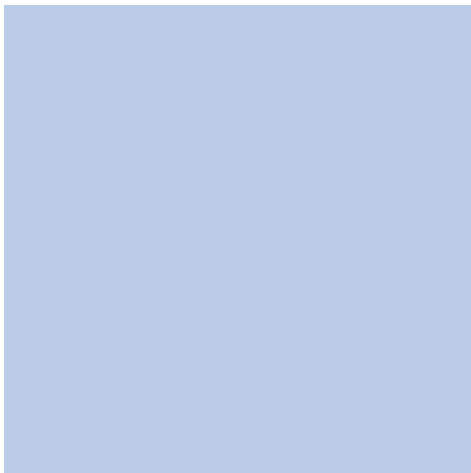


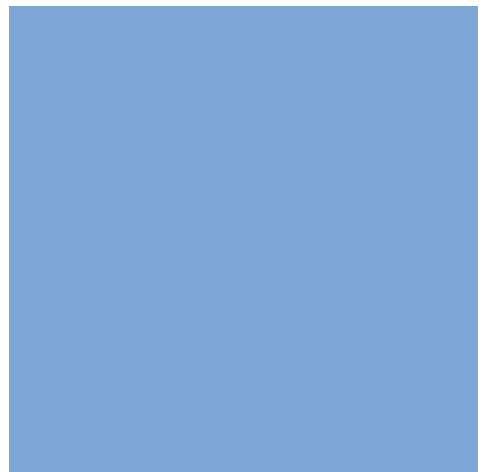
Managing fatigue in the workplace

A guide for the oil and gas industry



THE GLOBAL OIL AND GAS
INDUSTRY ASSOCIATION
FOR ENVIRONMENTAL
AND SOCIAL ISSUES

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Managing fatigue in the workplace

A guide for the oil and gas industry

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A photograph of a person with dark skin sleeping in a hospital bed, partially covered by a white sheet. The scene is dimly lit, suggesting a clinical or hospital environment. A large, semi-transparent blue rectangular overlay is positioned on the left side of the image, containing white text. The text discusses the scope of a publication, mentioning IOGP-IPIECA and four previous reports related to fatigue management in the workplace.

Scope

IOGP-IPIECA have previously developed four publications to assist the oil and gas industry in managing fatigue. This publication supersedes the preceding documents by bringing together and updating all the elements of the previous publications – Report 392 - *Fatigue Management in the workplace*, Report 488 - *Performance indicators for fatigue risk management systems*, Report 492 - *Assessing risks from operator fatigue*, and Report 536 - *Fatigue in fly-in, fly-out operations* – into one resource to help organisations to implement, monitor, and manage fatigue risk management systems.

Executive Summary

Fatigue is defined as a lack of mental alertness, or drowsiness, arising from lack of sleep. It does not include effects of physical effort, exposure to heat, or stress, or other factors. 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 synchronised by an internal process in the brain called the circadian rhythm (or 'body clock'). Every aspect of human function 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 to night shift, the body clock is not always fully able to adjust. In addition, 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, which can take many days, workers' alertness and decision-making 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.

