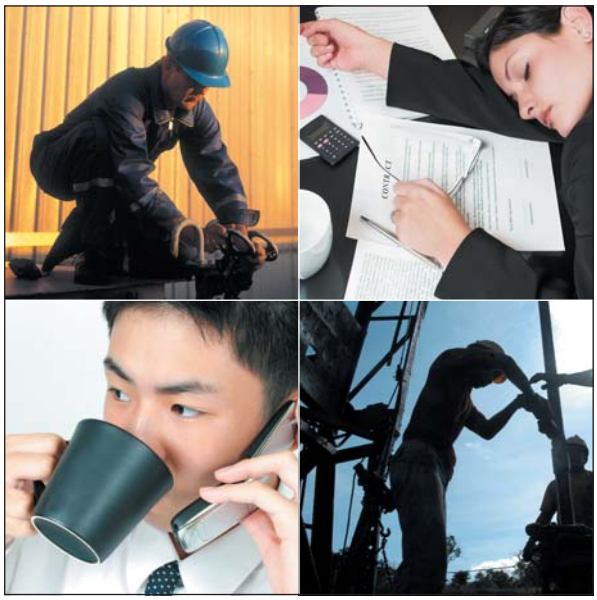

Managing fatigue in the workplace

A guide for oil and gas industry supervisors and occupational health practitioners

IPIECA

OGP

OGP Report Number 392

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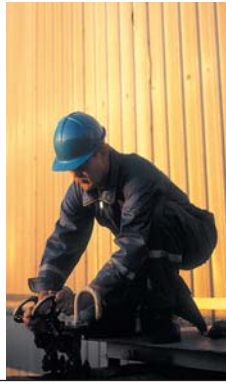


Purpose of this Guide

Fatigue can be defined as a progressive decline in alertness and performance that results in sleep. Fatigue is an everyday occurrence and in an ideal world would not pose a significant health and safety risk. The 24/7 society in which we live, however, insists that many people work outside of 'standard' office hours and thus experience an elevated level of fatigue. Shift work, long work hours and international travel can all promote fatigue. Other causes of fatigue include medical disorders, such as sleep disorders, medication, drugs and alcohol.

Excessive fatigue can have significant adverse outcomes for performance, health and well-being. Fatigue impairs our performance and—particularly in safety-critical industries—can contribute to serious incidents. Excessive fatigue affects millions of people around the world, and costs billions of dollars per year in medical expenses, accidents, injuries and lost productivity.

This guide is intended primarily as a tool to assist oil and gas industry supervisors and occupational health practitioners to understand, recognize and manage fatigue in the workplace.

The guide sets out to:

- explain the health and safety risk posed by fatigue;
- provide the necessary background information on sleep and the body clock; and
- describe the main causes of fatigue and provide strategies for managing the causes.

It is recognized that the information and recommendations given in this guide could have operational, manpower and financial impact; however, the guidance is based on sound scientific principles and deviation from this guidance potentially increases the risk of fatigue-related incidents. In the absence of regulation the extent to which this guidance is applied should be agreed between the stakeholders involved.

Why manage fatigue?

Accidents

Investigations into some of the worst industrial and environmental accidents of the past 30 years have identified fatigue as a major contributory factor to the incident. In some of these cases, fatigue was not the sole cause. Rather, there was an initial difficulty such as a technical fault, and because the operators were fatigued they did not manage the situation adequately and the situation escalated to an accident.

Fatigue contributes to accidents by impairing performance and at the extreme end of the scale by causing people to fall asleep. The UK Department for Transport has estimated that at least 20 per cent of fatal road accidents on UK motorways are the result of a driver having fallen asleep at the wheel. Fatigue is particularly problematic amongst professional drivers; in the USA driver sleepiness is estimated to have contributed to 57 per cent of fatal accidents involving trucks.

Why manage fatigue?

Performance

The impact that fatigue can have on performance and safety is not widely recognized and is generally underestimated. One of the key reasons for this lack of awareness is that fatigue cannot be directly measured. There is no chemical in the blood or any biological specimen that can give an accurate indication of how tired someone is.

To improve our appreciation of fatigue and its consequences for performance, researchers have compared the effects of fatigue to those of alcohol. Research has shown that after approximately 22 hours of wakefulness a person's performance will be as impaired as if they had a blood alcohol concentration (BAC) of 0.10 per cent, which is double the legal driving limit in most countries in the EU (Figure 1). In other words, one night of sleep deprivation can produce performance impairment significantly greater than what would be acceptable if you were driving a vehicle.

Our performance is impaired when we are fatigued quite simply because fatigue reduces (deactivates) the electrical activity of some regions of our brain (see Figure 2). Reductions in activation are especially evident in prefrontal cortices (the highlighted region to the right)—which control functions like situational awareness and problem-solving; the inferior temporal cortices (the highlighted region to the left) which are important for mental tasks such as mathematical calculation; and the thalamus (central highlighted region) which controls general alertness levels and attention.

Figure 1 Comparison on the effects of sleep loss and alcohol on performance (BAC = blood alcohol concentration)

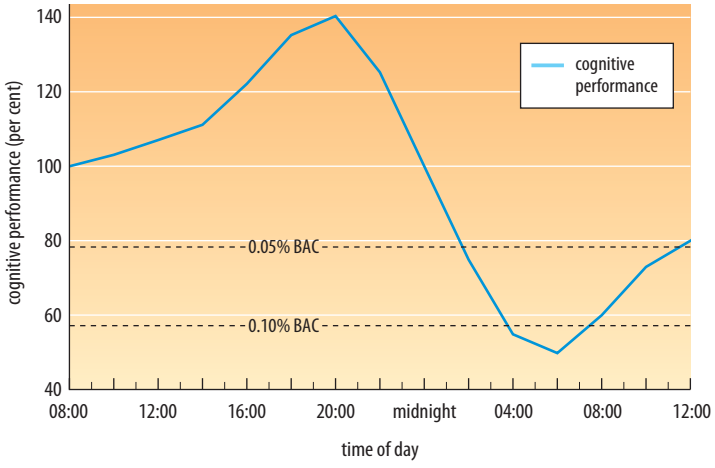
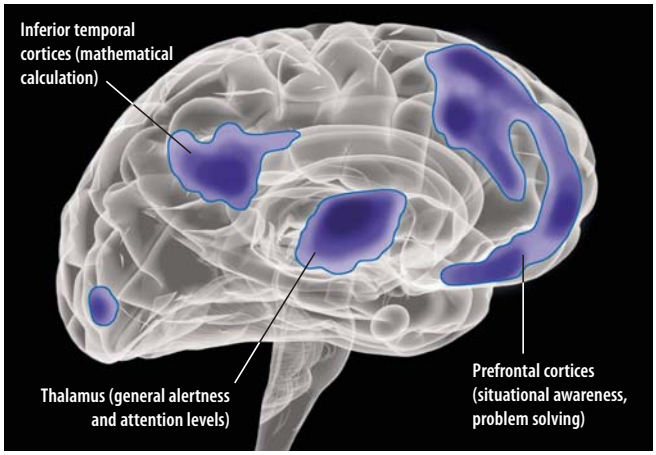


Figure 2 Fatigue reduces the electrical activity in some regions of the brain, and hence impairs performance. The highlighted areas indicate the areas of the brain in which the reduction of activity is especially evident.



