input checked="" type="radio"/> Yes <input type="radio"/> No
Fatigue during duty?	<input checked="" type="radio"/> Yes <input type="radio"/> No
Disrupted sleep?	<input checked="" type="radio"/> Yes <input type="radio"/> No
Other comments	
What did you do? (actions taken to manage or reduce fatigue)	(For example: nap, had a break)
What could be done? (suggested corrective actions)	



Module **03**

Fatigue and the seafarer



Fatigue and the seafarer

Module 3 contains practical information intended for the seafarer, master, officers, ratings and all other shipboard personnel.

Although the company is primarily responsible for creating a work and living environment that minimises fatigue-related risks, seafarers also have responsibilities. They must ensure that they use the time available for rest and sleep appropriately, and that their behaviour does not create or increase the risk of fatigue.

Recognising fatigue

When we are fatigued, we are poor judges of our own level of fatigue and performance, because fatigue affects that very ability to make decisions or solve complex problems.

There are three categories of fatigue-related signs and symptoms: physical, cognitive, and behavioural (see module 1). Seafarers may recognise some of these in others and, with time, learn to identify some of the signs and symptoms within themselves. These signs and symptoms of fatigue may also identify an individual's level of alertness.



Image | Sarah Myers

Some of the more apparent signs and symptoms include:



PHYSICAL

- » inability to stay awake (head nodding, or falling asleep involuntarily)
- » difficulty with hand-eye coordination
- » speech difficulties (slurred, slow or garbled)
- » increased frequency of dropping objects, like tools or parts
- » digestion problems



COGNITIVE

- » focusing on a trivial problem, neglecting more important ones
- » slow, or no response, to normal, abnormal or emergency situations
- » lapses of attention
- » poor judgement of distance, speed, time etc.
- » forgetting to complete a task, or part of a task
- » difficulty in concentrating and thinking clearly



BEHAVIOURAL

- » decreased tolerance, and/or anti-social behaviour
- » irregular mood changes (irritability, depression)
- » ignoring normal checks and procedures
- » increasing mistakes and carelessness

Long term, sleep loss may lead to cardiovascular diseases, gastrointestinal diseases, mental health problems and stress.

The more signs and symptoms seafarers observe in others or themselves, the more likely it is they will notice a significant reduction in alertness. Fatigue is not the only cause of such symptoms, but when several occur together, it is likely to indicate fatigue-related impairment.

If seafarers recognise that they, or a fellow crew member is fatigued, it is important they notify their crewmates and supervisors.

Open communication about fatigue detection and prevention is critical—seafarers need to feel comfortable about having such conversations.

Reducing and managing the risk of fatigue

The most effective strategy to mitigate fatigue is getting enough quality sleep.

The company should provide seafarers with an adequate sleep opportunity for recovery. If seafarers have insufficient sleep over several consecutive days, their alertness will be impaired—only sleep can maintain or restore performance levels.

Sleep is most valuable if obtained in a single block. While a nap can provide a powerful boost to your alertness, it does not eliminate the need for longer periods of sleep.

There may be instances when seafarers may not obtain adequate sleep, even when provided with the opportunity (see module 2).

Regardless of what circumstances are causing insufficient or poor-quality sleep, it is important to recognise these as potential shipboard hazards.

The company should have processes in place to provide seafarers with the opportunity to report situations when they have been unable to obtain adequate sleep, or feel at risk of making fatigue-related errors. Especially if the tasks they are doing are safety critical, it is important that seafarers can report without fear of reprisal. This can be as simple as reporting verbally to supervisors, to management and/or the vessel's safety committee.



Developing good sleep habits

There are some simple strategies you can adopt to develop good sleep habits:

- » Have consistent sleep times; for example, try to go to bed at the same time every day
- » follow a pre-sleep routine to promote sleep at bedtime; for example, have a warm shower, read calming material, or just make a ritual of pre-bed preparation
- » get enough sleep, especially if you're going into a time when you know you may not have the opportunity to get sufficient sleep
- » avoid stimulating activities before sleep such as exercise, television and movies
- » make your environment conducive to sleep, by
 - › having a dark, quiet and cool environment and a comfortable bed
 - › having a white noise generator or earplugs can be useful
 - › blocking out as much light as possible. This might involve using blackout curtains, roller shutters, heavy blinds, or an inexpensive option such as black plastic
 - › wearing a sleep mask
- » as much as possible, ensure there will be no interruptions during your sleep
- » avoid alcohol, caffeine and other stimulants before bedtime (remember: coffee, tea, soft drink, chocolate and some medications, including cold remedies and aspirin, contain alcohol and/or caffeine). Avoid caffeine at least four hours before bedtime
- » use relaxation techniques, such as meditation
- » do not nap if you have difficulty sleeping during your normal sleep period
- » avoid eating right before sleeping
- » limit use of electronic devices that emit blue light before bedtime, such as smartphones.

