

# Fatigue in fly-in, fly-out operations

Guidance document for the oil and gas industry

**Health**  
2015



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## IOGP Report 536

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# Fatigue in fly-in, fly-out operations

Guidance document for the oil and gas industry

## Acknowledgements

This document was prepared by the Fatigue Management Task Force on behalf of the Health Committee. The Health Committee would also like to thank Adam Fletcher (Integrated Safety Support), Alexandra Holmes (Clockwork Research), Ian Dunican (Sleep for Performance) and Kirsty McCulloch (The Keil Centre).

## Executive summary

This document is designed to provide managers with a practical, broad-based guide to understanding, recognizing and managing fatigue and fatigue-related issues in fly-in, fly-out (FIFO) operations in the oil and gas sector. These are operations that are often in remote locations, and which usually require workers to fly in from their homes, work and live on-site or close to the site during roster rotations, and fly out again at the end of a tour of duty. The guide explains the potential implications of FIFO-related fatigue for the performance and health of individual workers, for workers' families and lifestyles, and for operational safety and efficiency.

The Introduction defines and categorizes fatigue, explores its impact on human physiology, and introduces the challenges it presents for both workers and their families in the context of FIFO operations. This section also explains the purpose of this guide, which is to provide managers with an outline of the fatigue issues inherent in FIFO operations, and guidance on additional aspects including: travel-related fatigue issues; fatigue risk management systems; fatigue management training; fatigue and accommodation; worker fitness for task in relation to FIFO operations; and managing fatigue in FIFO operations.

The second section elaborates on the nature of FIFO operations with particular reference to the oil and gas sector.

Travel and related fatigue is the focus for the next section, which describes key elements and the disruptive potential of travel-related fatigue, and the need for careful travel planning to manage fatigue. Sleep basics, assessment of travel management plans, sleep scheduling, good sleep habits, sleep environments (noise, temperature, light, vibration, ventilation, humidity, etc.), sleeping onboard aircraft, and the impact of diet and alcohol are all explored. This section also examines alertness strategies, travel plan development, on-site arrival,

planning post-travel work allotment, and travel fatigue issues facing incoming management and technical specialists and workers travelling home.

Fatigue risk management systems are detailed in the next section. To be effective, such systems should take a comprehensive, multidisciplinary approach. This section examines the key enablers—leadership, resources, stakeholder involvement and intensive communication—and the need for management to focus on employee well-being.

The section on Training explores the need to provide all stakeholders with the knowledge and skills required to develop, plan and implement effective fatigue management. It also details factors contributing to fatigue-related risks, both within and outside the workplace.

Accommodation can have significant implications for fatigue. This section covers aspects of both onshore and offshore workforce accommodation, ranging from design to environmental management systems, and examines factors such as air quality, temperature, light, noise, vibrations, humidity and insects. Several national guidelines/regulations for accommodation are also reviewed.

Fatigue and employee fitness for work is examined in the penultimate section. This looks at a risk-based approach for assessing workers' fitness for FIFO operations.

The final section of the guide focuses on managing fatigue in FIFO operations. It provides an extensive and detailed checklist for all personnel with related responsibilities.

The Annex contains a 'fatigue improvement checklist' for Supervisors.

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## Introduction

Fatigue is the state of tiredness that is associated with long hours of work, prolonged periods without sleep and/or the requirement to work when people would normally be resting. A person experiencing fatigue is:

- more likely to make mistakes and take risks; and
- less able to respond to unusual or emergency events.

Normally, the brain and body functions, such as the sleep and wake cycle, hormone levels, temperature and digestion, remain synchronized by a 'timekeeper' in the brain, called the circadian clock. Every aspect of human functioning is controlled by this internal clock which also keeps the body in time with the world outside, and results in optimal physical and mental performance.

Following travel to a different time zone or a change from day shift to night shift, the circadian clock needs time to adjust. However, not all internal systems adjust at the same rate. For example, the sleep and wake cycle may adjust at one rate, while the temperature rhythm changes at a different pace. The digestive system may be on yet another schedule. During the adjustment period, workers' alertness and decision-making ability will be affected.

Fatigue is therefore a result of physiological factors, and is not a 'state of mind' that can be reversed with motivation, training or experience. Fatigue can occur over a short (i.e. less than 24-hour) period, which is known as acute fatigue, or can build up over days and weeks, which is known as cumulative fatigue. Acute fatigue can be experienced after a single episode of sleep loss or reduced sleep following, for example, an extended period of wakefulness, sleep disturbances, sleep disorders or inadequate sleep. Acute fatigue can occur when shifting from day shift to night shift if adequate sleep is not obtained on the change-over day. Ongoing sleep disruption or lack of adequate sleep can lead to sleep debt and cumulative fatigue.

Accordingly, it is important that work schedules provide adequate breaks, and that these breaks are used for recovery sleep between shifts and periods of work.

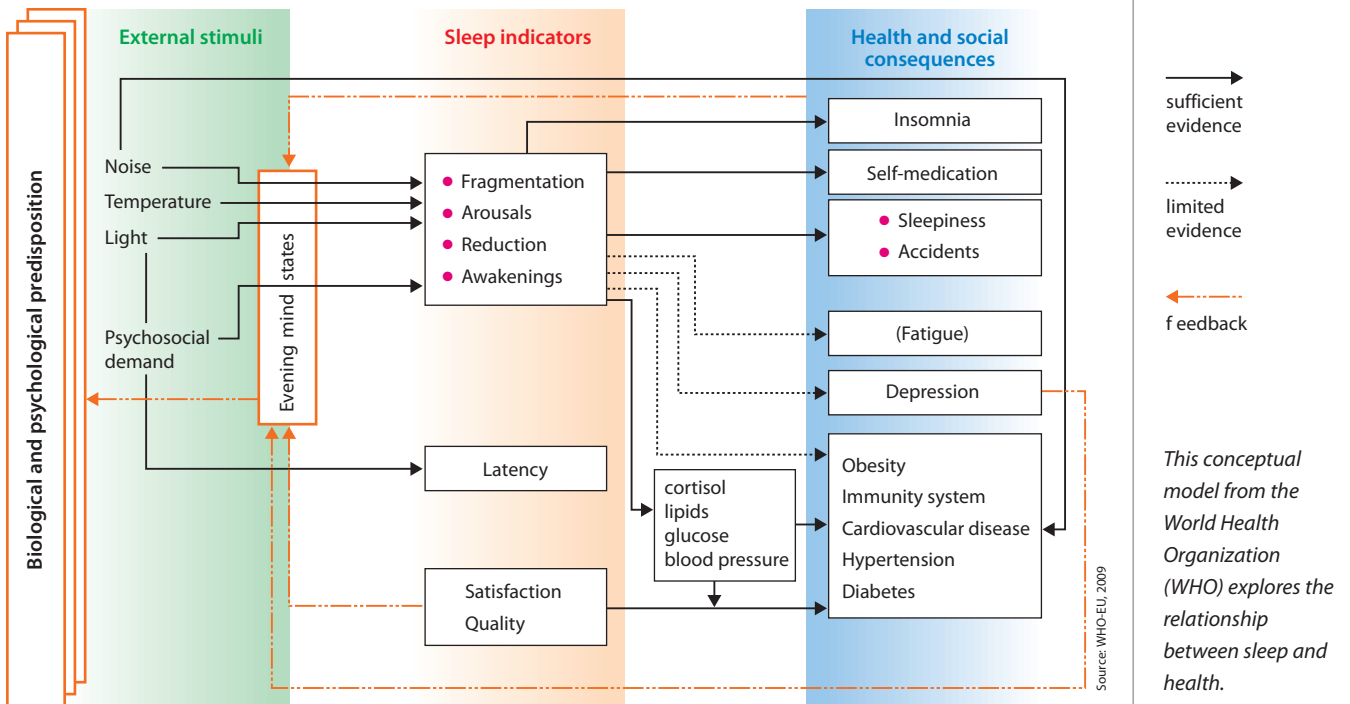
Even under ideal conditions, night-time alertness will generally be lower than daytime alertness. Long working hours and long journeys to and from work can also lead to fatigue.

Fly-in, fly-out (FIFO) operations employ individuals in geographically remote areas by transporting them temporarily to and from the worksite instead of relocating the employee and their family permanently. Although the individual may only travel from home to the worksite once every month, or even less frequently, the journey may be long and arduous, and involve crossing multiple time zones.

The recent Stratum white paper (Stratum, 2014) on attitudes of mine workers to FIFO schedules describes a prevailing sentiment that working a FIFO rotation is a 'young man's game'. Just under half of those surveyed (43%) worried about the impact of FIFO working on personal productivity and fatigue. Concerns were found to be higher in senior management. The main worry was the adverse impact on family life, where 65% described their concern as strong or critical.

Family crisis, alongside stress and depression, is cited as one of the top three issues faced by employee assistance programmes (Billings, 2008). Furthermore, personal stress related to family conflict can have a significant impact on sleep quality and duration. Insomnia may be associated with psychosocial stressors along with other factors such as co-morbid disease, the use of prescription and over-the-counter medications, and substance misuse (NICE, 2014). Although sleep disturbances are found in up to 90% of patients with depression, some researchers maintain that insomnia, in itself, can lead to depression (Franzen and Buysse, 2008). Safety at work may be compromised when

Figure 1 Experts conceptual model of relations between sleep and health (including fatigue)



workers with depression who experience poor concentration and poor memory, and who suffer from sleep disturbances with resultant fatigue attempt to perform safety-critical tasks.

Consequently, to mitigate concerns and address the adverse impact of fatigue in FIFO workers with respect to accommodation, it is necessary to improve sleep quality and duration, provide opportunities for workers to stay in contact with their families and to have confidential access to an employee assistance programme.

Figure 1 provides a conceptual model from the World Health Organization (WHO) that explores the relationship between sleep and health (WHO-EU, 2009).

The purpose of this guide is to provide managers with an outline of the fatigue issues inherent in FIFO operations, and guidance on:

- the nature of fly-in, fly-out operations;
- travel;
- fatigue risk management systems;
- training;
- accommodation;
- fitness for task in relation to FIFO operations; and
- managing fatigue in fly-in, fly-out operations.

## The nature of fly-in, fly-out operations

Fly-in, fly-out rosters in the oil and gas industry are frequently two weeks on/two weeks off, although schedules of two weeks on/three weeks off (often on production platforms) and even two weeks on/four weeks off (Norway) are also observed.

Extended rosters such as four weeks on/four weeks off are seen in some remote/overseas locations due to the logistical difficulties of flying people in and out and the cost benefits.

Drilling rigs generally apply equal time rotation, but rosters typically vary from two to four weeks on/off.

Longer and unequal rosters, where the worker spends a longer working period on-site compared to time off, would usually apply to overseas shore-based personnel. In addition, longer rosters on-site traditionally involve subcontracted personnel and are mainly driven by cost factors (e.g. transfers on/offshore).

Offshore specialists such as task force personnel routinely move from one installation to another and tend to have no fixed work/leave cycle.

The social and health effects of FIFO have not been sufficiently studied to know if, or when, a FIFO pattern provides the right balance of days at home to days on site. Even when this has been studied it will be the case that different rosters impact on individuals and their families differently.

Having a regular, predictable schedule can help to diminish the negative health effects of shift work. However, unplanned short-notice requirements for the employee to overstay due to his relief being delayed are likely to cause significant disruption for the employee.

Although subjective, some studies have shown that worker focus and family adaptation can be maintained on a 28 days on/28 days off pattern. This finding would appear to be supported by the limited attrition and staff turnover among expatriate offshore workers in the oil and gas sector. However, some national guidelines and regulations limit offshore tours to a maximum of 21 days. Specific authorization is required to extend the period offshore. The quality of living conditions is an important factor, and the financial motivations of such rosters cannot be ignored.







FIFO patterns where workers are away for more days than they are at home make it harder for families and workers to adapt to the roster and maintain the lifestyle in the longer term due to the repeated entry and exit of the employee from the family.

Some studies suggest that FIFO patterns where workers are away significantly more days than at home may make it harder for some families and workers to adapt to the roster and maintain the lifestyle in the longer term due to the repeated entry and exit of the employee from the family. However, more studies are required to better understand this issue.