Adapted from Thomas *et al.*, 2006

Health

We all know from personal experience that fatigue can make us irritable and short-tempered. In addition to having a negative impact on mood, fatigue has adverse consequences for health. There is increasing evidence to suggest that sleep loss is a risk factor for obesity and diabetes. In a recent study subjects who slept only four hours a night for two nights had an 18 per cent decrease in the hormone that tells the brain there is no need for more food (leptin), and a 28 per cent increase in the hormone that triggers hunger (ghrelin).

Shift workers encounter a particularly high degree of sleep loss and it seems likely that fatigue plays a role in the health complaints encountered by this group. Researchers have concluded that shift work is 'probably bad for the heart, almost certainly bad for the head and definitely bad for the gut' (Monk and Folkard, 1992).

Sleep and the body clock

There are a multitude of causes of fatigue ranging from long work hours, high workload and jet lag to intense domestic demands, health and drug/alcohol use. These factors can cause fatigue in a number of ways, for example by presenting demanding mental or environmental conditions, by promoting dehydration or increasing stress. Nonetheless, the prime underlying mechanisms via which fatigue is generated are insufficient sleep, prolonged wakefulness, being awake when one would normally be sleeping or trying to sleep during the day. This section provides background information on sleep and the body clock required to understand and manage fatigue.

Why do we sleep?

One answer to the question 'why do we sleep?' is because without sleep we are debilitated by fatigue and cannot survive. However, the actual purpose of sleep is still not completely understood. It is not simply the case that during sleep we 'switch off'. Sleep is a highly complex physiological process throughout which the brain is active, and some parts of the brain are as active during sleep as when we are awake. It seems likely that sleep serves a variety of purposes, including tissue repair and the consolidation of memory and learning.

How much sleep do we need?

Just as we all vary in how quickly alcohol affects us and how easily we lose or gain weight, we also differ in the amount of sleep that we need to perform optimally. Most adults need 7 to 8 hours of sleep in every 24 hours to be at their best, and a small proportion need as little as 6 hours or as much as 10 hours sleep. By necessity or choice sometimes we only obtain four or five hours sleep. While we can certainly function on this amount of sleep the important point to remember is that we will not be capable of our optimal performance.

The amount of sleep that you ideally need is not something you can change. For example, if your daily sleep requirement is nine hours and you regularly obtain six hours

How to determine your personal sleep need

If you want to determine how much sleep you need to perform optimally, you can do so next time you are on holiday by following these steps:

- Put your alarm clock away and arrange your daily schedule so that you can wake up naturally every morning.
- Allow at least two days to overcome any existing cumulative sleep loss.
- For the next three or four days, write down the time you go to bed at night and what time you naturally wake up in the morning.
- Calculate the average amount of sleep you obtain for these three or four days. This is the amount of sleep you require for optimal alertness, performance and well-being.

Sleep and the body clock

your body will not learn or adapt to getting less sleep. You may become accustomed to feeling tired, to the point that you don't even recognize it any more, but you will always require nine hours to be at your best.

Acute and cumulative sleep loss

Sleep loss can be either acute (losing a large proportion of one night's sleep), for example as a result of having to stay awake with a sick child, or more commonly, cumulative (regularly losing sleep over many nights), for example as the result of working a sequence of consecutive early shifts. Scientists have compared the effects of acute and cumulative sleep loss and found that both forms of sleep loss result in reduced levels of alertness or performance. A study in which sleep was restricted to between four and six hours per night for a fortnight found that cognitive performance, including attention and working memory, gradually deteriorated from one day to the next. By the end of the two-week period, performance had declined to a similar level to when the same people were kept awake continuously for between 24 and 48 hours.

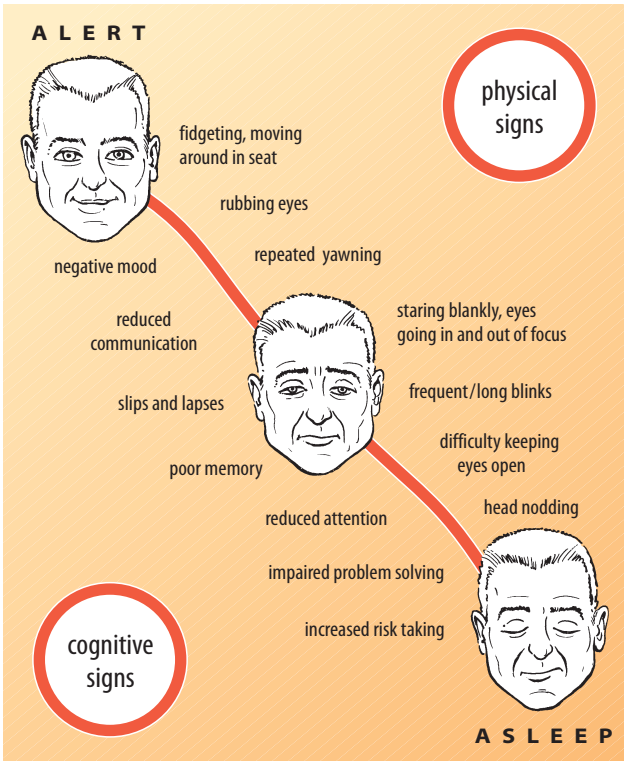
Two nights of good quality sleep should usually be sufficient to enable you to recover from acute sleep loss, i.e. you don't need to make up the lost sleep on an hour-for-hour basis. However, when you have lost sleep over repeated days you accumulate a 'sleep debt'. The amount of sleep required to recover fully from this sort of cumulative sleep loss is not yet known, but it is likely to be longer than two nights of sleep.

The consequences of sleep loss

Research has shown that for most people even one night of six hours sleep will lead to impaired performance the next day. Obviously the more sleep deprived we are the more impaired we become.

Figure 3 illustrates the physical and cognitive signs of fatigue, in increasing severity, that can be observed as fatigue progresses until the point that we are falling asleep uncontrollably.

Figure 3 The physical signs and cognitive symptoms of increasing fatigue



The cognitive signs of fatigue include:

i) Negative mood

Fatigue has a negative impact on our emotions and reduces our tolerance for what is going on around us. When we are fatigued we become irritable and are more easily frustrated. Fatigue makes us feel lethargic and lacking in initiative and motivation. We have a reduced willingness to interact with others.

ii) Reduced communication

Fatigued people have both a reduced willingness and a reduced ability to communicate. When we are fatigued we tend to use less descriptive language and may neglect to pass on important information to colleagues; this can be particularly problematic during the changeover of shift teams.

iii) Slips and/or lapses

An increase in slips and/or lapses is one of the easiest cognitive signs of fatigue to detect. A slip is defined as accidentally doing the wrong thing, for example picking up the wrong tool, while a lapse is defined as accidentally not doing the right thing, for example forgetting to tighten a nut.

iv) Poor memory

Fatigue impairs our short-term memory so that we do not always remember what we have done and what has not been done. When we are tired we may not be able to recall recent conversations or information we have read.

v) Reduced attention

Fatigue decreases our ability to maintain attention. When fatigued we find it more difficult to divide our attention appropriately between multiple tasks and to plan for future actions. We are more likely to suffer lapses in concentration and are more easily distracted from the task at hand.