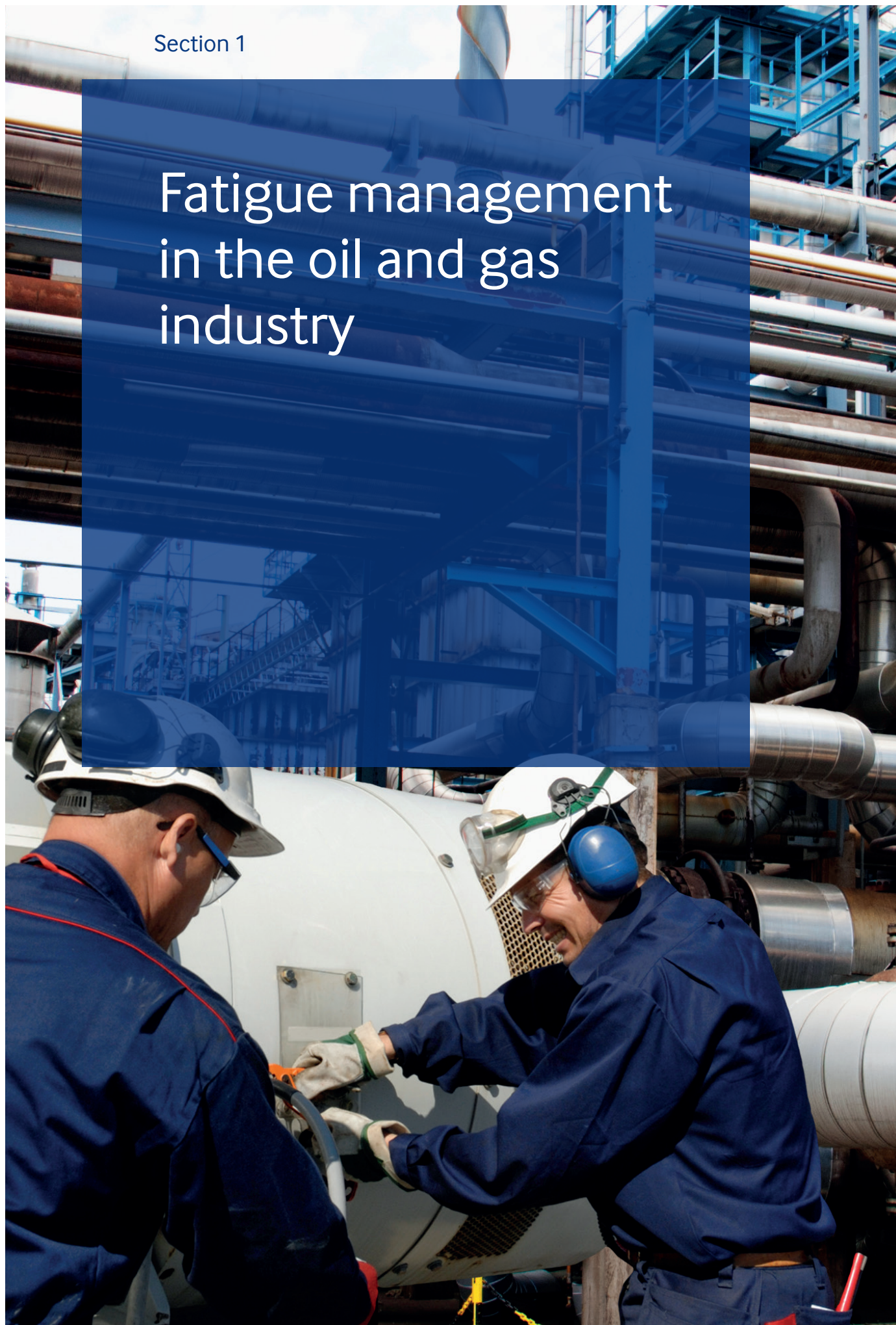
The oil and gas industry operates around the globe and has a number of unique characteristics which can contribute to fatigue. Although not an exhaustive list, this may include challenging work environments, fly-in fly-out operations, time zone changes, 24/7 operations, shift-work and transportation work. Given the inherent risks of the work, fatigue is increasingly being recognised as a potential contributor to safety incidents.

As an industry with a global presence, it is necessary to consider the impact of culture in the countries of operation. Fatigue risk management is inherently intertwined with personal sleep habits. These habits, and the approach to behaviour change, will be influenced by the culture in which the worker's habits have been formed and where they are working. An understanding of this, and sensitivity to any unique aspects, will be fundamental to a successful fatigue risk management approach.

This is a practical 'How To' guide to Fatigue Risk Management and provides an overview of the issues around fatigue with a focus on developing, implementing, and evaluating a Fatigue Risk Management System (FRMS). It gives managers and other personnel an outline of the fatigue risk issues inherent in oil and gas operations and offers guidance on their assessment and management.