FIFO workers are expected to work extended shifts. A 12-hour shift is the most common, particularly in the offshore sector, while individuals employed on-site work 7 days a week in most cases.

Longer rosters such as four weeks on/four weeks off, may allow one day's rest every second weekend. This feature is generally found in onshore operations. Most rosters, however, require staff to work every day while on-site, stay up to half an hour longer for daily shift handovers, and be available off-shift if required.

Several studies show that there is a consistent relationship between working hours and the effects on the workers' health, alertness and performance.

A typical tour of duty may comprise a combination of day and night shifts. However, to reduce the frequency of changes to their circadian cycle, studies favour fixed-shift schedules (all days or all nights).

When a roll-over shift from days to nights or vice versa is necessary, a night to day pattern is observed in most cases. This transition results in significant fatigue and performance effects. While it is favoured by employees as it enables them to be synchronized to a normal day wake/night sleep pattern when they are departing home, safety considerations favour a roll-over transition from days to nights.

## Travel

### Introduction

There are 24 time zones covering the 360° of the globe and, although there is a new time zone at approximately every 15° of longitude, these divisions do not cover the earth's surface in a straight line, pole to pole. Indeed, time zones are entirely man-made and vary in width producing arbitrary, albeit convenient methods of relating to time in different parts of the globe.

Time zones therefore have no direct physical or physiological properties, but the feelings of jet lag after a flight across multiple time zones (generally four or more) are nonetheless very real and are of concern in FIFO operations. They are due to a multitude of factors but the overall effect will depend on the relative contributions of two main components:

- the stress effects that extend from the physical and psychological aspects of the flight itself; and
- those due to the disruption of the internal body clock.

Both are key to the understanding of the potential impact of travel in FIFO operations.

### Elements of travel-related fatigue

Following a long journey, it is common to experience tiredness, malaise, nausea, headaches and aching joints. These are related more to the duration of the journey than the number of time zones crossed, and are due to the physical aspects of the journey, including the aircraft environment; they seldom last more than a day or two after the end of the trip. This aspect of the impairment is generally known as 'travel fatigue'.

Other symptoms, more commonly known as jet lag, stem from disruption of the internal body clock and the accompanying sleep loss. Such symptoms are much longer lasting and, as a result of a time zone change, it may not be

possible to fall asleep at the appropriate local night time, which results in sleep loss.

Thereafter, during the local day, it may be difficult to stay awake because the body clock, which is still on 'home time', indicates that the body should be asleep.

The disruption of sleep and the body clock, in turn, leads to a variety of other symptoms, such as fatigue, digestive upset and headaches. Jet lag will also significantly affect mental functions, judgement and decision-making, communication skills, memory, attention and other abilities crucial to optimal performance, particularly if prolonged effort or concentration is required.

The severity and duration of the jet lag symptoms will depend on a the following factors (Sack *et al.*, 2013):

- the number of times zones crossed;
- the direction of travel (westward travel is generally easier to manage than eastward travel);
- the opportunity for sleep during travel;
- the time of arrival at the destination and the proposed work schedule; and
- individual differences.

### Sleep basics

Sleep is as vital to humans as food, water and air, and without it death would be inevitable. The vital need for sleep has been clearly demonstrated and is central to health, well-being and performance. Most adults need about 8 hours of sleep each night, although this is an average and some people can cope well with 6 hours of sleep, while others need 10 hours.

Identifying how much sleep is required is fairly simple; it is the amount of sleep that allows an individual to feel alert, rested and able to function at their peak during the day. Hence, the amount of sleep needed is defined by daytime functioning.

There are two periods during the day when the internal biological clock is programmed to make them sleepy—from about 03:00 to 05:00 and 15:00 to 17:00; these periods are often known as the ‘window of circadian low’ (WOCL). It is common for everyone to be sleepy during these times, even if they have had enough sleep the night before.

## Assessment of travel management plans

### Sleep opportunities

#### *Sleep debt*

While, on average, humans need eight hours of sleep, many do not actually get this amount. What happens to these lost hours of sleep is important to consider. If an individual needs 8 hours of sleep, and they only get 6½ hours, then this sleep shortfall becomes a 1½ hour ‘sleep debt’. Over the course of days, this sleep debt will continue to accumulate, and an accumulating sleep debt can be a particular problem during international travel. Changing time zones, disruption of the internal body clock and irregular exposure to light, food and exercise patterns can all result in disrupted and reduced sleep, producing a cumulative sleep debt that needs to be carefully managed.

#### *The body clock prefers to fly westwards*

Though the body clock has difficulty adjusting to time-zone travel, it prefers westward to eastward flights. This is because, although humans live on a 24-hour day, the natural rhythm of the circadian clock is longer than 24 hours. The natural tendency of the internal clock is therefore to extend the day, and it goes against the biological programming to shrink or reduce the hours in a day.

While this is an interesting scientific fact, it is also important with regard to eastward travel. When flying west, the day is ‘extended’, adding hours,

and going in the natural direction of your internal clock. Flying eastward on the other hand involves ‘shrinking’ or reducing the day. For example, flying westward from London to New York involves ‘extending’ the day by 5 hours, while the eastward flight from New York to London results in ‘shrinking’ the day by 5 hours. In studies of long-haul pilots, westward travel has been shown to be associated with significantly better sleep quantity and quality than eastward trips.

In terms of how long jet lag lasts, the internal body clock adjusts by an average of 92 minutes/day after westward flights, but only 57 minutes/day after eastward flights (Aschoff *et al.*, 1975). It is therefore likely that it could take in excess of 1 week before the FIFO worker is fully adjusted to their destination time zone, be it work or home.

#### *What is the impact?*

Symptoms usually present during the 48 hours immediately after a flight. They are more pronounced and last longer the more time zones that have been crossed. However, the relationship is not linear and individual factors are important. Indeed, although 30% of trans-meridian travellers have little or no difficulty adjusting to the temporary desynchronization of their internal body clock, another 30% do not adjust well at all (Winget *et al.*, 1992).



## Sleep

### Sleep is both the problem and a solution

Sometimes, the best answer is the simplest. The most effective way to manage sleep loss and jet lag involves a low technology solution—sleep. Careful and thoughtful scheduling of sleep periods and the use of strategic naps can provide enormous benefit. The same strategies can, and indeed should, be applied following disrupted or delayed travel and operational emergencies.

There are many reasons why travel results in problems sleeping: changing time zones and schedules; changing light and activity levels; trying to sleep when the body clock is programmed to be awake; and disruption of the internal circadian clock.

Though a technological solution may be desired, the only direct method to counteract sleep loss is by getting sleep. The traveller therefore needs to plan when and where to sleep, and how to maximize the likelihood of being able to sleep. The key steps are *strategic sleep scheduling, good sleep habits, the sleep environment and sleeping on the aircraft.*

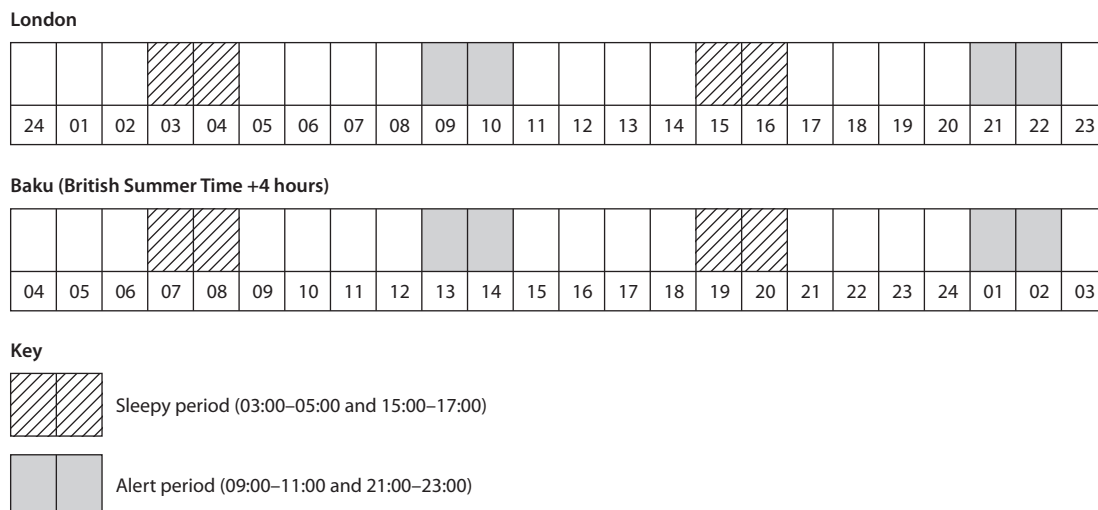
## Strategic sleep scheduling

### Timing

The key to strategic sleeping is timing. One of the challenges of time-zone travel is that the traveller may have to sleep at a time when their body clock wants them to be awake, and having to be awake when their body clock wants them to be asleep. It is difficult to force sleep if the body clock is not ready, no matter how dark or comfortable it is. Conversely, it will be very hard to stay awake if it is a time when the body wants to be asleep. This will be true regardless of how important the activity.

It is useful for travellers to keep track of what time it is for their body (starting with where they are starting their journey) by calculating when they would usually be sleeping, and identifying what time of day it is at their destination (see example in Figure 2). Travellers should try to plan sleep periods to take advantage of their body's natural rhythm for sleep. If their usual sleep period is in the middle of the day at their destination time, they should at least try to schedule a nap during that time.

Figure 2 Keeping track of the body clock when travelling





### Planned naps

Naps are essential strategies for managing the transition into work after flying in, during the transition from day to night shifts or vice versa during the rotation and following return home after flying out.

There are several guidelines for using naps effectively. The most important is that when the feeling of sleepiness is apparent, getting more sleep is better than less, and less is better than none. Specifically, if only a short period of time is available, consider a nap of 20–30 minutes which will reduce the chances of drifting into a deep sleep. However, if there is only 5 minutes to sleep, getting some sleep is better than none.

If more time is available, a longer nap of 90–100 minutes should be considered. This will allow the body to go through a full sleep cycle. However, the nap should not be taken too close to an evening sleeping period, otherwise it may be difficult to obtain further sleep later.

When waking from deep sleep, it is normal to feel disoriented and sluggish. This is called ‘sleep inertia’. It usually passes in about 15 to 30 minutes, but it is important to allow at least 30 minutes after the end of the nap before

beginning any safety-critical activity, which should be undertaken with a colleague not suffering from sleep inertia.

Some individuals wake from a nap and report that they don’t feel better, or may even feel worse. However, once any sleep inertia has passed off, performance and alertness are still usually improved. Napping during the day is not a sign of laziness, it is a sign of very sensible sleep management; a simple strategy that works!

The following can help to get the most from strategic naps:

- When it comes to sleep, more is better than less, less is better than none.
- If there is only a short amount of time available, limit the nap to 45 minutes or less.
- If a longer time is available, consider a 2-hour nap.
- After a longer nap, allow about 30 minutes to ‘wake up’ before any safety-critical activity.
- Avoid taking a long nap too close to the main sleep period.

### Good sleep habits

Getting better sleep during the tour of duty actually begins at home. It may not be possible to eliminate jet lag and sleep disruption, but there are effective strategies to help sleep, to minimize the effects of jet lag, and to obtain optimal sleep. The following suggestions should help improve sleep, both at home and away.

#### Establishing a regular pre-sleep routine

It is possible to teach the body that it is time to relax and go to sleep by developing a regular routine of activities before going to bed. Reading, taking a warm bath, getting into pyjamas or listening to music can all be routines that tell the body it is time for relaxation and sleep. What works may depend on the individual, but it is

important to undertake activities that will induce sleep and, for it to be most effective, it must be something that can be done away from home.

### **Observing the 30-minute ‘toss-and-turn’ rule**

If getting to sleep is proving difficult after about 30 minutes, it should be accepted that it is not possible to force sleep. Instead, it is recommended to get out of bed, and try to do something that promotes relaxation and sleep. It may be useful to use relaxation techniques such as those outlined below, or to listen to soothing music or read. The principal goal is to promote relaxation and, in turn, sleep.