Fatigue can lead us to become fixated on one particular task. This 'narrowing of focus' or 'cognitive tunnelling' can cause us to pay too much or insufficient attention to peripheral events and auxiliary tasks.

vi) Impaired problem solving

Fatigue disrupts many of the processes involved in effective problem solving, including: the identification and evaluation of alternative courses of action; construction of mental images; and the integration of incoming information with existing knowledge. When fatigued we tend to persevere with ineffective solutions, to keep trying the same old solution even if it doesn't work.

vii) Increased risk taking

Fatigue affects our ability to assess risks and increases our willingness to accept risks. The more tired we become, the more likely we are to cut corners and to accept lower standards in accuracy and performance.

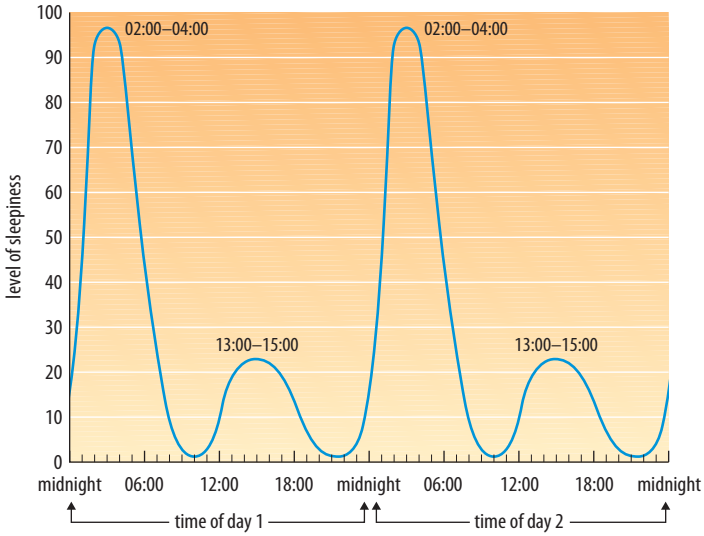
The body clock

All living beings, including plants, animals and humans, are regulated by 24-hour biological rhythms, known as circadian rhythms, which prime us for activity during the day and sleep during the night. In humans the source of circadian rhythms is the body clock, which is primarily located in a cluster of cells in the brain. The body clock is comparable to the conductor of a symphony orchestra. It instructs almost all of the body systems, including the sleep/wake cycle, cardiovascular activity and hormone secretion, to vary in a circadian rhythm.

Figure 4 (overleaf) shows the circadian rhythm in sleepiness. Sleepiness is relatively low in the evening and increases late at night to reach a peak in the early hours of the morning (approximately 02:00 to 04:00). It then declines and remains low during the day, except for a second small increase that occurs

Sleep and the body clock

Figure 4 The circadian rhythm in sleepiness



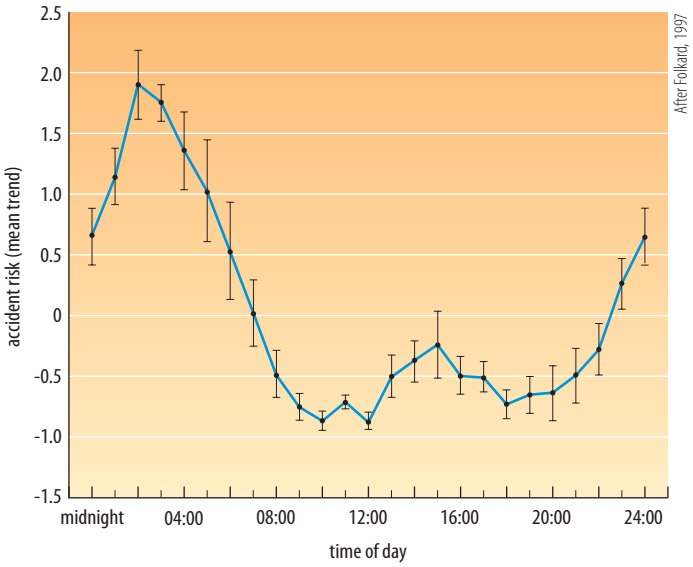
in the afternoon (approximately 13:00–15:00). The pattern repeats itself every 24 hours.

The early morning circadian peak in sleepiness coincides with an increase in fatigue-related accidents that occurs at this time of day (see Figure 5). Research conducted in the UK has found that 32 per cent of fatigue-related road accidents on motorways occur in the early hours of the morning. Shift workers returning home from a night shift are particularly likely to be involved in road accidents at this time of day. The small increase in sleepiness that occurs in the afternoon is the reason why some cultures take a nap or a siesta after lunch. From Figure 5 you can see there is also a small increase in fatigue-related accidents at this time of day.

The body clock and sleep

The circadian rhythm in sleepiness has an important influence on sleep and ensures that we get most sleep when we go to bed between about 22:00 and 02:00. It is also the reason why we have most difficulty sleeping between approximately 08:00 and 12:00 noon, and again between 17:00 and 21:00. These times are known as 'forbidden zones' for sleep. The forbidden zone in the evening is an important reason why sleep loss is problematic when working early shifts. Employees may try to go to sleep early knowing they have to be awake at 04:00 but the forbidden zone prevents them from falling asleep until around 22:00.

Figure 5 Road traffic accident risk over the 24-hour day (mean trend, and standard errors)



Shift work

The health and safety consequences of shift work

Most people understand intuitively what is meant by the term 'shift work' although the actual definitions vary from region to region and country to country. In the UK, for example, it is referred to as 'night work' as part of the European working time directive. Night work is defined as work between the hours of 23:00 and 06:00. Employees should be considered as 'night workers' if their daily working time includes at least three hours of work at night:

- on most days they work;
- on a proportion of the days they work which is specified in a collective or workforce agreement; or
- often enough for it to be said that they work such hours 'as a normal course'.

The words 'as a normal course', means on a regular basis. There has been a Court ruling that a worker who worked at night for one-third of his working time was a night worker. Occasional or ad hoc work at night does not make an employee a night worker.

For people working 'typical office hours' work and sleep occur at times that are aligned with the timing of the body clock. Work is scheduled for daytime hours when alertness is high and sleep is initiated when the body clock has prepared the body for sleep. For the 15–20 per cent of the working population in industrialized countries that are involved in shift work, however, work and sleep occur at times of the day which conflict with the underlying body clock.