Fatigue Risk Management is not simple, but it can be effective; it is a matter of an organisation providing the necessary resources, skills, and time to build a Fatigue Risk Management system that can be implemented, integrated, and updated as and when required. This is a process that requires commitment from senior leaders with support and understanding from the shop floor. It is not a 'one size fits all', 'off the shelf' system that can be easily incorporated with an existing Safety Management System to fulfil regulatory requirements or business conformance. Rather, Fatigue Risk Management is a dynamic programme that moves and flexes with business needs and safety outcomes. It is a means to minimise a recognised and named workplace hazard that can no longer be ignored through misinterpretation or misunderstanding of the issue. The Guide has provided a way to address fatigue as a risk factor for the oil and gas industry. However, what is written here applies to any organisation which has people at its core.

Fatigue management in the oil and gas industry



1. What is fatigue?

IOGP-IPIECA have adopted the definition of fatigue developed by one of their member companies: Fatigue is a lack of mental alertness, or drowsiness, arising from lack of sleep. It does not include the effects of physical effort, exposure to heat, or stress.

Fatigue is 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 (less than 24-hour) period, which is known as acute fatigue, or build 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 and the effect can persist for some days particularly when shifting from night to day shifts. Ongoing sleep disruption or lack of adequate sleep can lead to sleep debt and cumulative fatigue.

1.1 WHY MANAGE FATIGUE RISK IN THE OIL AND GAS INDUSTRY?

The extent to which fatigue affects an individual depends largely on the job being done, the characteristics of the individual, the organisational and social environment, workplace culture, and the features of the working time arrangement including for example breaks and shift duration. The data are extensive and clearly demonstrate that around the clock working time arrangements can create sleep loss and physiological disruption leading to reduced alertness and performance, loss of production and increased incidents. In addition, some jurisdictions have legal requirements in place to manage it.

However, there are significant challenges when addressing fatigue risk management:

1. The diversity among operational requirements. Even within specific work settings, the individual job requirements can vary.
2. The individual differences. Physiological differences exist, for example, sleep need and timing, ability of the body clock to adjust to different working patterns (e.g., day shift and night shift).
3. A company's existing workplace culture is often a formidable challenge to change; established practices, policies, and attitudes may be resistant to change.

4. Economics can be one of the most significant challenges; developing a business case for fatigue risk management can assist in managing this hurdle.
5. Business or locality specific issues may also important. It could be that the performance culture in the business is driving long hours of work or there may be a need to include important cultural or religious considerations, such as Ramadan.
6. Rapidly evolving business, travel, and technology and human interface issues.

1.2 WHO IS AFFECTED BY FATIGUE

All persons have the potential to be impacted by sleep loss and hence experience fatigue. Regardless of role, gender, motivation, endurance, age, training, working environment, or experience, at some point, fatigue is likely to be present in an individual's life.

It may be associated with the sleep loss that accompanies personal and work related stressors such as new parenthood, health events, work and home changes, travel across time zones, extended working hours, meeting deadlines and seasonal demands, participating in a teleconference out of hours, involvement in community, cultural or religious events, etc.

In a general sense fatigue is not an experience that is desired or even welcome. However, for some individuals it may be worn as a mantle of heroism and or devotion and loyalty where promotion may be seen as the reward. This is a misperception about the reasons and consequences of fatigue.

Fatigue and its potential consequences can occur in shiftworkers, night workers, office workers, Fly In Fly Out workers (FIFO), Drive In Drive Out workers (DIDO), Bus In Bus Out workers (BIBO), business travellers, graduates, contractors, workers, visitors to a work place, professional or non-professional drivers, off shore platform workers, managers, supervisors, parents, students who work extended hours, on call or overtime hours and experience acute or chronic sleep loss.

1.2.1 Contractors

At many operational sites in the oil and gas industry, there may be twice as many contractors and sub-contractors as there are company employees. To effectively manage fatigue risk, it is therefore important to include the contractor

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Fatigue management in the oil and gas industry

organisations as part of the stakeholder group during the development, implementation and evaluation phases of an FRMS.