### **Using relaxation techniques**

A considerable amount of scientific literature has demonstrated the usefulness of relaxation techniques to help people get to sleep and stay asleep. Some relaxation techniques are primarily mental exercises such as focusing the mind, internally repeating phrases, focusing on images or meditation. Other relaxation techniques are primarily physical such as tensing and relaxing the major muscle groups of the body. Many relaxation techniques involve a combination of both mental and physical activity.

There is nothing magical about relaxation techniques. They are just skills that, like any other skill, can be learned and need to be practised. Many resources for learning relaxation techniques are available in books, on tapes and CDs and on the internet. However, be cautious—although many of these products and services are based on scientifically valid principles and techniques, many other unsubstantiated claims are made on a wide range of techniques, devices and approaches to relaxation.

### **Watch out for caffeine**

Caffeine is a stimulant which, when taken too close to bedtime, can disrupt sleep. The amount of coffee, tea and cola drinks should therefore be managed carefully at all times, but kept to an absolute minimum within four hours of bedtime. Caffeine can also be present in foods such as chocolate, frozen desserts, coffee ice cream, and yoghurt but can also be found in unexpected places, for example, in cold medicines and pain relievers and even in decaffeinated beverages. It is important to be an informed consumer and to check the labels of foods, beverages and medications for caffeine content.

### **Making the sleep environment as comfortable as possible**

Workers have to manage their sleep at home, in hotels, in aircraft and in the camp or on the platform. Making all of these settings comfortable is a challenge. However, it is much easier if it is possible to adjust light, temperature, and noise levels to a comfortable level. The key is to know what works, and to try to have as much control over the environmental factors as possible.



## The sleep environment

Many environmental factors affect the quality of sleep, including light, noise and temperature.

### Light

In general, a dark room is better for sleep.

**Helpful hints:** Using eye shades can help. In a hotel, it may be practical to use tape or safety pins to clip together curtains that let in light. Also, thought should be given to creating low-level light for a middle-of-the-night trip to the bathroom.

### Noise

In general, a quieter room is better. However, what is most disruptive to sleep are random, loud noises, like sirens or the housekeeping trolley hitting the room door. Low-levels of constant background 'white' noise might be helpful in masking other noises and can help you to sleep.

**Helpful hints:** Request a hotel room away from lifts, housekeeping supply rooms and major thoroughfares such as hallways near offices or restaurants. Earplugs can help. 'White noise' can be generated by turning on a fan or the air conditioning system, or tuning the radio between channels. Put the 'Do not disturb' sign on the door. Turn down the volume on the telephone, or divert calls to voicemail. If sleeping during the day, call housekeeping to make sure they do not interrupt your sleep.

### Temperature

In general, cooler rooms are more conducive to sleep than warmer ones. However, either extreme (too hot or too cold) can disturb sleep.

**Helpful hints:** Have an additional blanket available for middle-of-the-night temperature adjustments.

## Personal comfort

What is comfortable for one person may not be so comfortable for another. It is most important to have an element of personal control over at least some of the environmental factors that can affect sleep. Some travellers bring personal comfort items, such as their own pillows, to help them sleep. Others find that small touches, such as a photo of family from home, can make a room seem less sterile and more comforting.

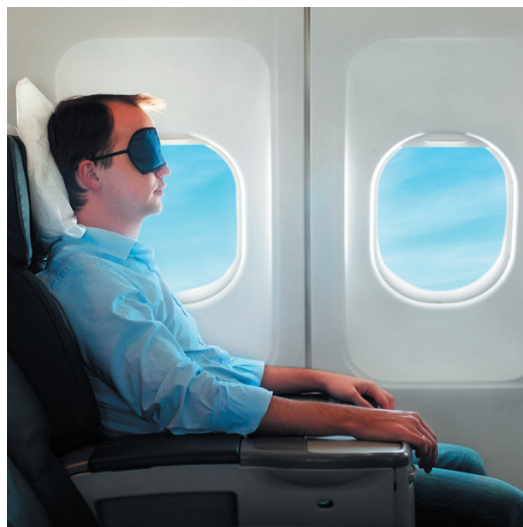
## Sleeping on the aircraft

### Light

Since darker environments are more conducive to sleep, travellers should consider using eye shades. The window shade should be pulled down. Some travellers even put a blanket over their heads to keep out the light.

### Noise

Aircraft are generally noisy places. People move around, talk, announcements are made and the engines drone. Engine sounds probably fall into the category of background noise and might even be helpful, but random, loud noises are



more likely to disrupt sleep. Travellers should use ear-plugs to block out noise or try using the audio headset and listening to relaxing music.

### Temperature

In terms of sleeping, a cool environment is generally better than one that is too warm. Travellers should dress comfortably, and in layers, so that they can add or take off items as required.

### Personal comfort

The more the environment can be adjusted to suit personal needs, the better the chances of sleeping comfortably. Some travellers bring their own personal comfort items onto the aircraft to help them sleep, such as a neck pillow or eye shade. Loose comfortable clothing is also important.

Sleep position is important. Sleeping in a sitting position decreases sleep time and increases sleep fragmentation. Keeping the legs level with the heart reduces leg swelling.

Seat belts should remain fastened and visible to the cabin crew should they need to make cabin checks.

## Other measures

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### Light exposure

A large body of scientific research has shown that light provides one of the most powerful cues to the internal body clock to keep it 'on time'. Light cues are transmitted directly through a pathway from the eye to the deep part of the brain where the internal clock is located. There are many ways to make sure that the brain gets this message from light but most simply, it is exposure to sunlight. There are also special devices, such as light boxes and light visors that provide artificial light and appear to have the same effect on the brain.

It is known that manipulating exposure to light can help reset the internal body clock and therefore help in adjusting to the effects of time zone changes and jet lag. However, the timing of the light exposure is critical in determining which direction the circadian clock will shift. Indeed, because light is so powerful, if exposure to light happens at the wrong time, it can worsen jet lag.

Some recommendations guide travellers to get out into the daylight and onto local time as soon as they arrive in the new destination. However, this may not be helpful in all cases and on all trips. Although it seems fairly straightforward, local light exposure may come at the wrong 'internal' circadian time and therefore slow adjustment. Even worse, the wrong timing of light exposure might send the internal body clock to a time zone on the other side of globe!

### Diet

There is a lot of folklore about how diet affects sleep and alertness. Many recommendations are made about how to manipulate diet to manage or eliminate jet lag. Unfortunately, controlled scientific research has shown that manipulating protein and carbohydrates, and feasting and fasting do not seem to have a positive effect on jet lag symptoms.

However, like the sleep pattern, the digestive system will not adapt immediately to a new local time and therefore hunger may be felt at times which are not normal meal times. In the first days after travel it is simplest to eat when hungry and gradually align the eating pattern with local time. However, travellers should not eat a large meal just before bed time as this may make sleep difficult.



## Alcohol

More than one or two units of alcohol will have a negative effect on sleep quality. Travellers should therefore avoid excessive alcohol intake and remember to remain well hydrated during travel.

## Alertness strategies

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To successfully manage the effects of jet lag, it is necessary not only to think about sleep strategies but also alertness strategies—in other words, how to maximize alertness for those key periods when in meetings, on shift and when driving, etc.

### Plan sleep periods

Travellers should identify times when it is possible to sleep, and should be committed to them. They should not let other activities encroach on preserved sleep time.

### Napping

If the feelings of sleepiness become apparent, the only remedy is sleep. Travellers should take a nap if possible—any sleep is better than none. If taking a short nap during the day, limit its length to 40 minutes and the problems of impaired performance post-sleep (sleep inertia) should be avoided.

If more time is available, a longer nap (90–100 minutes) may be considered. However, it should be remembered that the body will go into a deeper sleep which will result in symptoms of sleep inertia, and recovery time will be required before starting or returning to work. Also, a long nap will make it more difficult to have a good sleep at night.

## Caffeine

Caffeine is a powerful stimulant and should be used strategically. It takes approximately 30 minutes to work and lasts for about 4 hours. It should therefore be avoided before bedtime. Coffee generally contains more caffeine than tea, and drip/cafetière coffee usually contains more than other brews.

## Exercise

Vigorous exercise has a strong alerting effect. Combined with appropriately timed bright light exposure, exercise can assist in adjustment to a new time zone.

## Developing a travel plan

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It is clear that there are many ways for those travelling to and from FIFO operations to reduce the effect of travel on their sleep and alertness. However, for the strategies to work effectively, it is necessary to review the trip schedule as a whole to bring together knowledge about the body clock, sleep needs, and sleep and alertness strategies into a coherent plan for the trip.

To do this, it is necessary to review:

- how many time zones are being crossed;
- whether the travel is westward or eastward;
- the times of the natural periods of sleep and wakefulness;
- the opportunities for sleep during the journey and at the destination;
- the time of arrival at the destination and the proposed work schedule; and
- any individual factors that need to be considered.

Using this knowledge, it is possible to plan the journey, the arrival at site and the return home and ‘take control’ of many of the aspects that will affect sleep and alertness in the days immediately after travel. However, it must be remembered that there will at times be travel delays and/or operational emergencies which will have an impact on plans and make it necessary for alternative arrangements to be implemented at short notice.

It is clear that sleep is the key requirement for the management of the fatigue element of FIFO operations and that every effort should be made to protect sleep opportunities. It is therefore recommended that operators examine the impact of travel on the worker’s alertness on arrival at the site and on their return home. They should consider:

- the proposed travel schedule and class of travel, and the opportunity it provides for sleep;
- the use of approved hotels during the journey;
- the planning of work activities following arrival on-site; and
- the journey and arrival home.

## Arrival on-site

Both sleep debt and circadian disruption will have an impact on the alertness and performance of any individual travelling to and from FIFO operations. However, the extent and nature of that impact will depend on many factors and it is not possible to be prescriptive about the length of the rest period following arrival on-site. The factors that will need to be considered are:

- the extent of the circadian disruption, recognizing that, on average, it takes one day to acclimatize for every time zone crossed;
- the class of travel—business class travel will, in general, provide a greater sleep opportunity, particularly if the selected airline operates ‘flat beds’ in their premium cabin;
- the quantity of sleep:
  - before leaving home; and
  - during travel; and
- the quality of sleep, i.e. whether it was restful or disrupted at home and/or during travel.

Independent of jet lag however, the fatigue effects of the journey alone may suggest that a rest period incorporating at least one local night should be provided before the first shift.



## Planning of work activities

The sleep loss and circadian disruption of travel will significantly affect mental functions, judgement and decision making, communication skills, memory, attention and other cognitive skills. It is important for operators to consider work planning in the days following arrival on-site.

In particular, attention should be paid to involvement in safety-critical activities, and the requirement for extended duties and call-out during the time before circadian adaptation.

## Visits by management or technical visitors

Visitors arriving from abroad may at times be suffering from the effects of jet lag and the length of the journey itself, and resulting tiredness may have a negative impact on attentiveness, security and performance. In addition, alcohol consumption during travel to the site should be discouraged as it will have an impact on the quality of sleep (Chevron, 2010).

Management or technical visitors unaccustomed to the length of the journey or remoteness of the site should be reminded:

- to take account of travel time including outward and return flights and local transportation, including the type of transport (*Note: sea transfer may lead to motion sickness and employees should be advised to seek prophylactic medical treatment*);
- to develop travel and work plans and to actively use sleep and alertness strategies on both the outward and return journeys; and
- in the first few days after arrival, to avoid scheduling meetings during their normal hours of sleep.

## Travel home

Fatigue and jet lag will also be encountered during the journey home, and careful consideration should be given to any work and/or safety-critical activities during the period of recovery and acclimatization.

In particular, attention should be drawn to driving; if the traveller will have been awake for 16 hours or more by the time they arrive home (i.e. if more than 16 hours will have elapsed since their last normal sleep period at the camp or in a transit hotel), alternative arrangements should be made to transport them to their final destination to avoid the need for them to drive.



## Fatigue risk management systems

As with other health management topics, the effective management of fatigue in FIFO operations requires a comprehensive, multidisciplinary approach capable of addressing all fatigue contributors (Mellor and Webster, 2013). Key enablers are strong senior leadership support, dedicated resources, involvement of all stakeholders and intensive communication. Success requires the integration of FIFO knowledge into a coherent whole, striking a balance between a focus on occupational and lifestyle risks, and depends on the readiness of managers to highlight the well-being of employees in the management of FIFO operations.