Maintaining fitness for duty

Seafarers must be fit for duty and able to maintain safe levels of alertness and performance.

It can be helpful to monitor and assess seafarers' levels of fatigue before commencing work to ensure they are able to perform tasks safely. As discussed in module 2, there are a number of tools that can be used to assess how seafarers feel before and during their duty period, such as self-monitoring or fatigue assessment tools.

It is important to report (to supervisors and/or management levels) any instances in which seafarers feel that safety could have been, or would be, compromised due to fatigue impairment in either themselves or their peers.

Get proper sleep to recover physically and mentally.

There are some strategies that may help seafarers maintain their fitness for duty:

- » take strategic naps (the most effective length of time for a nap is about 20 minutes)
- » take advantage of scheduled breaks
- » monitor and effectively manage sleep
- » maintain and monitor fitness for duty, including medical fitness
- » report any fatigue impairment in yourself and others that may have the potential to affect vessel safety
- » record and report actual hours of work and rest as required by the MLC and the STCW Conventions
- » eat regular and well-balanced meals
- » exercise regularly
- » limit the use of medications that may affect levels of alertness and performance, including seasickness medications (if you take such medications, you should inform the shipboard supervisor accordingly).

Countermeasures can provide some relief in managing fatigue. However, these will not restore your alertness, they only provide short-term relief and may simply mask the symptoms. At some stage, you need full and proper sleep to recover physically and mentally.

Short-term countermeasures

Short rest breaks within duty periods

Short breaks or changes in activity can provide rest during the duty period. Rest breaks are helpful when maintaining performance over long periods. Factors influencing the need for rest include:

- » length and intensity of the activities before a break or a change in activity
- » length of the break
- » nature or change of the new activity.

Strategic napping

Research has identified strategic napping as a short-term relief technique to help maintain performance levels during long periods of wakefulness. Naps as short as 10 to 15 minutes can deliver measurable benefits and are helpful in maintaining performance if a seafarer has not had a sufficient longer sleep. They should be encouraged as part of a planned activity of fatigue management and prevention.

The most effective length of time for a nap is about 20 minutes.

Seafarers should take naps in the way they believe best suits them. However, there are some drawbacks associated with napping. One such drawback is that naps longer than 30 minutes will cause sleep inertia (grogginess and/or disorientation for up to 20 minutes after waking). A second potential drawback is that the nap may disrupt later sleep (a person may not be tired when the time comes for an extended period of sleep).

Caffeine

Another popular fatigue countermeasure is the strategic use of caffeine (encountered in coffee and tea, and to a lesser extent in soft drink and chocolate) as a stimulant. Caffeine can improve alertness temporarily, but it is not a substitute for adequate sleep and rest. It takes caffeine 15 to 30 minutes to take effect, and caffeine levels drop by half every five or six hours. Its effects can last long after consumption, and may interfere with needed sleep. It is important to consider that there are individual differences in the effects of caffeine, tolerance and withdrawal. It is best to avoid caffeine before bedtime. Regular usage over time also reduces its value as a stimulant, and may increase tiredness and reduce your ability to sleep. Caffeine consumption can also cause other side effects, such as hypertension, headaches, mood swings and anxiety.

Nutrition and hydration

Adequate nutrition and hydration is important for managing and preventing fatigue. Ideally, seafarers should have a balanced diet, eat regularly, consume healthy snacks, plan meals, drink water regularly, and avoid meals just before bedtime (this can result in slower digestion). The recommended daily intake of water is two litres or eight glasses. Monitoring fluid intake helps to optimise alertness and wakefulness.

Environment

Bright lights, cool dry air, obtrusive or loud music, or other annoying irregular sounds may temporarily increase alertness.

Physical activity

There are a number of key components to physical wellbeing, such as exercise, diet, hydration and sleep. Any type of physical activity helps to maintain alertness and can improve sleep: including running, walking and stretching. Even chewing gum can stimulate your level of alertness. Looking after yourself physically has a number of benefits, including reserves of energy during the duty period, consistent and restful sleep patterns, a proper concentration span and a satisfying sense of feeling healthy. Regular exercise also improves mood, makes you better at coping with stress, and enhances your self-esteem and general wellbeing.

Social interaction

Social interaction—having a conversation with a crew member—can help seafarers stay awake. However, to be effective, it needs to be a two-way, interactive conversation.

Job rotation when practicable

Changing the order of activities is a good technique for breaking job monotony, such as mixing tasks requiring high physical or mental work with a low-demand task.