Shift workers encounter fatigue because they need to sleep when the body is programmed for wakefulness and are at work when the circadian rhythm in sleepiness is high. The degree of fatigue that shift workers encounter depends on the schedule that is being worked, but is generally most severe on night shifts and shifts that start early in the morning. Unpredictable work hours, for example call-out arrangements, are also particularly problematic.

An additional disadvantage to shift work is that it can lead to feelings of isolation and to relationship difficulties. Shift work can place added strain on social and personal relationships. Working shifts can also make it difficult to lead a healthy lifestyle, for example due to eating irregularly and at times that are out of synch with the body's natural rhythms and by making it more difficult to keep to an exercise schedule.

Research has shown that, in the long term, there is an association (but not necessarily a causation) between shift work and increased incidences of:

- domestic disharmony;
- gastrointestinal problems, including peptic ulcers;
- cardiovascular disease, including hypertension and coronary heart disease;
- spontaneous abortions, miscarriages and premature births in pregnant women; and
- possibly breast and colon cancer.

The causation of all these conditions is multi factorial.

Do we adapt to shift work?

Daily cues (known as 'zeitgebers') ensure that the timing of our body clock matches the 24-hour period of day and night. The most important zeitgeber is light and this influences the body clock via receptors in the eye. Other zeitgebers include temperature, activity and food. When we work shifts or travel to a different time zone, the timing of zeitgebers changes. In response, the timing of our body clock gradually changes so that eventually it matches the new timing of the zeitgebers.

After travelling across a time zone the timing of all zeitgebers is similarly changed. As a result, the body clock can usually shift by

Shift work

approximately 30 to 60 minutes per day and successful adaptation eventually occurs.

In contrast, when working shifts the timing of zeitgebers that are associated with work are changed, while those associated with the environment remain the same. For example, the times that you are active and are asleep change, but you may still eat at normal times and are exposed to sunlight during the day. These mixed messages mean that the timing of the body clock changes very slowly and successful adaptation to shift work almost never occurs. In addition, any adaptation that occurs over a block of shifts is usually undone on days off when shift workers revert to the routine of their family and friends.

Managing the fatigue risk associated with shift work

Fatigue Management Plans (FMPs) are becoming increasingly common in safety critical industries including the oil and gas industry. An FMP is a framework designed to enable operational and employee concerns regarding fatigue to be addressed in a preventative manner. The aim of an FMP is to maintain, and when possible, enhance safety, performance and productivity and manage the risk of fatigue in the workplace.

FMPs typically include the following fundamental components (Baker and Ferguson, 2004):

a) Policy

A document formally outlining the approach, commitment and accountability, including a requirement for internal and external auditing processes.

b) Training

A training and education programme to enable employees and managers to identify the signs and symptoms of fatigue, and to adopt coping strategies in and outside the workplace.

c) Tracking incidents: metrics

A programme for the tracking and understanding of all incidents, accidents and near misses. These events should be plotted for time of day, day of roster, hours of prior wakefulness and sleep length in order to determine the role that the roster and sleep loss may have played in the event.

d) Support

Medical and well-being support that includes diagnosis of sleep disorders and other health problems causing sleep disturbance, treatment of sleep problems and, where necessary, referrals to general practitioners, psychologists, counsellors and sleep clinics.

Designing safer shift work arrangements

Within the framework of an FMP it is necessary to assess the risks associated with the schedules being worked. There are many different shift work schedules, each with different features. The sheer diversity of work and workplaces means that there is no single optimal shift system that suits everyone. However, there are a number of key risk factors in shift schedule design, which should be considered when assessing and managing the risks of shift work. These are the workload, the work activity, shift timing and duration,

direction of rotation and the number and length of breaks during and between shifts. Other features of the workplace such as the physical environment, management issues and employee welfare can also contribute to the risks associated with shift work.

Good practice guidelines for shift design

- Plan an appropriate and varied workload.
- Where employees are working rotating shifts these should be forward rotating (e.g. earlies, days, lates).
- Ideally, where rotating shifts are operated, rotation should be rapid (e.g. every two to three days).
- Avoid early morning starts. Shift change-over time should take into account the length of commute and the availability of public transport.
- Limit shifts to 12 hours including overtime.
- Encourage workers to take regular breaks and allow some choice as to when they are taken.
- Consider the needs of vulnerable workers, such as young workers, and new and expectant mothers.
- The aging workforce brings with it additional challenges in managing shift operations.
- Limit consecutive work days to a maximum of five to seven days and restrict long shifts, nights and earlies to two to three consecutive shifts.
- Allow two nights of full sleep when switching from days to night shifts and vice versa.
- Build regular free weekends into the shift schedule.

Good practice guidelines for the work environment

- Provide night workers with similar facilities (e.g. canteen, food storage and preparation) and access to training opportunities to those available during daytime.
- Ensure temperature and lighting is appropriate and preferably adjustable.
- Provide training and information on the risks of shift work and ensure supervisors and management can recognize problems.
- Consider increasing supervision during periods of low alertness.
- Control overtime, shift swapping and on-call duties and discourage workers from taking second jobs.
- Allow time for communication at shift handovers.
- Provide opportunities for interaction between shift workers and support for lone workers.
- Encourage workers to tell their family doctor and occupational health physician that they are shift workers.
- Provide free health assessments for night workers, the content of which should focus on relevant health issues.
- Ensure the workplace and surroundings are well lit, safe and secure.

Additional considerations: offshore units and drilling rigs

Offshore shift systems tend to be different from those onshore in that they are 12 hours in duration for periods of 14 to 21 days. 'Split shifts' where operators work 7 nights followed by 7 days are also common. This shift is very difficult to adapt to as operators are 'out of phase' for 5 of the 7 nights and then go out of phase again for the following 4 to 5 days. However, this shift is favoured because operators are adjusted to a normal day/night cycle at the end of their tour.

Evidence suggests that a 7-day/7-night shift would be better but this means operators would have to spend the first few days back onshore recovering from nights. On arrival back onshore many operators will also be tired following their last night shift and consequently may not be fit enough to continue their journey home by car. Alternative methods of

Shift work

travel, including car sharing (pooling) and or the provision of suitable facilities in which operators could rest (take an extended nap) would need to be explored.

At present the most favoured offshore shift schedule would appear to be 14 days and 14 nights operating between 06:00–18:00–06:00. Operational units working a 14-day on/21-day off shift pattern should consider moving to this schedule.

Researchers have also predicted that a 14-day/14-night schedule operating between 00:00–12:00–00:00 would be better and have speculated that a schedule operating between 03:00–15:00–03:00 would be better still.

Research also indicates that it might be possible to improve adaptation with carefully timed light treatment; careful timing of main sleep periods; and the use of napping during night shifts, particularly during the first night of a tour.

Rapid shift rotation is not advocated offshore. Safety critical tasks should not be scheduled during circadian low points (03:00–05:00). Review manning and workload levels and consider appointing additional multi-skilled staff who are able to cover staff shortages arising because of fatigue or who can assist/help with safety critical tasks that cannot be rescheduled.