An organization or entity should establish a fatigue risk management system (FRMS), i.e. a risk-based plan or system of controls that identifies, monitors and manages fatigue risk with the aim of ensuring that, so far as reasonably practicable, employees are performing with an adequate level of alertness. An FRMS should be risk- and evidence-based, but grounded by operational experience and practicalities. It should also be integrated into existing corporate safety and health management systems (Energy Institute, 2014).

The four principles that underpin an effective FRMS are (Energy Institute, 2014.):

1. The FRMS should be customized to the operation for which it is developed.
2. The FRMS should be based on assessed risk and evidence.
3. The FRMS should be built on the principle of shared responsibility.
4. The FRMS should be integrated into existing management systems.

A number of authors have outlined the key characteristics of an FRMS, but the following concepts as defined in Moore-Ede (2009) are

generally considered essential to the success of FRMS implementations:

1. Science based: supported by established peer-reviewed science.
2. Data driven: decisions based on collection and objective analysis of data.
3. Cooperative: designed together by all stakeholders.
4. Fully implemented: system-wide use of tools, systems, policies, procedures.
5. Integrated: built into the corporate safety and health management systems.
6. Continuously improved: progressively reduces risk using feedback, evaluation and modification.
7. Budgeted: justified by an accurate return-on-investment business case.
8. Owned: responsibility accepted by senior corporate leadership.

These characteristics can be translated into the core components of an FRMS:<sup>1</sup>

1. Fatigue management policy.
2. Fatigue risk management, including collecting information on fatigue as a hazard, analysing its risk, and instigating controls to mitigate that risk.
3. Fatigue reporting system for employees.
4. Fatigue incident investigation.
5. Fatigue management training and education for employees, management (and families).
6. Sleep disorder management.
7. A process for the internal and external auditing of the FRMS that delivers corrective actions through a continuous improvement process.

All but the sixth element are direct analogues of those normally found in a safety management system (SMS). Sleep disorder management is unique to an FRMS.

<sup>1</sup> Holmes and Stewart (2008); ALPA (2008); Booth-Bourdeau *et al.* (2005); Fletcher (2007); FAA (2006); CASA (2002); HMSO (2006).

## Importance of senior management

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Programmes that deliver tangible improvements to employee health outcomes and productivity cannot simply be 'added on'. Rather, they require a systemic change in an organization's structure, processes and culture. If the cultural norms are meeting work demands at any cost, or working long hours with limited time for respite and recovery, managers will lead according to these 'implicit' norms. Senior management influences the cultural norms of an organization and what is done at subsequent levels by their strategic decisions and behaviours. One of the key enablers identified in the success of this approach is the integration of the company's health, safety and well-being strategy into wider management systems and business plans.

An FRMS requires a senior manager to be ultimately accountable for managing fatigue risk, with the roles and responsibilities for implementation and operation of the FRMS being clearly defined. However, all key

stakeholders need to be actively engaged. Thus, a positive organizational culture where employees and management trust one another and where information about fatigue is openly reported is important to the successful implementation of an FRMS. As with the management of all risks, however, there is no 'one-size-fits-all' solution, and the FRMS must be developed in response to the needs of the industry, the regulatory environment, and the organisation in which it applies.

## Collaboration with other functions within the organization

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Any organizational or operational changes that are made to minimize the impact on health and alertness will require close cooperation with human resources, learning and development, performance management, pay and reward, operational management and other departments and functions.



## Training content and outcomes

Fatigue management training provides all stakeholders (including company leaders, managers, supervisors and operators) with the knowledge and skills required to implement fatigue risk controls, both in and outside the workplace.

In order to adequately address the unique aspects of FIFO operations, the training should consider the psychosocial factors (work organization and management), individual health and health-related lifestyles (e.g. nutrition, physical exercise), and the social environment outside the workplace with which employees interact.

Prerequisites for a successful education and awareness strategy include:

- understanding your company: copying and pasting successful programmes from other organizations will not work—it needs adaption to the culture and goals of your organization; and
- developing the programme ‘brand’—successful programmes generally have a common language, look and feel.

To ensure that the topic is communicated well within the organization, the fatigue aspects of FIFO operations should be discussed at management meetings at different levels; management should be constantly informed of any outstanding issues and should highlight them as areas for improvement. This requires good communication from the occupational health and human factors teams as the management team depends on the expertise of their specialists to provide the necessary information.

For successful engagement with senior management it is advisable to (Young and Jordan, 2008):

- ensure that the fatigue message is ‘simple and succinct’—do not provide unnecessary detailed information;
- use ‘non-technical’ language wherever possible;
- aim to demonstrate value; and
- ask for their support and place a focus on their responsibility.

Occupational health and human factors experts should make senior management aware of the issues to ensure that they recognize the benefits of training and provide their support.

FIFO operating companies should:

- train new employees on fatigue management and reinforce the training regularly, keep records of employee training on fatigue management and ensure that these are maintained;
- check that employees understand the issues associated with fatigue and the procedures that are in place within the company to manage fatigue; and
- assess training effectiveness at defined intervals and implement improvements as required.

Where possible, training should be delivered during shifts and not just during daytime hours. Educate bed partners/families about what they can do to minimize fatigue outside the workplace, and on the steps that they can take to help the FIFO employee to report for work fit, rested and alert.

Recommended learning outcomes for fatigue training are provided in Table 1 on page 19.

All stakeholders should receive training on:

- basic sleep, circadian and fatigue physiology;
- strategies for achieving good quality, restorative sleep;
- recognizing the symptoms of sleep disorders and how to obtain appropriate medical advice and treatment;
- managing an alert and healthy lifestyle;
- understanding the specific risks of fatigue impairment in their own work environment and work duties;
- managing jet lag and sleep management during air travel; and
- recognizing the signs of fatigue impairment and knowledge on the healthy and effective ways of mitigating them.

**Table 1** Recommended learning outcomes for fatigue management training

<p><b>1. Introduction to fatigue management</b></p> <ul style="list-style-type: none"> <li>● Identify the main components of a fatigue management programme.</li> <li>● Distinguish management’s role in managing fatigue from employees’ roles.</li> <li>● Identify and understand the aims of this fatigue management training programme.</li> </ul>	<p><b>6. Managing fatigue at work</b></p> <ul style="list-style-type: none"> <li>● Identify short-term countermeasures for managing fatigue at work.</li> <li>● Estimate how much caffeine employees consume each day.</li> <li>● Be aware of how to reduce their caffeine intake if necessary.</li> <li>● Recognize which substances can affect alertness.</li> </ul>
<p><b>2. Causes and consequences of fatigue</b></p> <ul style="list-style-type: none"> <li>● Understand what fatigue is.</li> <li>● Identify the primary causes of fatigue.</li> <li>● Describe the main causes of fatigue in employees’ lives.</li> <li>● Identify the effects of fatigue on safety.</li> <li>● Identify the skills that are impaired by fatigue.</li> </ul>	<p><b>7. Managing driver fatigue</b></p> <ul style="list-style-type: none"> <li>● Recognize the risk of driving while drowsy.</li> <li>● Identify effective preventative strategies against driving while drowsy.</li> <li>● Distinguish effective short-term countermeasures from those that are not effective.</li> <li>● Recognize effective emergency countermeasures against driving while drowsy.</li> <li>● Recognize when an emergency countermeasure should be applied.</li> </ul>
<p><b>3. Sleep, sleep loss and the body clock</b></p> <ul style="list-style-type: none"> <li>● Estimate employees’ personal sleep needs.</li> <li>● Understand sleep loss and describe how it builds up.</li> <li>● Identify the times of day at which alertness and sleepiness peak.</li> <li>● Identify how the body clock influences fatigue on employees’ rosters.</li> <li>● Recognize how being a 'morning' or an 'evening' person can affect alertness.</li> </ul>	<p><b>8. Managing fatigue during travel</b></p> <ul style="list-style-type: none"> <li>● Recognize strategies to help if employees are suffering from jet lag or the effects of long journey time from home to work.</li> <li>● Understand the pros and cons of sleep during international flights of long journey time to work.</li> </ul>
<p><b>4. How to improve your sleep</b></p> <ul style="list-style-type: none"> <li>● Identify behaviours that interfere with employees’ sleep.</li> <li>● Recognize effective strategies for improving sleep habits.</li> <li>● Recognize the most effective napping strategies.</li> <li>● Recognize strategies to help if employees are having difficulty falling asleep.</li> <li>● Recognize when they should consult a doctor if they are having difficulty sleeping.</li> </ul>	<p><b>9. Reporting fatigue</b></p> <ul style="list-style-type: none"> <li>● Identify when employees need to report fatigue.</li> <li>● Recognize why it is necessary to report fatigue.</li> <li>● Ensure that supervisors understand the appropriate response to fatigue reports.</li> <li>● Understand the process used for recording fatigue-related incidents.</li> </ul>
<p><b>5. Recognizing the signs of fatigue</b></p> <ul style="list-style-type: none"> <li>● Identify the signs of fatigue.</li> <li>● Rank the signs of fatigue according to severity.</li> <li>● Recognize the signs of fatigue in specific operating environments.</li> </ul>	

All stakeholders should subsequently adopt the education and training that they have received.

In addition, supervisors should receive additional training on how:

- staffing levels can influence employee fatigue;
- work and rest scheduling can effect employee fatigue, and how to schedule work to minimize the risk;
- to manage fatigue risk within a team;
- to manage declared or observed fatigue; and
- to determine whether fatigue contributed to an incident or near miss.

Education and training should be subject to continuous improvement, just like any other aspect of a fatigue management plan.

### Training for different roles

The training that an individual receives should be determined by their role and responsibilities within the FRMP. Table 2 provides an example of the types of training that one organization introducing an FRMP provides to its existing employees, management and support staff.

Following the training programme, it is anticipated that (Chapman, 2001):

- all staff are knowledgeable about the programme’s purpose;
- reminders are provided frequently;
- perceived needs are addressed in the programme;
- the programme does not stand alone;
- educational content is coordinated and messages are compatible; and
- evaluation efforts are focused and linked to programme goals.

**Table 2** Example of fatigue risk management training provided to different individuals in one organization

	Initial training	Refresher training	Fatigue risk management for managers	Fatigue management workshops and conferences
Format	CBT* or classroom**	In-house classroom	In-house classroom	External
Duration	Half day	Quarter day	Half day	2 days
Frequency	Once	Annually	Once	Annually
Employees				
Safety officers	✓	✓		
Scheduling officers				
Operations managers				
Shift managers	✓		✓	
Safety managers				
Occupational health	✓			
Fatigue risk management systems (FRMS) leaders				
Subject matter experts				✓

\* computer-based training (CBT) \*\* Depending on the number of employees to be trained, a computer-based solution may be more practical.



## Accommodation

Measures to help prevent fatigue in relation to accommodation for FIFO workers in the oil and gas industry need to take into account both onshore and offshore accommodation. However, the principles of fatigue prevention in this context as well as the risk factors for fatigue are mostly common across both onshore and offshore environments. The design and engineering challenges would, however be different onshore versus offshore. Engineering controls are typically more cost-effective when introduced during the design phase of a new offshore or onshore accommodation rather than trying to retrofit accommodations to mitigate or prevent the various risk factors discussed below.

### Noise and vibration

FIFO workers should be considered a high-risk group in terms of reducing noise during sleeping time to improve sleep and, in turn, minimize fatigue.

- Noise levels<sup>1</sup> outside should be kept below 55 dB  $L_{\text{night, outside}}$  and ideally as close to 40 db as reasonably practicable taking into account cost, technical feasibility and practicality.
- Noise levels inside should be kept below 35 dB  $L_{A \text{ max, inside}}$  as far as reasonably practicable. NORSOK for instance requires offshore cabin noise levels be limited below 40 dB(A) and 45 dB(A) for mobile offshore installations during operations (NORSOK, 2004). The NOPSEMA technical report is consistent with ISO 15138 and NORSOK with overall noise levels in cabins to be kept below 40 dB(A) ( $L_{\text{Aeq,T}}$ ) (NOPSEMA, 2011).
- Exposure assessment and monitoring should be performed to assess noise exposure both inside and outside sleeping accommodation

areas. Consideration should be given to both continuous noise and noise events, both of which affect sleep.