For smaller contractor organisations or those engaged after the commencement of the organisation's FRMS, a standard clause should be inserted into the procurement contract to ensure that the contractor organisation undertakes to manage worker fatigue through an established FRMS. Such a clause may be as simple as:

'The contractor shall manage fatigue through an established fatigue management programme.'

Such a requirement will need to be clearly highlighted in the contractor service level agreement. In addition, the organisation may wish to establish specific key performance indicators (KPIs) to be monitored as part of the quarterly contractor performance review process.

1.3 PURPOSE OF THE GUIDE

To provide managers and other personnel with an outline of the fatigue risk issues inherent in oil and gas operations and guidance on their assessment and management.

1.4 HOW TO USE THE GUIDE

This is a practical 'How To' Guide to Fatigue Risk Management.

It provides an overview of the issues around fatigue with a focus on developing, implementing and evaluating an FRMS. Topics such as sleep, sleep disorders, risk mechanisms and tools, incident investigation processes and questions, learning outcomes for fatigue management training and other information are detailed in this document, its appendices, and associated supplementary documents of IOGP-IPIECA Report 626-1 – *Fatigue Information Sheets*, 626-2 – *Biomechanical Model References*, and Report 626-3 – *Supplementary Checklists and Tools*.

Depending on where the organisation is currently placed in relation to fatigue risk management, some sections of this guide may not be relevant as the business may have already developed and implemented a functional fatigue risk management system.

Therefore, the way to utilise the Guide is to determine the company's current fatigue risk management status and then examine each section and the appendices for information.

Use the relevant sections and information pertinent for the development and or improvement of the fatigue risk programme in the facility.



2. Legislation and Regulation

Historically, the risk associated with fatigue was largely managed by limiting the number of hours worked. Some regions have specific legislation relating to working limits, such as the Working Time Regulations 1998¹ in the UK, which implement the European Working Time Directive². All EU Member States have incorporated the Working Time Directive into their national regulatory frameworks. These working time limits have their foundations in the Conventions of the International Labor Organisation (ILO), which set daily and weekly working hours.

Several countries also have specific legislation relating to fatigue in specific industries or sectors, such as air-traffic control operators and airline crews, train drivers, and/or for drivers of heavy vehicles (see References and further reading at the end of this section).

However, there is increasing understanding that Hours-of-Service (HOS) limits by themselves may not achieve the objective of managing the risk from fatigue. This, together with the restrictive impact on operations, has led industry and regulators to move away from using rules based solely on hours of work, and instead adopt a more comprehensive style of fatigue risk management using fatigue risk management systems (FRMS).

This enables a more flexible approach which may be increasingly relevant as working time arrangements become more complex, being enabled and supported by advanced scheduling tools. This alternative approach to HOS regulations will better assist industry to meet the demands and nature of global operations.

2.1 DISADVANTAGES OF THE HOURS-OF-SERVICE APPROACH

Put simply, one size doesn't fit all, and adherence to prescriptive limits is only part of the picture. If working time limits are embedded in legislation, then safety may be viewed as the responsibility of the regulator and not individual companies. A move from prescription isn't a new philosophy - the 1972 Robens Report³ in the UK suggested that health and safety legislation was too prescriptive, and for it to be more effective, it should focus on goal setting.

Legislation that aims to limit working hours plays a role, but is insufficient on its own. For example, prescriptive limits may state that staff should take rest after a certain number of hours worked, but they don't state where – and the quality of rest may depend upon where and when in the day it is taken. Rest periods on site, or in a nearby worker's camp, may be very different to rest taken at home.

Limits such as those outlined in national legislation or standards often fail to address that fatigue can arise even when the prescriptive limits are not breached. For example, such limits do not consider non-work related causes of fatigue, such as when a worker has a second job, long commutes to and from work, a lack of quality sleep due to the birth of a new baby, or the presence of sleep disorders that affect the quality or quantity of sleep obtained. These approaches assume that workers use their rest breaks between shifts for sleep; however, research shows that this is not always the case, and so they may not be alleviating the potential accumulation of sleep debt or other negative impacts of the work-rest pattern. Compliance with basic legal requirements may not provide the employer with mitigation of the lifestyle factors that they have limited or even no control over, but are known to impact on the quality and quantity of sleep obtained. This means that workers may be arriving at work in a state of sleep deprivation or may develop increased levels of fatigue across the shift even though their working pattern may be compliant with legislative requirements.