Extended tours of duty

Each operating unit should have a work time control process in place which describes normal shift pattern rotation schedules, routine work periods, control process and contingency arrangements to deal with the occasional circumstances when the standard cannot be complied with.

Sleep debt will build when working for extended periods without a break. Night shift workers' performance, in particular, will decrease as the tour progresses. Workload/task assignment/staffing levels may need to be amended/modified to reflect this. Recommendations include monitoring for adverse effects, scheduling safety critical tasks for the safest period of the shift and verifying that these have been completed correctly.

Suggested requirements	
Extended tours of duty	
Maximum working hours within a 24 hour period	12 hours total
Maximum number of working days per tour	28 days including travel to and from site
Work breaks (including meals) during a working shift	Minimum of 30 mins. break after every 5 hrs.
Offshore platforms	
Maximum working hours within a 24 hour period	12 hours total
Maximum number of working days per tour	28 days including travel to and from site
Work breaks (including meals) during a working shift	Minimum of 30 mins. break after every 5 hrs.
Direction of shift rotation	Morning then evening
Speed of rotation	Shift should rotate over a long period of time and as a minimum every 7 days

Personal countermeasures

How well an individual copes with shift work is dependent on a range of factors including their age, the ease with which childcare arrangements can be organized, commute time and their health. Young adults seem to cope better with shift work than older workers, one reason being because from middle age onwards the structure of our sleep changes. With increased age we spend less time in deep sleep and our sleep becomes more disrupted.

The degree of training and support that employees require to fulfil their responsibilities within an FMP will vary between organizations

and populations. However, education about personal countermeasures to assist individuals to cope with shift work is essential.

The following sections provide suggestions for shift workers that may help them cope better with their work hours:

At work

- Schedule tedious and boring tasks for times of the day when alertness is high, and leave the stimulating and motivating tasks for times of the day when alertness is lower.
- Use a 'buddy system' so that colleagues help to keep each other alert and encourage breaks if signs of drowsiness appear.
- Exercise, walk around or do some physical activity during breaks.
- Use caffeinated drinks (coffee, tea, colas) strategically—avoid them at times when you are alert and use them as a countermeasure when alertness is low.
- Advise your supervisor if you have had insufficient sleep, feel tired or are exhibiting any of the signs and symptoms of fatigue outlined in Figure 3.
- For many shift workers the most high-risk task that they perform is driving home in the morning or at the end of a tour of duty. If possible, avoid driving home by using an alternative form of transport or arranging a lift. If you have to drive ensure you are properly rested before setting off.

Naps

Naps can be used to prepare for, or recover from, work (e.g. before a night shift or after an early start), before driving home and, where appropriate, at work. During the night shift the best time to nap is between approximately 04:00 and 06:00. Obviously, the longer a nap the greater the benefit it will have for alertness. If you nap for longer than 30 minutes, however, you need to give yourself time to recover from sleep inertia—the groggy feeling that we experience when we wake from a deep sleep which results in poor coordination and cognitive impairment.

A 'power nap' of 15 to 20 minutes is not as beneficial as a longer nap but it does avoid the problem of sleep inertia. You can enhance the value of a nap by consuming some caffeine just before the nap. Caffeine takes about 20 minutes to take effect so when you wake up from the nap you will be experiencing the alerting properties of both the nap and the caffeine.

At home

To improve the degree to which employees cope with shift work they will need the help of their families and friends. Below are some of the things that they can do at home to improve their quality of life:

Try to schedule your social/domestic responsibilities around sleep

- Explain to your family/friends why it is important that you obtain sufficient sleep and the consequences that tiredness can have for you, them and safety.
- At the same time, schedule special times for family and friends so they know when to expect to spend time with you.
- Put your roster on the fridge (or somewhere prominent) so others know when you will be at home and at work.
- Use a 'Do not disturb' sign on the bedroom door.

Diet and exercise

A healthy diet provides longer-lasting energy—concentrate on complex carbohydrates (e.g. oats) rather than simple carbohydrates (sugar) and avoid fatty foods and junk food. Contrary to some speculations, there is no scientific evidence that some foods (e.g. turkey) promote sleep. Nonetheless, sitting down to have a glass of warm milk before bed can be relaxing, particularly if part of a bedtime routine.

Shift work

Most of us are aware of the benefits of exercise, but did you know that physical exercise can improve your sleep? Regular exercise taken earlier in the day can be an effective aid for sleeping, partly because it is a means of relieving stress. It is important that you don't exercise just before sleep though as the adrenalin released during exercise can make it difficult to get to sleep.

Avoid alcohol and nicotine

Many people believe that drinking alcohol can help them get a good night's sleep. However, while it is true that alcohol has a relaxing and sedative effect, it actually disrupts sleep. Alcohol increases the likelihood of snoring, causes early awakening, disrupts sleep quality and increases fatigue the next day. When used by individuals suffering from insomnia or obstructive sleep apnœa (see 'Health and sleep disorders' on page 14), alcohol increases the severity of the sleep disorder.

If you smoke, avoid smoking cigarettes immediately before going to bed: nicotine is a mild stimulant and may increase the amount of time that it takes you to fall asleep.

Evening preparation

During the evening as bedtime approaches there are a number of strategies that can be implemented to promote sleep. These strategies concentrate on helping you to gently unwind and prepare both your body and mind for sleep.

- *Unwind by avoiding anxiety*
  In the hours before bedtime avoid activities that will make you mentally active or anxious. Using the internet or playing computer games prior to bedtime can make it more difficult to unwind for sleep.
- *Have a warm shower or bath*
  Another particularly useful strategy for promoting sleep and relaxation is to take a warm bath or shower. Research has shown that we fall asleep faster when we have warm feet.
- *Being too full or hungry*
  Obviously going to bed hungry can disturb your sleep. A light snack before bed, such as a bowl of cereal with milk, can stave off hunger pangs during the night. To avoid being kept awake by indigestion steer clear of acidic, spicy or high fat foods. Another reason for avoiding fat and sugar in the evening is that our metabolism falls to its lowest point at night, meaning we are less likely to burn off the extra calories.
- *Write a 'to-do' list*
  Make a list of things to do before you go into the bedroom. Rather than lying awake and worrying about forgetting things that you have to do, keep a pen and paper by your bed.
- *Establish a bedtime routine*
  To train your mind and body to prepare for sleep you should establish a consistent bedtime routine. By following the same pattern of daily behaviour, over time your body will come to associate this with sleep.

  An example routine could be: to switch everything off downstairs, lock the front door, have a light snack, a relaxing bath, brush teeth, prepare clothes for tomorrow, get into bed, set alarm clock, read for 15 minutes, and put the light out.