- Accommodation should be located in an area that is relatively quiet—away from generators, process plants, mobile heavy equipment or areas with noisy machinery. Special consideration should be made to locate accommodation away from the helideck at offshore locations.
- If accommodation cannot be sited away from a noise source, engineering controls should be implemented to lower ambient noise levels as low as reasonably practicable. For example, an acoustic shield can be placed to deflect and/or absorb noise between the source and accommodation facility, or a noisy pump could be enclosed. Alternatively, noise absorbing material could be used to reduce indoor noise levels within accommodation rooms.
- Vibrating equipment offshore that is not well isolated can contribute to structure-borne noise that is transmitted to accommodation areas. This can be mitigated through proper choice of equipment and/or by installing vibration isolation equipment to reduce transmission of vibration to the supporting structure. Furthermore, proper accommodation fit-out using a floating floor/wall/ceiling system can mitigate structure-borne noise (NOPSEMA, 2011).
- Whole body vibration on an offshore installation of sufficient intensity and duration may cause fatigue and affect performance particularly at certain frequency ranges (generally 1 to 80 Hz). Accommodation areas on offshore installations with vibrating machinery may possibly be affected both by

<sup>1</sup>  $L_{\text{Aeq,T}}$  = exposure to noise for the duration of a given time interval T (a 24-hour period, a night, a day, an evening) is expressed as an equivalent sound pressure level (measured in dB(A)) over the interval in question.

$L_{A \text{ max}}$  = maximum outdoor sound pressure level associated with an individual noise event.

$L_{\text{night}}$  = refers to the EU definition in Directive 2002/49/EC: equivalent outdoor sound pressure level associated with a particular type of noise source during night-time (at least 8 hours), calculated over a period of a year.

Available from 'Night Noise Guidelines for Europe' at: [www.euro.who.int/\\_\\_data/assets/pdf\\_file/0017/43316/E92845.pdf](http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf)

noise and excessive whole body vibration as a result. The UK Health and Safety Executive has provided some technical guidance on vibration for offshore facilities that relate to BSI 6841, and the NOPSEMA guideline has aligned with this (HSE, 2001; NOPSEMA, 2011).

- The NOPSEMA technical report provides further information on layout considerations for cabins in offshore facilities to minimize noise (NOPSEMA, 2011).
- The accommodation facility design should try to minimize the glazed area on the façade exposed to the main source of noise. Ideally, climate and indoor air quality conditions permitting, the windows on the exposed façade should not open if the outside noise levels exceed 55 dB  $L_{\text{night.outside}}$  provided it is possible for windows to open on the non-exposed façades.
- There is little difference in terms of noise insulation between single glazing and double glazing. (Passchier-Vermeer, 2002)
- The walls, roof and floor should be constructed to insulate the sleeping quarters sufficiently from outside noise. Partitions between cabins, between cabin and corridor, between cabin and ablutions, and between quiet rooms and adjacent areas should be sufficiently insulated to prevent sound transmission. Both NORSOK and NOPSEMA provide guidance and requirements for sound insulation index rating ( $R_w$ ) values for various internal partitions (NOPSEMA 2011, NORSOK 2004). Modular prefabricated cabins may provide better acoustic performance for offshore facilities.
- Doors should have self-closing hinges that are adjusted so that the doors cannot slam. There should be regular maintenance to check the hinges and door seal.
- Air-conditioning units and overhead fans should be maintained regularly so they do not make excessive noise. Both NORSOK and NOPSEMA provide guidance for noise limits for HVAC systems in offshore living quarters (NORSOK, 2004; NOPSEMA 2011).
- A policy or standard should outline the requirements relating to noise in sleeping accommodation areas.
- Signage should indicate that the sleeping quarters are low-noise areas.
- Workers should be educated about the importance of keeping noise levels down in the vicinity of sleeping quarters.
- FIFO workers should have single-status rooms with one person per room where reasonably practicable, or at most two persons per room/cabin. If two people are sharing a room one should be on night shift when the other is on day shift and vice versa, so they are not trying to sleep at the same time.
- Recreation areas should be located away from sleeping quarters, or soundproofed to reduce noise transmission to sleeping quarters.

### Indoor air quality

Indoor air quality (IAQ) should conform to WHO standards. Poor ventilation of a room with high levels of CO<sub>2</sub> may cause headaches and have other health effects. Poor indoor air quality will increase the likelihood of FIFO workers opening windows, thus reducing the noise insulation of the room. Heating, ventilation and air-conditioning (HVAC) systems should ensure adequate fresh air changes per hour in accommodation—for example, this would be at least three air changes per hour if the American Society for Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) standard 62.1 is followed. Measures to improve indoor air quality in accommodation areas may include controlling sources of pollution (such as volatile organic compounds), ensuring adequate fresh air, changing air filters regularly on air conditioning units and HVAC systems and ensuring proper humidity control. There should be a strict non-smoking policy in accommodation and recreation areas.

### **Cabins and layout**

It is important that the bed, mattress and pillows provided should be of sufficient quality to promote restful sleep. There should be a sufficient number of beds or bunks to accommodate the number of persons expected to sleep on an offshore installation without 'hot bunking'. This should take into account temporary increases in persons on board during staffing peaks. Furthermore, accommodation should be grouped together on dedicated floor levels for offshore facilities. Beds in offshore facilities should be orientated fore and aft, rather than port and starboard, to reduce the likelihood of motion sickness in floating facilities where the length is much greater than the beam.

### **Reasonable privacy**

Single occupancy accommodations should be provided. If that is not practicable, accommodation should be restricted to a maximum of two persons per cabin or room during a 24-hour work/rest period to support good sleep and ensure reasonable privacy. An exception may be made during crew change days when more than two people may be allocated to a cabin/room for a 24-hour work/rest period. Workers often prefer having a television/computer/tablet in their room so they can better manage their recreational options. However, the presence of such a device in the room could adversely affect the length and quality of sleep. There is overwhelming evidence that most adults of working age require at least 7 to 9 hours of sleep per night. Watching television, playing games, responding to emails and texts in sleeping quarters will reduce the time available to sleep unless the worker is disciplined. Such activities within an hour of bed stimulate the body, and may disrupt natural melatonin cycles through exposure to bright light (especially in the blue spectrum).

### **Light**

Ambient light above a certain threshold and especially in the blue spectrum significantly affects melatonin hormone secretion and hence circadian rhythms. FIFO workers that perform shift work will require window curtains and door seals that reduce daylight levels in sleeping quarters to below 1 lux. Workers not on shift work also require dark rooms with light levels below 1 lux at night. If windows cannot be sufficiently screened to prevent light intrusion, outside light should be minimized. Offshore cabins with more than one bunk should have bed curtains fitted to ensure privacy and block light.

### **Temperature and humidity**

A comfortable temperature and humidity is important to reduce the need to open windows if there is significant outside noise, to promote good quality sleep. High and low temperature extremes lead to fragmentation of sleep. A temperature of around 18 to 20°C is ideal for promoting good quality sleep (Shneerson, 2005).

### **Altitude**

As altitude increases the partial pressure of oxygen decreased. Above 3,500 to 4,000 metres oxygen pressures are reduced sufficiently to adversely affect sleep. Poor sleep quality is a critical health effect of high altitude work, and needs to be managed.

### **Insects**

Onshore accommodation should be insect-proofed if insect ingress is an issue in the area. This is particularly important in malaria and other vector-borne disease zones, where accommodation needs to be mosquito-proofed to ensure that occupants are not at risk. In any area, occupants should not be disturbed by flying insects while trying to sleep.

*In addition, consideration should be given to workers' well-being and psychological health, including the following:*

### **Exercise**

Exercise is important to relieve stress. Regular exercise reduces risk factors for chronic disease. However, exercise within three hours of sleeping may delay sleep onset and reduce melatonin secretion. FIFO workers should be given opportunity and facilities to exercise before work rather than before bed.

### **Food**

Large meals taken before sleep can affect sleep quality. Not only may this cause indigestion, but it can also promote catecholamine synthesis and lead to wakefulness. (Shneerson, 2005). Education materials for FIFO workers about healthy eating habits to improve sleep and combat fatigue should be included in an overall information and education campaign.

### **Family contact and psychological support**

The accommodation area should provide access to high speed wireless internet and sufficient telephones in the sleeping quarters or in rest areas with reasonable privacy for FIFO workers to stay in regular, private and undisturbed contact with their families. Furthermore, access to telemedicine psychology services and/or employee assistance services online will support the psychological health of FIFO workers and may help to reduce stress, depression and hence fatigue.

### **Information, education and awareness**

FIFO workers should receive information and education on the how to prevent fatigue with respect to noise, light, exercise and food, and on employee assistance programmes and communications with their family.

## **Industry guidelines and standards**

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A number of organizations and regulatory bodies provide guidance or requirements relating to offshore accommodation that are applicable for use in the prevention of fatigue. For the UK offshore environment, this includes guidance and requirements from the UK HSE on prevention of excessive noise, reasonable lighting indoors, proper ventilation, appropriate room temperatures, prevention of overcrowding and provision of reasonable privacy (HSE, 2010).

For Norway, NORSOK, provides detailed requirements applicable to offshore accommodation. These include design and engineering controls for reducing noise that should be taken into account during the project planning and engineering phase, along with prevention of excessive noise in cabins and living areas, provision of telephones, provision of exercise rooms and equipment, prevention of overcrowding (maximum of two to a cabin), adequate lighting, prevention of excessive vibration, and adequate ventilation (NORSOK, 2001; NORSOK, 2004; NORSOK, 2006).

For Australia, NOPSEMA provides detailed information and guidance on good practices to ensure good sleep and reduce fatigue for offshore accommodation. This includes guidance on limiting noise, proper layout to prevent overcrowding, ensuring privacy and reducing noise and vibration, ensuring adequate indoor air quality and lighting, providing exercise and recreation facilities, and facilitating communications with family (NOPSEMA, 2011).

## Fitness for work

### Introduction

The primary purpose of a medical assessment for fitness for work is to ensure that an individual is fit to perform the assigned task(s) effectively and without risk to their own or others' health and safety. It is not intended to exclude or remove the individual from the job but to modify or adjust as necessary to allow for safe and efficient work (IPIECA-IOGP, 2011).

A risk-based approach should be adopted to ensure that specific occupations or groups are assessed for fitness for work (e.g. crane operators, divers, offshore workers, expatriates, etc.). In some countries, legislative requirements will dictate the assessment frequency and components (i.e. Oil and Gas UK, Australian Maritime Safety Authority, Australian Petroleum Producers and Exporters Association, Norwegian Maritime Directorate, Petronas Malaysia).

Individuals who are required to fly in/fly out should have a fitness for work assessment that includes consideration of the impact of fatigue. Individuals who have health conditions that may be affected by disruption to their circadian rhythms should be assessed carefully. Fatigue management strategies should be identified as part of the assessment to minimize adverse health effects.

### The specific elements of fitness for work for fly-in, fly-out operations

While many of the assessments conducted review the major bodily systems (i.e. cardiovascular, respiratory, nervous, gastrointestinal, etc.), few assessments focus on identifying risk factors for poor adaptation to shift work and/or consideration of sleep disorders and other health and medical conditions that might have an impact on an individual's ability to cope and perform safely

and effectively during shiftwork or following circadian disruption.

The general framework of a fitness for work assessment includes:

- requirements based on a comprehensive job and task analysis;
- functional assessment;
- factors influencing work performance;
- objective tests;
- matching the individual to the job/task; and
- presentation of the assessment (certificate of fitness—fit, unfit, fit subject to work modifications).

### Assessment for overseas/remote placement

For individuals who may be working overseas or in remote locations where access to quality medical facilities may be delayed, or where exposure to severe climatic conditions and communicable diseases might occur, it is important for the fitness for work assessment to identify specific conditions that may require advanced levels of care and emergency evacuation. Such assessments should include the consideration of any condition that may cause sudden incapacitation (e.g. asthma, heart disease, epilepsy) together with an assessment of the worker's mental state.