When feeling fatigued, seafarers may adopt individual fatigue countermeasures, such as walking around, and/or using caffeine or stimulants, to reduce the likelihood of fatigue-related errors. However, there may be instances when countermeasures will not mitigate a high level of fatigue.

Management level seafarers, supported by the company, will need to take prompt, consistent and appropriate action whenever a seafarer is potentially not fit for duty. This may include the need for additional actions, such as task rotation and organising supporting resources for managing fatigue-related risks. The aim should be to maintain and promote safety.



Image | International Maritime Organization

Seafarer responsibilities

Fatigue is a safety hazard, and managing shipboard fatigue and its associated risks is the shared responsibility of the company and the seafarer. Many of the measures mentioned are beyond one person's ability to influence, such as voyage scheduling, ship design and work scheduling.

Seafarer responsibilities include:



Doing their best to begin duty in a fit state to work the expected duty length and perform assigned shipboard work safely.



Monitoring and effectively managing hours of sleep.



Reporting fatigue-related hazards that affect safety.



Communicating appropriately about safety.



Being aware of fatigue and how to counter its effects.



Using available rest periods appropriately, as well as using personal fatigue mitigation strategies.

Seafarers are responsible for monitoring and seeking appropriate treatments for any health concerns that may influence their fitness for duty. A variety of factors can affect seafarers' wellbeing, including health conditions, genetic predispositions, nutrition, hydration and sleep difficulties. A wide range of sleep difficulties can affect fatigue, circadian rhythm, sleep duration and sleep quality.

Management-level seafarers' responsibilities

Below are some important fatigue management strategies for management-level seafarers:



Ensuring compliance with minimum hours of rest and/or maximum hours of work.



Using rested personnel to cover for those travelling long hours to join the vessel; for example, allowing proper time to overcome fatigue and become familiar with the vessel.



Managing the amount of time seafarers need to spend performing physically and mentally demanding work (e.g. tank cleaning or navigation through congested waters).



Ensuring nutritious food options are served on board and seafarers have continuous access to drinking water.



Providing night-time personnel with appropriate meal choices.



Maintaining interaction between shore and vessel management about fatigue awareness and preventive measures on board the vessel.



Creating an open communication environment, by making it clear to crew members that it is important to inform supervisors when fatigue is impairing their performance, or that of others, and ensuring that there are no recriminations for such reports.



Ensuring that selected seafarers can do the job for which they are assigned, to prevent the potential for fatigue in other crew members.



Improving shipboard conditions to ensure that when there is an opportunity to sleep, crew members can take advantage of it without interruption. For example, by scheduling drills and routine maintenance functions so that disturbances to rest periods are minimised, and relevant seafarers are aware of these protected sleep opportunities.



Establishing onboard management techniques to schedule shipboard work and rest periods more efficiently.



Where possible, assign work by mixing up tasks to break monotony and to combine work requiring high physical or mental demand with low-demand tasks (job rotation).



Avoiding scheduling potentially hazardous tasks during the circadian lows of the seafarers involved.



Providing support for seafarers to recognise and deal with the effects of fatigue, including onboard training.



Emphasising the seafarer's responsibility to sleep during rest periods and ensure they get adequate sleep.



Taking time to monitor that all personnel are getting adequate sleep.



Ensuring that shipboard conditions are conducive to quality sleep, for example maintaining the heating, ventilation and air conditioning on schedule, light bulbs are replaced and sources of unusual noise are taken care of at the first opportunity.



Reappraising work patterns and areas of responsibility on board to establish the most efficient use of resources, such as sharing the long cargo operations between all the deck officers.



Promoting supportive relationships on board (good morale) and dealing with interpersonal conflict between seafarers.



Establishing shipboard practices for dealing with fatigue incidents and learning from them, e.g. as part of the safety meeting.



Increasing awareness of the benefits of a healthy lifestyle including exercise, relaxation, and proper nutrition.



Timely coordination of scheduled activities between the company, management-level seafarers and other stakeholders.



Allowing time for effective communication at watch and work handovers.



Image | Chris Beerens © Commonwealth of Australia

A photograph of a male worker in profile, facing left. He is wearing a white hard hat, safety glasses, and a high-visibility orange safety jacket with reflective silver stripes on the sleeves. He is also wearing yellow work gloves. He is focused on working with a metal rod or tool. The background is slightly blurred, showing what appears to be an industrial or maritime setting with white structures and a red lifebuoy. A dark blue horizontal banner is overlaid on the top right of the image, containing the word 'References' in white text. A decorative graphic of two parallel diagonal lines, one cyan and one orange, is positioned on the left side of the banner.

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