Prepare an ideal bedroom environment

- *Keep the bedroom for sleep*
  It goes without saying that the bedroom should be comfortable and relaxing, but all too often we treat our bedrooms as an extension of our living rooms or offices. The bedroom should be reserved for sleep and intimate relations, and not for surfing the internet or other activities that will make you mentally active or anxious. Remove desks, computers and even televisions as these can all prevent you from relaxing. Taking away these items will eventually lead you to naturally associate the room with sleep and to feel calm when you enter.
- *Block out light*
  Street lights, daylight and the light from a television can all upset circadian rhythms and send a signal to the brain that it is time to wake up. Try to keep your bedroom as dark as possible by fitting heavy curtains. Alternatively, wear an eye mask.
- *Keep your bedroom quiet*
  Below are some of the basic things you can do to help minimize the chances that you will be disturbed by noise when trying to sleep:
  - Turn off the phone and switch your mobile phone off or to silent mode;
  - Put a 'Do not disturb' sign on the front door;
  - Use ear plugs or fit double glazing;
  - Use a source of white noise (e.g. a fan).

- *Keep your bedroom cool*
  Our ability to regulate our body temperature is diminished when we are asleep. Therefore, if during the night it is too cold or too hot we spend more time in the lighter stages of sleep, or awake (so that we can control temperature better). We sleep best when the bedroom temperature is slightly cool (approximately 18° C).
- *Ensure your bed is comfortable*
  As a rule your bed should be neither too hard nor too soft. If your mattress is lumpy or worn it is worth investing in a new one: after all, you spend a third of your life in bed.

  Your pillow can also affect your sleep. Depending on what position you sleep in you may need a different type of pillow. If you sleep mainly on your stomach a soft pillow may be best for you. If most of the time you sleep on your back you may benefit from a medium pillow, whereas if you sleep on your side you may prefer a firm pillow. If you have back or neck pain during sleep or when you awake, you will probably benefit from a contour pillow, which can minimize the strain on your neck during the night.

Sleep hygiene

Appendix 1 provides a list of undesirable sleep hygiene practices. This can be used to raise employee awareness of sleep hygiene and to stimulate discussion about the types of strategies that could be implemented to increase the chances of obtaining effective sleep and promoting daytime alertness.

Health and sleep disorders

There are a multitude of medical causes of sleep loss including pain, chronic cough, mental ill-health and sleep disorders. While the proportion of accidents related to health complaints is not known, sleep disorders can lead to a significant increase in accident risk: one study found that the accident rate of people with a sleep disorder was more than 13 times higher than that of a control group. There are more than 80 medically-defined sleeping disorders: some of these disorders, e.g. insomnia, affect us all at one time or another, while others are extremely rare. This section provides information on some of the more common sleep disorders.

Obstructive sleep apnœa (OSA)

Obstructive sleep apnœa (OSA) is a sleep disorder associated with obstruction of the airway in the throat. Complete obstruction can last from a few seconds to up to 30 seconds and may occur many times an hour. Each closure of the airway results in hypoxia (oxygen deficiency) which causes the sufferer to awaken momentarily to re-open the airway. OSA is always accompanied by loud snoring and sometimes by gasping or choking sounds.

As OSA causes repeated awakening it is inevitably associated with poor sleep quality, excessive fatigue and performance impairment. Research has shown that drivers suffering from OSA are typically between 2 and 3 times more likely to have road accidents than those without the condition. As well as increasing the risk of accident, OSA is a serious medical disorder which, if left untreated, increases the risk of heart disease, diabetes and stroke.

Who is at risk from OSA?

As many as 4 per cent of men and 2 per cent of women are thought to suffer from OSA. The disorder can affect anyone but is particularly common in middle-aged men; it is associated with obesity and large neck size. The majority of people who suffer from OSA do not know that they have the disorder. People can suffer from the condition—undiagnosed—for many years, and be unaware of their debilitation.

If someone has OSA their sleeping partner is more likely than them to be aware of the loud snoring and respiratory pauses. A partner may also note frequent awakenings, body jerking and gasping.

What treatments are available for OSA?

The most effective treatment for OSA is to use a CPAP (Continuous Positive Airway Pressure) device when sleeping. A CPAP device consists of a mask that fits over the nose, and in rare cases over the mouth, connected via a plastic tube to a mini-air compressor. The stream of air that flows through the nose forces the airways to remain open, thereby facilitating unobstructed breathing and stopping snoring. The device does not cure sleep apnœa, but when used correctly and every night, this treatment can substantially reduce symptoms and reduce the risk for cardiovascular morbidity and mortality.

Unfortunately many people that try CPAP do not use the device on an ongoing basis. The device can be inconvenient, cause nasal

congestion, claustrophobic sensations, and other side-effects. It is therefore important that people using CPAP receive extensive education, attend regular follow-up appointments and receive the support that they need to maintain treatment.

If an individual cannot use CPAP there are surgical treatment options available, although these are not as effective as CPAP. The surgical options include clearing nasal passages and removal of the uvula along with removal of excess tissue in the palate and pharynx. Some people may benefit from wearing a mandibular advancement device (a type of gum shield) at night. The device holds the lower jaw and tongue forward and elevates the soft palate to keep the airway open.

The severity of sleep apnœa can be reduced with weight loss, avoidance of alcohol, sedatives and muscle relaxants, and by sleeping on the side (OSA is most severe when sleeping on the back). In mild cases of OSA these lifestyle adjustments may provide sufficient relief.

Insomnia

Insomnia is a disorder of too little or poor-quality sleep and usually takes one or more of the following forms:

- Difficulty falling asleep—more common among young people.
- Sleeping lightly and restlessly, waking often, lying awake in the middle of the night—more common in people over 40. In younger people it may be associated with depression.
- Waking early and being unable to get back to sleep—this is more common in older people and anyone worrying about something in particular.

Insomnia can be an acute problem, lasting for a few nights or weeks, or may persist in the long-term, lasting for several weeks, months or even years. It can be caused by a range of factors including stress, grief, job worries, acute illness (fever, coughing, nasal obstruction, etc.), pre-existing medical, physical or psychological conditions as well as poor daytime and bedtime habits. Prescribed medication as well as illicit drug and alcohol use can provoke insomnia.

The solution to insomnia usually involves focusing on practicing good sleep hygiene (see the countermeasures for fatigue described in the section on 'Shift work') and addressing the source of the problem. In cases of acute insomnia this may involve simply waiting for the cause of the insomnia to pass. For long-term insomnia medication may be necessary or attempts made to change attitudes to sleep—a psychologist or sleep specialist can assist with this process.

A short course (two weeks) of prescribed sleep medication, supervised by a doctor, can be useful. As sleeping medication can have hangover effects (reduced alertness and impaired performance the next day) it is important that a doctor advises on whether the individual can drive and what sort of work tasks are appropriate. Long-term use of sleep medication is rarely helpful because people become accustomed to the medication and it loses its effectiveness. Paradoxically, stopping sleep medication can cause insomnia as a withdrawal symptom.