### Assessment for impact of shift work and circadian disruption on health

High levels of fatigue cause reduced performance and productivity, and increase the risk of accidents and injuries. Fatigue also affects the ability to think clearly. Individuals who are fatigued are unable to gauge their own level of impairment, and are unaware that they are not functioning as well or as safely as they would be if they were not fatigued.

In addition, lack of sleep has been indirectly linked with health effects such as:

- heart disease and high blood pressure;
- stomach disorders;
- mental illnesses;
- lower fertility;
- obesity; and
- some cancers.

It is important that consideration is given to employees with pre-existing health conditions that may be affected by shiftwork or circadian disruption. In particular, shiftwork can adversely affect the administration of time dependent medication in conditions such as asthma and diabetes. Similarly, those workers suffering from a sleep disorder may experience increased levels of fatigue as a result of inadequate restorative sleep.

## Common sleep disorders

According to the International Classification of Sleep Disorders (ICSD), there are more than 95 identified and classified sleeping disorders. The following are the most prevalent in shift workers.

### Insomnia

People who suffer from insomnia do not feel rested and often complain that they cannot fall asleep, or cannot stay asleep for a full night. They may frequently wake up during the night, wake up too early, not be able to fall asleep at night, or have difficulty getting back to sleep if woken. Insomnia can be both short term (in response to a stressful event or change in environment) or long term.

### Sleep apnoea

Most cases of sleep apnoea are caused by what is known as 'obstructive sleep apnoea'. With sleep apnoea, there are frequent interruptions to sleep, making sleep less restful and often

causing sufferers to complain of early morning headaches and excessive daytime sleepiness.

Symptoms of sleep apnoea include:

- chronic, loud snoring;
- gasping or choking while sleeping;
- excessive daytime sleepiness; and
- personality changes or difficulties with thinking.

### Restless legs syndrome

In restless legs syndrome, sufferers report sensations of creeping, crawling, pulling or tingling which cause an irresistible urge to move their legs. This phenomenon usually happens as an individual is trying to fall asleep, making sleep difficult. Movements may also occur during sleep, partially waking the individual and disrupting sleep patterns.

### Narcolepsy

Narcolepsy is a rare condition associated with sudden sleep 'attacks' where an individual will suddenly fall asleep many times in one day.

### Other situations

Substances such as nicotine, caffeine and alcohol can affect the quality of sleep (IPIECA-IOGP, 2007).

Caffeine can remain in the body for up to six hours and may therefore affect sleep. Alcohol may shorten the time to fall asleep, but disrupts subsequent sleep. Finally, nicotine disrupts sleep and reduces total sleep time.

Other substances including over-the-counter and prescription medications may also affect sleep. For example, long-acting benzodiazepines (drugs used to relieve anxiety or insomnia), may contribute to daytime sleepiness.

## Managing fatigue in fly-in, fly-out operations

Table 3, *Managing fatigue in FIFO operations* (pages 28–37) can be used to identify potential fatigue risk factors and associated risks. The Table indicates at which point action should be taken and suggests interventions that can be adopted.

Five common factors that contribute to fatigue in FIFO operations have been identified:

1. Work scheduling and planning.
2. Hours worked.
3. Operational and site factors.
4. Individual factors.
5. Travel to the workplace.



To use the Table, a three step process should be followed:

1. Identify potential fatigue risk factors.
2. Assess the level of risk for the fatigue risk factors identified.
3. Implement control measures where a fatigue risk factor is identified as red or purple risk.

### Box 1 Key points to bear in mind

- Fatigue can be caused by a combination of work-related and individual factors, and may accumulate over time.
- Fatigue risk factors can be interrelated and should not be considered in isolation.
- Identify priorities and address these first.
- The most effective way to reduce risk is to implement a combination of risk control measures.
- Adopt the 'hierarchy of controls' (e.g. elimination, substitution, administrative controls).  
Some controls may need to be trialled before they are adopted, e.g. roster re-design.
- Effective fatigue management requires a participative approach that involves all key stakeholders. For example:
  - Changes to the safety management system which are the responsibility of management.
  - Changes to employee behaviour which only they can make.
  - Issue resolution which only management and employees working together can achieve.
- Effective fatigue management is dependent on the underlying safety culture at the FIFO operation.
- Fatigue should be managed through the FIFO operation's safety management system.

**Table 3** *Managing Fatigue in FIFO operations*

<p><b>Step 1:</b> Identify potential fatigue risk factors. Consider each factor in the context of each specific FIFO operation and associated safety culture.</p>	<p><b>Step 2:</b> Assess the level of risk for the fatigue risk factors identified and set priorities. The green, amber, red and purple colour code used below serves to provide a general <b>indication</b> of the level of risk exposure for each fatigue risk factor.</p>	<p><b>Step 3:</b> Implement control measures where a fatigue risk exposure factor is identified as red or purple risk. Adopt the 'hierarchy of control'. Review the effectiveness of the control measures that have been adopted.</p>
<p><b>1 Work scheduling and planning</b></p>		
<p>Fatigue risk factors</p>	<p>Risk assessment</p>	
	<p><b>Lower</b></p>	<p><b>Higher</b></p>
<p>Shift length (daily work hours)</p>	<p>8 hrs</p>	<p>10 hrs</p>
	<p>12 hrs</p>	<p>&gt; 12 hrs</p>
<p>Shift start/shift finish</p>	<p>Start after 0700 hrs</p>	<p>Finish after 2200 hrs Start before 0600 hrs</p>
	<p>Start before 0700 hrs</p>	<p>Shift duration crosses 0000 hrs and 0500 hrs</p>
	<p>Control measures</p>	<p>Long shift duration is an important cause of fatigue.</p> <ul style="list-style-type: none"> <li>● Scheduled shifts should not exceed 12 hours.</li> <li>● Limit overtime, unscheduled overtime.</li> <li>● Ensure overtime does not become a regular part of working time arrangements.</li> <li>● Limit work to a maximum of 14 consecutive hours in any 24 hours.</li> <li>● Interrupt scheduled sleep periods only when critical to do so.</li> <li>● Implement an exceptions process to manage any work beyond 14 consecutive hours duty time or interruption of scheduled sleep periods (e.g. repair to critical item of equipment, emergency situation).</li> <li>● Monitor hours of work.</li> <li>● Defer non-urgent work.</li> </ul>
	<p>Control measures</p>	<p>Early morning starts can lead to sleep loss from both the early start and from difficulties associated with trying to sleep in the early evening.</p> <ul style="list-style-type: none"> <li>● Avoid or limit shifts that start or finish between 2200 hrs and 0600 hrs.</li> <li>● Avoid scheduling tasks that are susceptible to fatigue at the start and end of these shifts.</li> <li>● Formalize procedures to ensure that information exchanged at shift handover is correct and complete.</li> <li>● Ensure enough time for effective communication at shift handover.</li> </ul>

*continued...*



Table 3 Managing Fatigue in FIFO operations (continued)

<p><b>Step 1:</b> Identify potential fatigue risk factors. Consider each factor in the context of each specific FIFO operation and associated safety culture.</p>	<p><b>Step 2:</b> Assess the level of risk for the fatigue risk factors identified and set priorities. The green, amber, red and purple colour code used below serves to provide a general <b>indication</b> of the level of risk exposure for each fatigue risk factor.</p>	<p><b>Step 3:</b> Implement control measures where a fatigue risk exposure factor is identified as red or purple risk. Adopt the 'hierarchy of control'. Review the effectiveness of the control measures that have been adopted.</p>
<p><b>1 Work scheduling and planning (continued)</b></p>		
<p>Fatigue risk factors</p>	<p>Risk assessment</p>	<p>Control measures</p>
<p>Breaks during work</p>	<p>Lower Adequate regular breaks</p>	<p>The length of time between breaks and the number of breaks impact on the overall risk of incidents.</p> <ul style="list-style-type: none"> <li>• Ensure that there are adequate and regular breaks. Consider providing short breaks of 5–15 minutes every 1–2 hours.</li> <li>• After every 5 hours of work, consider providing a longer break of 30 minutes to enable meals to be taken.</li> <li>• Provide some flexibility and allow employees to take breaks as required.</li> </ul>
<p>Break between shifts</p>	<p>10–12 hrs 12 hrs or more (adequate time for travelling, eating, washing and sleeping)</p>	<p>Inadequate breaks between shifts will reduce the time available for sleeping. Sleep is the time the body regenerates, as well as allowing for memory consolidation, learning and other brain functions. Note: this should be considered in conjunction with shift timing. A 12-hour break across the night, is much more effective for sleeping than a 12-hour break across the day.</p> <ul style="list-style-type: none"> <li>• Ensure breaks between shifts allow enough time for travelling, eating, washing and sleeping.</li> <li>• Provide a protected 8-hour sleep opportunity.</li> <li>• Advise employees that they should not consume tea, coffee or other sources of caffeine within 4–6 hours of going to sleep.</li> <li>• Provide adequate facilities for sleep, rest and meals.</li> <li>• Provide a good range of fitness equipment. Maintain a basic level of fitness.</li> </ul>
<p>Higher &lt; 8 hrs (inadequate time for travelling, eating, washing and sleeping)</p>		<p>Inadequate or infrequent breaks</p>
<p>8–10 hrs</p>		<p>Break between shifts</p>

continued ...

Table 3 Managing Fatigue in FIFO operations (continued)

<p><b>Step 1:</b> Identify potential fatigue risk factors. Consider each factor in the context of each specific FIFO operation and associated safety culture.</p>	<p><b>Step 2:</b> Assess the level of risk for the fatigue risk factors identified and set priorities. The green, amber, red and purple colour code used below serves to provide a general indication of the level of risk exposure for each fatigue risk factor.</p>	<p><b>Step 3:</b> Implement control measures where a fatigue risk exposure factor is identified as red or purple risk. Adopt the 'hierarchy of control'. Review the effectiveness of the control measures that have been adopted.</p>
<p><b>1 Work scheduling and planning (continued)</b></p>		
<p><b>Fatigue risk factors</b></p>		
<p><b>Risk assessment</b></p>		
<p>Shift pattern (length of tour)</p>	<p><b>Lower</b> 14 days or less</p> <p><b>Higher</b> &gt; 28 days</p>	<p>Long tours of duty increase accident risk due to cumulative fatigue.</p> <p><b>14 day tours</b></p> <ul style="list-style-type: none"> <li>● Provide an alternating shift pattern with 14 days on one tour and 14 nights on the next. This shift pattern removes the mid-tour roll-over and also halves the numbers of circadian adjustments over the working year.</li> <li>● Avoid rotating from nights to days mid-tour.</li> </ul> <p><b>28 day tours</b></p> <ul style="list-style-type: none"> <li>● Provide a shift pattern where employees change shifts from days to nights mid-way through their tour.</li> </ul>
<p>Break between tours of duty</p>	<p>14 days or more</p> <p>7–14 days</p> <p>&lt; 7 days</p>	<p>Breaks of sufficient duration enable individuals to recover from a sleep debt built up following a long work schedule. Longer periods at work require longer periods for recovery.</p> <p><b>14 day tours</b></p> <ul style="list-style-type: none"> <li>● Provide, as a minimum, a break of 14 days between tours.</li> <li>● Provide a break of 21/28 days after night work tours, e.g. 14 work days/14 rest days/14 work nights/21 rest days</li> </ul> <p><b>28 day tours</b></p> <ul style="list-style-type: none"> <li>● Provide a break of 28 days between tours.</li> </ul> <p><b>Second jobs</b></p> <ul style="list-style-type: none"> <li>● Discourage employees from taking second jobs during breaks between tours of duty.</li> </ul> <p>Extended breaks between tours may impact employee ability to maintain situational awareness of operating processes.</p> <ul style="list-style-type: none"> <li>● Ensure effective crew handover procedures are in place.</li> </ul>

continued ...