Whilst a working time regulatory framework exists in EU Member States, an 'opt-out' clause has been widely adopted, such that many workers are working more than the recommended limits. In other countries, significant exclusions in regulatory frameworks have led to certain staff groups (such as executives and managers) not benefitting from these safeguards. Furthermore, it is not uncommon that substantial gaps exist between legislation and work in practice. There may be definitions of a standard working week, or a requirement for maximum working hours in many countries and regions, but long working hours are still common as per API RP 755 - Fatigue Risk Management System.⁴

Worksafe⁵, an Australian statutory government body that develops policy related to workplace health and safety, takes the view that it is a shared responsibility of employers and employees to manage the risks from fatigue. Furthermore, in the UK it has been recognised that compliance with legislation alone, such as the Working Time Regulations, is insufficient to manage the risks of fatigue. Managing fatigue should be a process, like the management of any other hazard. The risk assessment process required by the Management of Health and Safety at Work Regulations 1999⁶ (MHSWR), like that contained in the International Standard on risk management (ISO 31000),⁷ provides a suitable structure for managing all risks, including fatigue.

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Fatigue management in the oil and gas industry

The 'General Duties' within the MHSWR, the UK Health and Safety at Work Act 1974, and similar legislation in other regions, require employers to protect the health, safety and welfare at work of their employees and others affected by the work – and it is these general duties that underpin a risk management approach to all risks, including fatigue.

In summary, prescriptive approaches assume that compliance with the 'rules' ensures safety. They assign no responsibility to an employee, do not address 'risk', and do not provide management strategies for risk mitigation when and if fatigue occurs.

2.2 HOW IS AN FRMS DIFFERENT TO PRESCRIPTIVE APPROACHES?

The prescriptive approach has now been replaced by a Safety Management System (SMS) framework and the development of a Fatigue Risk Management System (FRMS). An FRMS is a systematic process for proactively managing the risk of fatigue by identifying fatigue risk and developing barriers and controls to reduce this risk.

A clear advantage is that the FRMS approach provides greater operational flexibility, rather than adhering to strict hours-of-work restrictions. It can be designed to best accommodate staff and their requirements; and so is much more flexible, whilst at the same time more robust at managing the risks from fatigue. Unlike approaches based around compliance with legislation, the FRMS approach considers the work activity and environment and provides a mix of controls, metrics, and KPIs as a means of determining effectiveness.

Section 2: References and further reading

1. The Management of Health and Safety at Work Regulations (UK) 1999 <http://www.legislation.gov.uk/ukxi/1999/3242/contents/made>
2. European Commission. *Report from the Commission on the operation of the provisions of Directive 2003/88/EC applicable to offshore workers* - <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52006DC0853>
3. Safety and Health at Work. Report of the Committee 1970-72. <http://www.mineaccidents.com.au/uploads/robens-report-original.pdf> (Robens Report).
4. American Petroleum Institute. *Fatigue Risk Management System: RP 755*.
5. Safework Australia. *Fatigue Overview*. Canberra, 2017. <https://www.safeworkaustralia.gov.au/fatigue#overview>
6. Health and Safety at Work etc. Act 1974 (UK) s2 <http://www.legislation.gov.uk/ukpga/1974/37>
7. ISO 31000:2009, *Risk management – Principles and guidelines*

Additional national level resources for truck drivers (Australia)

National Transport Commission. *Model Legislation - Heavy Vehicle Driver Fatigue Regulations 2007* <https://www.legislation.gov.au/Details/F2016C00713/Download>

(United States of America)

Federal Motor Carrier Safety Administration. *Interstate Truck Drivers' Guide to Hours of Service*. Washington, 2016. https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/Drivers_Guide_to_HOS_2016.pdf

3. Risk Management and Fatigue

3.1 WHAT RISK IS BEING MANAGED?

To make an effective business case for fatigue risk management, it is important to be clear about the risk being managed and the associated consequences. The definition of fatigue adopted by IOGP-IPIECA very clearly and succinctly highlights the key adverse effect of fatigue, namely reduced mental functioning and the principal underlying cause: lack of sleep.