Health and sleep disorders

Periodic limb movements in sleep

Periodic limb movements in sleep (PLMS) is a condition characterized by twitching, jerking or bending of the limbs (usually only the feet or toes) during sleep. The movements briefly wake the individual, although they will not remember this, and lead to poor quality sleep. PLMS movements are usually very small, for example toe twitches, but can include kicking and flailing of the arms and legs.

Most people with PLMS are not aware that they have the disorder although some will complain that no matter how long they sleep they still feel tired. Treatments for PLMS include iron supplements, behavioural or lifestyle changes (e.g. walking, stretching, yoga, massage) and, for severe cases, medication to control symptoms.

Managing the risk of sleep disorders

To manage the risk of sleep disorders it is essential that employees and their partners are educated to identify the signs of these disorders. Appendix 2 provides a copy of a simple scale called the Epworth Sleepiness Scale which can be used to determine an individual's level of daytime sleepiness. The scale can be incorporated into employee screening procedures and annual check-ups, and used to raise awareness of sleep disorders.

Appendix 3 includes a questionnaire that can provide an indication of whether someone may be suffering from OSA. As well as making the questionnaire available at work it is a good idea to mail the questionnaire, plus additional educational material on OSA, to employees' partners as they are the people who are most likely to detect the symptoms of the disorder.

Anyone with a suspected sleep disorder should seek diagnosis and treatment from a doctor and, ideally, from a qualified sleep specialist. Depending on their reported

symptoms they may require an overnight sleep study. This is a non-invasive monitoring procedure that can be performed in hospital or at home, and simply involves recording a range of physiological variables, for example heart rate and brain activity, throughout the night.

If local certified sleep disorder centres are available, it is recommended that a list of these be provided to the employee. It is also important to develop ways of encouraging employees, particularly those in safety-sensitive positions, to voluntarily report and seek diagnosis of any sleep disorder.

Medication

Illicit drugs such as marijuana, heroin, amphetamines and cocaine have obvious adverse consequences for health and safety. This section, however, focuses on prescribed medications and those that are available over the counter at the chemist, which can affect alertness—these are used much more widely than illicit drugs.

Prescription medication

Medication can elevate fatigue in two ways—directly, by reducing alertness (e.g. sedatives) and indirectly, by disrupting sleep. Aside from sleeping medications, prescription medicines that can have sedative effects include painkillers, muscle relaxants and treatments for high blood pressure, anxiety and depression. Medications that can promote fatigue by disturbing sleep include stimulants such as theophylline (a respiratory stimulant used to treat asthma) and treatments for epilepsy and psychiatric disorders.

In addition to having an effect individually, many drugs and medicines can interact to create additional problems. Employees should be advised to always tell their doctor and pharmacist what they do for a living, to make sure that the medication they are taking does not interfere with their responsibility to be fit for work.

Over-the-counter (OTC) medication

Many of the treatments for colds, flu and hay-fever that you can buy at the chemist contain one or more of a group of substances called 'antihistamines'. As well as reducing a runny nose, sneezing, allergies, etc., some antihistamines have such a strong sedating effect that they are also sold, under different names, as night-time sleep aids. Taking antihistamines during the day can impair your performance at work and your ability to drive safely. In fact, the drowsiness caused by these antihistamines is so pronounced that an OTC taken at night can have hangover effects that last into the next day.

The most common antihistamines liable to cause drowsiness are:

- chlorpheniramine;
- diphenhydramine;
- promethazine; and
- triprolidine.

If you need to remain alert, you should check the active ingredients of any OTC medication to make sure these antihistamines are not included. There will usually be an alternative medication available that contains newer antihistamines, developed specifically to have less of a sedating effect.

Other OTC medications that can promote drowsiness include sleeping aids, painkillers and travel sickness pills. Herbal remedies for sleep problems include camomile, valerian root, hops, lavender and passion-flower (*Passiflora*). Herbal sleep aids are unlikely to cause as much of a sedating effect as the aforementioned antihistamines, but they are not so rigorously tested and can have significant side-effects and drug interactions.

Before using any medication always read the warning label and the information leaflet. If in any doubt consult your doctor or the pharmacist.

Jet lag

'Jet lag' is the term applied to the effect on the body of crossing time zones. It is caused by the disruption of the body's circadian rhythms. The effects of jet lag depend on the number of time zones crossed and are subject to each individual's susceptibility. Symptoms can include insomnia, disorientation, tiredness, irritability, as well as changes in eating, sleeping and bowel habits.

To limit jet lag avoid alcohol, caffeine and excess food on flights. Ensure you are not dehydrated—drink plenty of water prior to and during a flight. The rule of thumb is that recovery from jet lag takes 24 hours per time zone crossed. You should avoid critical meetings on the first day after arrival and avoid driving, certainly long distances, for at least a few days.

On business trips that only last a few days you are unlikely to adapt to your new time zone. When possible, it is therefore best to try and maintain your home sleep/wake pattern. If you are staying in a new time zone for an extended period you can speed up the rate at which you adjust by trying to synchronize sleeping patterns and meal times to your new environment as soon as possible.

Resources and further reading

Canadian Lung Association: Sleep Apnœa webpage
website: www.lung.ca/diseases-maladies/apnea-apnee_e.php

Energy Institute, UK: Human Factors webpage
website: www.energyinst.org.uk/index.cfm?PageID=703

International Classification of Sleep Disorders (Philipps-Universität, Marburg, Germany)
website: http://web.uni-marburg.de/sleep/enn/database/asdadefs/welcome.htm

National Institutes of Health, Bethesda, Maryland, USA: sleep disorders
website: http://health.nih.gov/result.asp/601

National Sleep Foundation,Washington DC, USA
website: www.sleepfoundation.org

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Appendix 1

Sleep hygiene

Review the statements below to see which undesirable sleep-related behaviours may apply to you.

Sleep-related behaviours which may affect your ability either to get to sleep or remain asleep, or which can disturb the quality of sleep
I take daytime naps lasting two or more hours
I go to bed at different times from day to day
I get out of bed at different times from day to day
I exercise to the point of sweating within one hour of going to bed.
I stay in bed longer than I should two or three times a week
I use alcohol, tobacco, or caffeine within four hours of going to bed or after going to bed
I do something that may wake me up before bedtime (for example: play video games, use the internet, or clean)
I go to bed feeling stressed, angry, upset or nervous
I use my bed for things other than sleeping or intimate relations (for example: watching television, reading, eating or studying)
I sleep on an uncomfortable bed (for example: poor mattress or pillow, too many or too few blankets)
I sleep in an uncomfortable bedroom (for example: too bright, too stuffy, too hot, too cold or too noisy)
I do important work before bedtime (for example: pay bills or study)
I think, plan, or worry when I am in bed

Adapted from: Mastin *et al.*, 2006

Appendix 2

The Epworth Sleepiness Scale: can you drive a vehicle safely?

How likely are you to doze off or fall asleep in the situations listed below, in contrast to feeling just fatigued? The Epworth Sleepiness Scale is used in many countries and organizations to measure daytime sleepiness and predict the degree of sleep deprivation and/or disturbance and one's ability to drive a company vehicle or perform other tasks without falling asleep. It is closely correlated to the polysomnography or sleep tests.