Table 3 Managing Fatigue in FIFO operations (continued)

<p><b>Step 1:</b> Identify potential fatigue risk factors. Consider each factor in the context of each specific FIFO operation and associated safety culture.</p>	<p><b>Step 2:</b> Assess the level of risk for the fatigue risk factors identified and set priorities. The green, amber, red and purple colour code used below serves to provide a general <b>indication</b> of the level of risk exposure for each fatigue risk factor.</p>	<p><b>Step 3:</b> Implement control measures where a fatigue risk exposure factor is identified as red or purple risk. Adopt the 'hierarchy of control'. Review the effectiveness of the control measures that have been adopted.</p>
<p><b>1 Work scheduling and planning (continued)</b></p>		
<p>Fatigue risk factors</p>	<p>Risk assessment</p>	<p>Control measures</p>
	<p>Lower &lt; 7</p>	
<p>Consecutive night shifts</p>	<p>7–14</p>	<p>Higher &gt; 21</p>
	<p>&gt; 14</p>	<p>Long tours of night shifts are associated with cumulative fatigue due to a lack of restorative sleep. Reliable execution of safety-critical/complex tasks is highly susceptible to employee fatigue.</p> <ul style="list-style-type: none"> <li>● Plan safety-critical/complex work for daytime.</li> <li>● Avoid scheduling safety-critical/complex work between 0200–0600 hrs and to a lesser extent between 1400–1600 hrs.</li> <li>● Avoid scheduling higher-risk tasks on the first and second nights of a tour of night shifts.</li> <li>● Minimize routine administrative tasks so that employees can focus on their primary tasks.</li> </ul> <p>Planned naps are an effective fatigue countermeasure.</p> <p><b>Emergency naps</b></p> <ul style="list-style-type: none"> <li>● Schedule emergency naps for around 40 minutes to allow employees to prepare for their nap, to sleep for 20–30 minutes and to refresh and regain alertness before returning to work.</li> </ul> <p><b>Scheduled rest</b></p> <ul style="list-style-type: none"> <li>● Provide a 90–100 minute sleep opportunity plus 30 minutes to refresh and regain alertness before returning to work. Where a safety-critical task is to be undertaken, this should be done with a colleague not suffering from sleep inertia.</li> </ul> <p><b>Facilities</b></p> <ul style="list-style-type: none"> <li>● Provide appropriate facilities for napping.</li> </ul>
<p>Speed and direction of shift rotation</p>	<p>Forward rotation (day/afternoon/nights)</p>	<p>The speed and direction of rotation influence individual fatigue and individual adaptation.</p> <ul style="list-style-type: none"> <li>● Avoid rotating shifts quickly (e.g. every 2–3 days).</li> <li>● Avoid rotating shifts every week.</li> <li>● Use forward rotation (morning/afternoon/night) whenever possible.</li> <li>● Minimize the number of circadian adjustments over the year.</li> </ul>
<p>Backward rotation (night/evening/morning)</p>	<p>Slower rotation (weekly/3–4 weekly)</p>	

continued ...

Table 3 Managing Fatigue in FIFO operations (continued)

<p><b>Step 1:</b> Identify potential fatigue risk factors. Consider each factor in the context of each specific FIFO operation and associated safety culture.</p>	<p><b>Step 2:</b> Assess the level of risk for the fatigue risk factors identified and set priorities. The green, amber, red and purple colour code used below serves to provide a general indication of the level of risk exposure for each fatigue risk factor.</p>	<p><b>Step 3:</b> Implement control measures where a fatigue risk exposure factor is identified as red or purple risk. Adopt the 'hierarchy of control'. Review the effectiveness of the control measures that have been adopted.</p>																
<p><b>2 Hours of work</b></p>																		
<p>Fatigue risk factors</p>	<p><b>Risk assessment</b></p> <table border="1"> <tr> <td data-bbox="475 1550 518 1729">Lower</td> <td data-bbox="475 1361 518 1550"></td> <td data-bbox="475 1173 518 1361"></td> <td data-bbox="475 990 518 1173">Higher</td> </tr> <tr> <td data-bbox="523 1550 608 1729">Total hours worked in a 7-day period</td> <td data-bbox="523 1361 608 1550">60 hrs</td> <td data-bbox="523 1173 608 1361">84 hrs</td> <td data-bbox="523 990 608 1173">&gt; 84 hrs</td> </tr> <tr> <td data-bbox="612 1550 697 1729">Total hours worked over a 4-week period</td> <td data-bbox="612 1361 697 1550">240 hrs</td> <td data-bbox="612 1173 697 1361">336 hrs</td> <td data-bbox="612 990 697 1173">&gt; 336 hrs</td> </tr> <tr> <td data-bbox="702 1550 786 1729">Commute from camp to workplace</td> <td data-bbox="702 1361 786 1550">&lt; 15 mins</td> <td data-bbox="702 1173 786 1361">15–30 mins</td> <td data-bbox="702 990 786 1173">&gt; 60 mins</td> </tr> </table>	Lower			Higher	Total hours worked in a 7-day period	60 hrs	84 hrs	> 84 hrs	Total hours worked over a 4-week period	240 hrs	336 hrs	> 336 hrs	Commute from camp to workplace	< 15 mins	15–30 mins	> 60 mins	<p><b>Control measures</b></p> <p>Longer periods at work require longer periods for recovery.</p> <p>Long commuting times to and from camp to work increase the working day and may reduce time available for sleeping. In addition, driving at the end of a shift may be hazardous.</p> <ul style="list-style-type: none"> <li>• Reduce hours worked to account for long commute time.</li> <li>• Provide company transport.</li> <li>• Provide a sleep opportunity before commute begins.</li> </ul> <p>Unpredictable overtime/shift extensions can cause difficulty in scheduling sufficient sleep and cause acute or cumulative fatigue.</p> <ul style="list-style-type: none"> <li>• Avoid regular overtime when working 12-hr shifts.</li> <li>• Set a limit of 14 hrs work in any one shift or any period of 24 hrs.</li> <li>• Implement an exceptions process to manage any work beyond 14 hrs duty time (e.g. repair to critical item of equipment, emergency situation).</li> </ul> <p>Split shifts reduce time available in which to obtain restorative sleep.</p> <ul style="list-style-type: none"> <li>• Eliminate/avoid the use of split shifts for particular jobs or activities.</li> <li>• Reduce working hours.</li> <li>• Increase staff numbers.</li> <li>• Optimize timing so that employees are provided with the best sleep opportunity.</li> </ul>
Lower			Higher															
Total hours worked in a 7-day period	60 hrs	84 hrs	> 84 hrs															
Total hours worked over a 4-week period	240 hrs	336 hrs	> 336 hrs															
Commute from camp to workplace	< 15 mins	15–30 mins	> 60 mins															
<p>Overtime/shift extensions</p>	<p>Predictable shifts</p> <p>Occasional shift extended by &lt; 2 hrs or on-call</p> <p>Regular, unpredictable shift extensions of &lt; 2 hrs or on-call</p> <p>Unpredictable shift extensions of &gt; 2 hrs or on-call</p>	<p>Split shifts (length of the total working day)</p>																

continued ...

Table 3 Managing Fatigue in FIFO operations (continued)

<p><b>Step 1:</b> Identify potential fatigue risk factors. Consider each factor in the context of each specific FIFO operation and associated safety culture.</p>	<p><b>Step 2:</b> Assess the level of risk for the fatigue risk factors identified and set priorities. The green, amber, red and purple colour code used below serves to provide a general <b>indication</b> of the level of risk exposure for each fatigue risk factor.</p>	<p><b>Step 3:</b> Implement control measures where a fatigue risk exposure factor is identified as red or purple risk. Adopt the 'hierarchy of control'. Review the effectiveness of the control measures that have been adopted.</p>
<p><b>3 Operational and site factors</b></p>		
<p><b>Fatigue risk factors</b></p>	<p><b>Risk assessment</b></p>	
<p>Employee fatigue</p>	<p><b>Lower</b> Employees report feeling well-rested, generally getting 6+ hours sleep per night, and rarely exhibit fatigue-related symptoms.</p>	<p>Employees report periods of fatigue, generally get 6+ hours sleep per night, and exhibit low level fatigue-related symptoms.</p>
	<p>Employees report periods of fatigue, often get less than 6 hours sleep per night, and exhibit moderate level fatigue-related symptoms.</p>	<p><b>Higher</b> Employees report regular periods of fatigue, regularly get less than 6 hours sleep per night, and exhibit severe level fatigue-related symptoms.</p>
<p>Physical or mental demand</p>	<p><b>Control measures</b></p> <p>Fatigue increases the risk of incidents and long-term health problems.</p> <ul style="list-style-type: none"> <li>● Inform all employees of their responsibility to report for work fit, rested and alert.</li> <li>● Foster a site culture in which employees are comfortable declaring they are fatigued or have observed fatigue in a colleague.</li> <li>● Encourage employees to discuss personal sleep or other health issue with their line manager or a member of the site health team.</li> <li>● Adopt a fatigue impairment checklist that supervisors can use to make decisions regarding the management of declared or observed fatigue (see the Annex on page 38).</li> <li>● Implement a 'just culture' that supports intervention to address observed or declared fatigue.</li> </ul> <p>Physical and mental demands can increase fatigue risk and adversely impact human performance.</p> <ul style="list-style-type: none"> <li>● Re-design jobs to eliminate or reduce repetitive or boring work, sustained physical or mental effort, or highly complex tasks.</li> <li>● Plan an appropriate workload for the length and timing of the shift.</li> <li>● Consider shortening the length of the shift if work is particularly demanding.</li> <li>● Schedule demanding tasks for when employees are most alert and least likely to be fatigued.</li> <li>● Ensure that rest breaks, task variation and job rotation during shifts allow recovery from physical and/or mental fatigue.</li> <li>● Ensure staffing levels are sufficient to address task demands.</li> <li>● Provide training and experience to enable multi-skilling and effective job rotation.</li> </ul>	

continued ...

Table 3 Managing Fatigue in FIFO operations (continued)

<p><b>Step 1:</b> Identify potential fatigue risk factors. Consider each factor in the context of each specific FIFO operation and associated safety culture.</p>	<p><b>Step 2:</b> Assess the level of risk for the fatigue risk factors identified and set priorities. The green, amber, red and purple colour code used below serves to provide a general <b>indication</b> of the level of risk exposure for each fatigue risk factor.</p>	<p><b>Step 3:</b> Implement control measures where a fatigue risk exposure factor is identified as red or purple risk. Adopt the 'hierarchy of control'. Review the effectiveness of the control measures that have been adopted.</p>
<p><b>3 Operational and site factors (continued)</b></p>		
<p><b>Fatigue risk factors</b></p>		
<p><b>Risk assessment</b></p>		
	<p><b>Lower</b></p>	
<p>Seasonal variability (hours of light/hours of darkness)</p>	<p>Higher</p>	<p>Prolonged hours of light/darkness</p>
<p>Religious requirements of fasting or extended wakefulness (e.g. Ramadan)</p>	<p>Not applicable</p>	<p>Applicable</p>
<p>Staffing levels</p>	<p>Adequate staffing levels</p>	<p>Inadequate staffing levels</p>
<p>Workload</p>	<p>Appropriate and varied workload</p>	<p>Inappropriate workload</p>
<p>The long daylight hours of summer and the long dark days of winter experienced in many countries both impact employee ability to obtain the restorative sleep they need.</p> <p><b>Long daylight hours</b></p> <ul style="list-style-type: none"> <li>Advise employees to practise good sleep hygiene.</li> <li>Provide adequate facilities for sleep, i.e. cool, quiet and dark.</li> <li>Provide eye masks and ear plugs.</li> </ul> <p><b>Dark days</b></p> <ul style="list-style-type: none"> <li>Advise employees to practise good sleep hygiene.</li> <li>Provide adequate facilities for sleep, i.e. cool, quiet and dark.</li> <li>Schedule time outside in natural daylight.</li> <li>Encourage regular exercise.</li> </ul>	<p>Employees who observe Ramadan may experience increased levels of fatigue.</p> <ul style="list-style-type: none"> <li>Educate employees about how the observance of religious practices can increase the risks of fatigue and of the fatigue countermeasures that can be adopted.</li> </ul>	<p>Inadequate staffing levels may lead to excessive hours of work which are fatiguing, and to delays in planned maintenance activities.</p> <ul style="list-style-type: none"> <li>Provide adequate staffing levels and relief systems to avoid regular working of excessive hours or overtime.</li> </ul>
<p>Individuals with an appropriate and varied workload will be more effective.</p> <ul style="list-style-type: none"> <li>Plan an appropriate and varied workload.</li> <li>Provide a variety of tasks, both physical and mental, and if practical allow employees to choose the order in which they are undertaken.</li> </ul>		

continued...