Fatigue is common in the workplace with a prevalence of 37.9% in the US workforce¹. The resulting performance effects include increased periods of delayed response or lapses during attention-based tasks, slowed information processing, increased reaction times and reduced accuracy of short-term memory, and accelerated decrements in performance with time on task².

For workers in safety critical roles or engaged in safety-critical activities, fatigue impairs both their judgment and cognitive reasoning. Divided attention tasks which require anticipation and pro-active planning are typically the first to degrade. As fatigue impairment progresses, workers are more likely to experience loss of awareness and significant increases in lapses of attention. The risk of such occurrences is proportionate to the degree of vigilance required to safely perform the task³.

For example, in practice, this translates to a loss of attention across multiple screens for the control room operator to a delay in completion or failure to complete tasks for a shift supervisor and from an inability to multi-task for an emergency response manager to falling asleep at the wheel for a driver.

Fatigue is determined by a multitude of work-related and individual factors. For the oil and gas industry, one of the most significant contributors to fatigue is the need for 24-hour or extended hours operations and for workers to engage in non-standard hours, including stand-by and long duties. While there are a wide range of potential shift work patterns, some schedules disrupt the natural sleep/wake cycle and promote fatigue more than others (e.g., night shifts, shifts that start/finish very early, unpredictable shifts, and/or long runs of consecutive work periods without days off, etc.).

In addition, several individual factors may contribute to fatigue, such as long commutes, the presence of a new baby in the home, emotional difficulties such as stress and grief, a poor sleep environment, and social/recreational activities or secondary employment, etc. Sleep disorders are notoriously under-diagnosed and under-treated; indeed, around 40 million Americans are estimated to suffer from one of the 95 sleep disorders that have been identified^{4,5}. In Australia, medical sleep conditions are also very common, with diagnosed sleep apnoea affecting 8%, significant insomnia 20% and restless legs 18% of adults⁶. Many prescription and over-the-counter medicines can disrupt sleep, cause excessive daytime drowsiness, or impact judgement and the ability to perform complicated tasks including those often used to treat conditions such as depression, anxiety, heart disease, vertigo, nasal congestion, colds, flu, hay fever, and travel sickness. However, workers should consult with their medical practitioner if they have any concerns about the impact of prescribed or over-the-counter medication. Workers should not self-medicate or alter their medication without seeking medical advice.

3.2 HOW TO MANAGE FATIGUE RISK

A Fatigue Risk Management System (FRMS) employs multi-layered defences to manage fatigue-related risks regardless of their source (see Figure 1). It includes data-driven, ongoing processes that can identify fatigue hazards and then develop, implement, and evaluate controls and mitigation strategies. These include both organisational and personal mitigation strategies. However, the cost and complexity of an FRMS may not be justified for small operations where fatigue-related risk has been determined to be low. Some operators may therefore choose to place only certain parts of their operations under an FRMS or not implement an FRMS at all. However, whether an FRMS is implemented or not, it remains the operator's responsibility to manage fatigue-related risks through their existing safety management system and /or processes.