A self-test to determine whether you are getting enough sleep

The questions below refer to your usual way of life in recent times. Even if you have not done some of these things recently try to imagine how they would have affected you.

Use the following scale to choose the most appropriate number for each situation:
0 = no chance of dozing 1 = slight chance of dozing 2 = moderate chance of dozing 3 = high chance of dozing

What is your chance of dozing in the following situations:	**Enter 0, 1, 2 or 3 (see scale above)**
Sitting and reading	
Watching TV	
Sitting inactive in a public place (e.g. a theatre or a meeting)	
As a passenger in a car for an hour without a break	
Lying down to rest in the afternoon when circumstances permit	
Sitting and talking to someone	
Sitting quietly after a lunch without alcohol	
In a car, while stopped for a few minutes in traffic	
TOTAL SCORE:	

INTERPRETING YOUR SCORE:

Score	**How important is your sleep debt and sleep problem?**
0–5	Slight or none—you are getting enough sleep.
6–10	You are experiencing a moderate degree of sleepiness.
11–20	You are experiencing a high degree of sleepiness.
21–24	You are experiencing a very high degree of sleep loss.

If you score 10 or more on this test, you should consider whether you are obtaining adequate sleep, need to improve your sleep hygiene and/or need to see a sleep specialist. These issues should be discussed with your personal physician.

Any score above 15 should lead to a medical consultation before being authorized to drive a company vehicle or operate heavy machinery in the workplace.

Johns, M. W., 1991

Appendix 3

Do you suffer from obstructive sleep apnœa (OSA)?

The test below provides an indicator as to the likelihood that you might have OSA. The test is by no means definitive and only a trained physician can make a formal diagnosis of OSA.

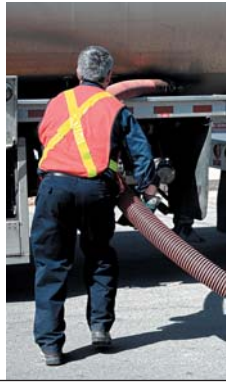
To take the test all you need to do is answer 'Yes' or 'No' to each question and then refer to the box at the bottom of the page. Ideally you should do the test with your bed partner as they can probably help you out with many of the answers.

A self-test to determine whether you suffer from obstructive sleep apnœa

Answer 'Yes' or 'No', then refer to the box at the foot of the page:	**'Yes' or 'No' ?**
1. Are you overweight? (Calculate your BMI using the tool provided in Appendix 4— if your BMI is higher than 30 answer 'yes' to this question.)	
2. Do you snore loudly when sleeping?	
3. Do you choke or gasp at night?	
4. Have you been told that you hold your breath or stop breathing when you sleep?	
5. Do you feel excessively tired and sleepy during the daytime?	
6. Do you have restless sleep and frequently toss and turn at night?	
7. When you wake up in the morning do your mouth and throat feel dry?	
8. Do you suffer from high blood pressure?	
9. Do you wake up at night, feeling your heart thumping, sometimes with an irregular beat?	
10. Do you wake up perspiring heavily?	

INTERPRETING YOUR RESULTS:

If you answered 'Yes' to three or more questions it is recommended that you speak to your doctor as soon you can about the possibility that you might be suffering from OSA.



Appendix 4

Are you obese?

Use the guide below to measure and interpret your body mass index.

Calculation and interpretation of body mass index (BMI)

The BMI is your weight in kilogrammes divided by the square of your height in metres:

$$BMI = \frac{\text{weight in kgs.}}{\text{height in metres} \times \text{height in metres}}$$

Example 1:

If your weight is 70 kg and your height is 1.75 metres, your BMI is calculated as follows:

$$BMI = \frac{70}{1.75 \times 1.75} = 22.85$$

Example 2:

If your weight is 100 kg and your height is 1.75 metres, your BMI is calculated as follows:

$$BMI = \frac{100}{1.75 \times 1.75} = 32.65$$

To determine your BMI using pounds and inches, multiply your weight in pounds by 704.5, then divide the result by your height in inches, and then divide that result by your height in inches a second time.

INTERPRETING YOUR BMI:

BMI	Interpretation
< 18	You are underweight.
20–25	You are in the normal weight range for your height.
25–30	You are overweight.
> 30	You are obese.
> 40	You have what is called 'morbid' obesity.
> 50	You are in the category of 'super' or 'malignant' obesity.

The OGP/IPIECA Membership

Company members
ADNOC
AgipKCO
Amerada Hess
Anadarko Petroleum Corporation
BG Group
BHP Billiton
BP
Cairn Energy
Chevron
CNOOC
ConocoPhillips
Dolphin Energy
DONG
ENI
ExxonMobil
Gaz de France
GNPOC
Hellenic Petroleum
Hocol
Hunt Oil Company
Hydro
Japan Oil, Gas & Metals National Corporation
Kuwait Oil Company
Kuwait Petroleum Corporation
Mærsk Olie og Gas
Marathon Oil
Nexen
NOC Libya
OXY
OMV
Papuan Oil Search Ltd
Perenco Holdings Ltd
Persian LNG
PetroCanada
Petrobras
Petropars Ltd
PDVSA
PEMEX
PDO
Petronas
Petrotrin
Premier Oil
PTT EP
Qatar Petroleum
RasGas
Repsol YPF
Saudi Aramco
Shell International Exploration & Production
SNH Cameroon
Sonatrach
Statoil
TNK-BP Management
TOTAL
Tullow Oil
Wintershall
Woodside Energy
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IADC
IAGC
IOOA
M-I SWACO
NOGEPA
OLF
PAJ
Schlumberger
South African Petroleum Industry Association
UKOOA
WEG
World Petroleum Council

International Association of Oil & Gas Producers (OGP)

OGP represents the upstream oil and gas industry before international organizations including the International Maritime Organization, the United Nations Environment Programme (UNEP) Regional Seas Conventions and other groups under the UN umbrella. At the regional level, OGP is the industry representative to the European Commission and Parliament and the OSPAR Commission for the North East Atlantic. Equally important is OGP's role in promulgating best practices, particularly in the areas of health, safety, the environment and social responsibility.

International Petroleum Industry Environmental Conservation Association (IPIECA)

The International Petroleum Industry Environmental Conservation Association was founded in 1974 following the establishment of the United Nations Environment Programme (UNEP). IPIECA provides one of the industry's principal channels of communication with the United Nations.

IPIECA is the single global association representing both the upstream and downstream oil and gas industry on key global environmental and social issues. IPIECA's programme takes full account of international developments in these issues, serving as a forum for discussion and cooperation involving industry and international organizations.

IPIECA's aims are to develop and promote scientifically-sound, cost-effective, practical, socially and economically acceptable solutions to global environmental and social issues pertaining to the oil and gas industry. IPIECA is not a lobbying organization, but provides a forum for encouraging continuous improvement of industry performance.

IPIECA

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