Table 3 Managing Fatigue in FIFO operations (continued)

<p><b>Step 1:</b> Identify potential fatigue risk factors. Consider each factor in the context of each specific FIFO operation and associated safety culture.</p>	<p><b>Step 2:</b> Assess the level of risk for the fatigue risk factors identified and set priorities. The green, amber, red and purple colour code used below serves to provide a general <b>indication</b> of the level of risk exposure for each fatigue risk factor.</p>			<p><b>Step 3:</b> Implement control measures where a fatigue risk exposure factor is identified as red or purple risk. Adopt the 'hierarchy of control'. Review the effectiveness of the control measures that have been adopted.</p>	
<p><b>3 Operational and site factors (continued)</b></p>					
<p><b>Fatigue risk factors</b></p>		<p><b>Risk assessment</b></p>			<p><b>Control measures</b></p>
<p>Safety-critical work</p>	<p><b>Lower</b></p> <p>Safety-critical tasks undertaken during the daytime</p>		<p><b>Higher</b></p>	<p>Arrange safety- and production-critical tasks so they are undertaken when employees are most likely to be alert. Avoid these tasks:</p> <ul style="list-style-type: none"> <li>● towards the end of a shift;</li> <li>● in the early hours of the morning; and</li> <li>● immediately after a meal.</li> </ul> <p>Other job design measures that can be taken to minimize fatigue risk to safety- and production-critical tasks include:</p> <ul style="list-style-type: none"> <li>● providing additional supervision;</li> <li>● co-worker double-check systems;</li> <li>● varying workload; and</li> <li>● rotating between tasks.</li> </ul>	
	<p>Minimal exposure</p>	<p>Significant exposure</p>		<p>The mental and physical demand of work may influence employee fatigue.</p> <ul style="list-style-type: none"> <li>● Avoid working during periods of temperature extremes.</li> <li>● Control exposure to chemical and physical agents to national/international occupational exposure limits.</li> </ul> <p>NB: Exposures may need to be adjusted to reflect shift length.</p> <ul style="list-style-type: none"> <li>● Consider whether different types of personal protective equipment are required for different shifts.</li> <li>● Ensure that the workplace is well lit.</li> <li>● Avoid work environments that promote drowsiness, i.e. quiet, warm, badly lit and lacking stimulation.</li> </ul>	
<p>Fatigue awareness and countermeasures training</p>	<p>Training provided to all employees</p>	<p>No training provided</p>		<p>Training gives employees and supervisors the knowledge and skills required to implement fatigue risk controls.</p> <ul style="list-style-type: none"> <li>● Educate all employees who work extended hours or around-the-clock about good sleep hygiene, napping and the strategic use of caffeine.</li> <li>● Provide comprehensive supervisor fatigue training.</li> </ul>	

continued ...

Table 3 Managing Fatigue in FIFO operations (continued)

<p><b>Step 1:</b> Identify potential fatigue risk factors. Consider each factor in the context of each specific FIFO operation and associated safety culture.</p>	<p><b>Step 2:</b> Assess the level of risk for the fatigue risk factors identified and set priorities. The green, amber, red and purple colour code used below serves to provide a general <b>indication</b> of the level of risk exposure for each fatigue risk factor.</p>	<p><b>Step 3:</b> Implement control measures where a fatigue risk exposure factor is identified as red or purple risk. Adopt the 'hierarchy of control'. Review the effectiveness of the control measures that have been adopted.</p>
<p><b>4 Individual factors</b></p>		
<p>Fatigue risk factors</p>	<p>Risk assessment</p>	
	<p>Lower</p>	<p>Higher</p>
<p>Sleep opportunity</p>	<p>Night-time sleep</p>	<p>Daytime sleep</p>
<p>Fitness for work (FFW)</p>	<p>Minimal FFW or health issues</p>	<p>Several FFW or health issues</p>
<p>Daytime sleep is less restorative than night-time sleep. Both sleep quantity and quality are affected.</p> <ul style="list-style-type: none"> <li>● Provide accommodation that facilitates daytime sleep, i.e. cool, dark and quiet.</li> <li>● Provide single occupancy bedrooms/cabins. If this is not feasible consider double occupancy bedrooms where one employee works days and the other nights.</li> </ul>		
<p>Medical conditions, sleep disorders, prescription medicines, over-the-counter drugs and alcohol can affect sleep quantity or quality.</p> <ul style="list-style-type: none"> <li>● Offer employees who are about to start work at a FIFO operation a pre-placement health assessment.</li> <li>● Educate employees and their families about sleep disorders.</li> <li>● Provide employees with access to professional advice, e.g. an employee assistance programme, a sleep disorder clinic, an on-site health centre.</li> <li>● Educate employees about the impact that prescription medicines, over-the-counter medicines and alcohol can have on sleep.</li> </ul>		

continued ...



Table 3 *Managing Fatigue in FIFO operations (continued)*

<p><b>Step 1:</b> Identify potential fatigue risk factors. Consider each factor in the context of each specific FIFO operation and associated safety culture.</p>	<p><b>Step 2:</b> Assess the level of risk for the fatigue risk factors identified and set priorities. The green, amber, red and purple colour code used below serves to provide a general <b>indication</b> of the level of risk exposure for each fatigue risk factor.</p>	<p><b>Step 3:</b> Implement control measures where a fatigue risk exposure factor is identified as red or purple risk. Adopt the 'hierarchy of control'. Review the effectiveness of the control measures that have been adopted.</p>
<p><b>5 Travel to the workplace</b></p>		
<p><b>Fatigue risk factors</b></p>	<p><b>Risk assessment</b></p>	
	<p><b>Control measures</b></p>	
<p>Total travel time from home to place of work</p>	<p><b>Lower</b> &lt; 4 hrs</p>	<p><b>Higher</b> &gt; 12 hrs</p>
<p>Number of time zones crossed</p>	<p>&lt; 2 time zones</p>	<p>&gt; 6 time zones</p>
<p>Rest on arrival at work prior to commencement of first shift</p>	<p>&gt; 24 hrs</p>	<p>6–12 hrs</p>
<p>Sleep debt and circadian disruption will impact on employee alertness and performance, particularly on the first shift of the tour.</p> <ul style="list-style-type: none"> <li>● Start work on the day after arrival and travel home on the day after the tour is finished.</li> <li>● Provide accommodation to enable employees to sleep before/after travel, particularly before/after international travel.</li> <li>● Roster a shorter first day (late start/early finish) and minimize safety-critical activities during the first 24–48 hours.</li> <li>● Adjust the shift schedule to take account of long travel time to the workplace.</li> <li>● Encourage employees to sleep during travel to the workplace, particularly those that involve travel across multiple time zones. Consider providing international rotators with a travel pillow, ear plugs, eye mask and fleece.</li> </ul>		

## Annex: Fatigue impairment checklist for supervisors

This checklist is designed to assist supervisors in making decisions regarding fatigue management, and guide the subsequent supervisory response to confirm that decisions are made in a consistent manner. Think of this checklist as a guide to a conversation in four parts.

Fatigue is a state of tiredness that is associated with long hours of work, prolonged periods

without sleep, or the requirement to work when an individual would normally be resting.

The checklist responses reflect the opinions and perceptions of the worker who has completed it. The checklist alone cannot determine or verify whether a worker is fatigued.

### Step 1: Observation

What do you notice about the worker's behaviour or how they are working compared to their usual pattern of behaviour over the last month?

	Yes	No
1. They appear to be having problems keeping their eyes open.	<input type="checkbox"/>	<input type="checkbox"/>
2. They keep nodding their head.	<input type="checkbox"/>	<input type="checkbox"/>
3. They keep yawning.	<input type="checkbox"/>	<input type="checkbox"/>
4. They demonstrate poor concentration.	<input type="checkbox"/>	<input type="checkbox"/>
5. They demonstrate poor coordination.	<input type="checkbox"/>	<input type="checkbox"/>
6. They demonstrate poor communication skills.	<input type="checkbox"/>	<input type="checkbox"/>
7. They stare.	<input type="checkbox"/>	<input type="checkbox"/>
8. They demonstrate problems remembering things.	<input type="checkbox"/>	<input type="checkbox"/>
10. They appear to be distracted.	<input type="checkbox"/>	<input type="checkbox"/>
11. They appear easily irritated.	<input type="checkbox"/>	<input type="checkbox"/>
12. They appear depressed.	<input type="checkbox"/>	<input type="checkbox"/>

**If you have answered 'yes' to three or more of the above, go to Step 2**

### Step 2: Understand the situation

	Yes	No
1. Has this worker reported themselves, or has someone else reported them as being at risk of fatigue?	<input type="checkbox"/>	<input type="checkbox"/>
2. Do they perform safety or production-critical roles?	<input type="checkbox"/>	<input type="checkbox"/>
3. If the answer to either question 1 or 2 above is 'Yes', do you recommend that further enquiries are made into the worker's behaviour?	<input type="checkbox"/>	<input type="checkbox"/>

**If you think further enquiries are required, go to Step 3.**

**Step 3: Speak to the employee**

You should speak to the worker; this may help you understand or explain what you have noticed. For example, a worker may not be fatigued, but they may have a low blood-sugar level because they have not had anything to eat in the past eight hours.

Possible causes of fatigue include:

- Long hours of work.
- Prolonged periods without sleep.
- Working when an individual would normally be resting.

What is their explanation of what you have noticed?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

1. According to the worker, how many hours is it since they last slept? \_\_\_\_\_ hours
2. According to the worker, how long did they sleep for (at least 6 hours)? \_\_\_\_\_ hours
3. According to the worker, how many hours continuous rest did they have before starting work? \_\_\_\_\_ hours
4. According to the worker, is there a reason they did not get enough sleep or why they did not sleep well?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

5. What tasks have they done during this shift?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

6. Are these tasks fatigue-inducing (for example, are they repetitive, monotonous, dull, boring or conducted in a warm or poorly lit environment)? Yes  No

If 'Yes', for how long have they been doing these tasks? \_\_\_\_\_ hours

7. According to the worker, how long ago did they last have a break? \_\_\_\_\_ hours
8. According to the worker, how long was that break? \_\_\_\_\_ hours
9. According to the worker, how long ago did they last have a drink or something to eat? \_\_\_\_\_ hours

**Continue to Step 4—decide what action, if any, is required**

Notes:

Shift start time: \_\_\_\_\_ Shift end time: \_\_\_\_\_

**Step 4: Action**

- You should now decide whether or not it is safe to allow the worker to carry on with their tasks.
- There are several suggestions about things that might help below, but if you believe these will not work, you should consider sending the worker home. You should ask yourself what else you might need to do to stop this incident from happening again.

	Yes	No
1. Do you think that the worker should continue working without further action being taken?	<input type="checkbox"/>	<input type="checkbox"/>
2. If the answer to question 1 is no, what action will be taken?		
● Move them to a lower-risk activity.	<input type="checkbox"/>	<input type="checkbox"/>
● Have them do different tasks.	<input type="checkbox"/>	<input type="checkbox"/>
● Let them have a short break.	<input type="checkbox"/>	<input type="checkbox"/>
● Let them have a nap.	<input type="checkbox"/>	<input type="checkbox"/>
● Have them work with a partner or supervise them more.	<input type="checkbox"/>	<input type="checkbox"/>
● Send them home (perhaps in a taxi).	<input type="checkbox"/>	<input type="checkbox"/>
3. Have any problems with fatigue been identified for this worker in the past?	<input type="checkbox"/>	<input type="checkbox"/>
4. Have you done the following?		
● Filled in an incident report.	<input type="checkbox"/>	<input type="checkbox"/>
● Referred them for training in managing fatigue.	<input type="checkbox"/>	<input type="checkbox"/>
● Referred them to the employee assistance programme or to Occupational Health.	<input type="checkbox"/>	<input type="checkbox"/>
● Sent your completed checklist to your fatigue management supervisor.	<input type="checkbox"/>	<input type="checkbox"/>

Name of the worker: \_\_\_\_\_

Name of the supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

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