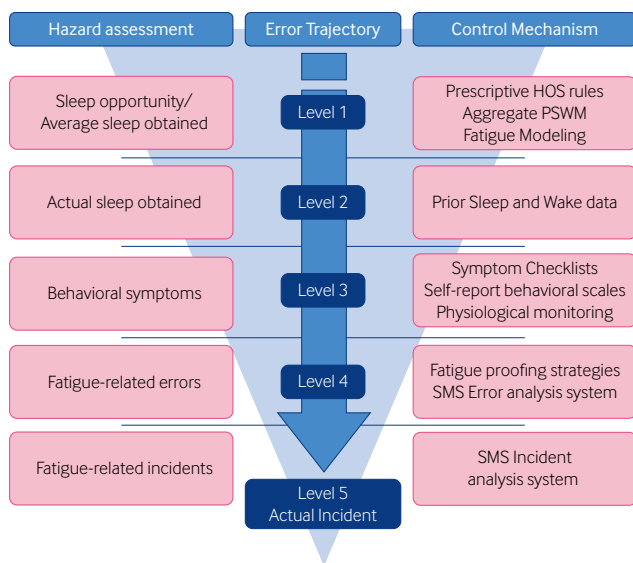


Figure 1
Fatigue-risk trajectory. There are multiple layers that precede a fatigue-related incident, for which there are identifiable hazards and controls. An effective Fatigue risk management system (FRMS) should attempt to manage each layer of risk⁷

Like other safety management systems, an FRMS represents a performance-based approach (in contrast to the prescriptive approach of hours of service limits). This means that an FRMS defines requirements for the organisation to manage fatigue risk, rather than prescribing limits that cannot consider aspects specific to the organisation or operating environment.

Similar to programmes for substance use and dependency, an FRMS should form part of an organisation’s overall health and safety programme. It is intended to help increase worker awareness of fatigue and manage the associated risk factors to prevent or reduce fatigue related loss including injury, illness, productivity interruption, and damage to the environment or to an organisation’s reputation.

As with other risk management topics, the effective management of fatigue in oil and gas operations requires a comprehensive, multidisciplinary approach capable of addressing all fatigue contributors⁸. Key enablers to effective management are strong senior leadership support, dedicated resources, involvement of all stakeholders and intensive communication. Success requires the integration of operational 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 workers in the management of business operations.

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4. Fatigue Risk Management System (FRMS) and Plan (FRMP)

A comprehensive Fatigue Risk Management Plan (FRMP) requires buy-in from many stakeholders, a potential culture change, and ongoing commitment to the Fatigue Risk Management System (FRMS). Depending on the size and structure of the organisation, resources with subject expertise for developing an FRMP may be found within the company, from a third-party consultant or a combination of the two. Additionally, the size, structure, and existing risk management framework of the organisation will impact the approach.

Most successful fatigue risk management systems involve a phased sequence of activities focusing on exploration of the concept by gap assessment and risk/benefit analysis, development of a strategy appropriate to the organisation's needs and capabilities, and detailed planning, implementation, and evaluation for continuous improvement. Within each phase there should be a feedback loop to stakeholders and decision-makers to ensure alignment and buy-in. Many companies have a defined process for development and implementation of programmes that impact workers.

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. The four principles that underpin an effective FRMS are¹:

1. Customised to the operation for which it is developed.
2. Based on assessed risk and evidence.
3. Built on the principle of shared responsibility.
4. 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-Ede²) (2009) are generally considered essential to the success of FRMS implementations:

Table 1 – Fatigue Risk Management System (FRMS) characteristics

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.

When implementing the FRMS, the core components of the resulting Fatigue Risk Management Plan (FRMP) are therefore:

1. Fatigue risk 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 workers.
4. Fatigue incident investigation.
5. Fatigue management training and education for workers, 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 element 6 are direct analogues of those normally found in a safety management system (SMS). Sleep disorder management is unique to an FRMP.

4.1 DEVELOPING AN FRMP

4.1.1 Starting out

When creating an FRMP, it is necessary to seek the support of executive and senior leadership and ensure that sufficient resources are available to implement and maintain the FRMS.

To develop an FRMP that is both meaningful and functional, it is important to first examine and understand the business's current position relative to fatigue risk. To do this, it will be necessary to have access to incident and accident data, absenteeism and sick leave data, hours worked (planned and actual), and/or worker satisfaction surveys, for example. This data will help identify fatigue related trends and potential hot spots such as time of day, day of week, task, crew impacts and further what control measures, if any, are working or not working, or are present or absent from the business to assist in reducing identified fatigue risk.

4.1.2 Engaging with the workplace

To determine the final version of the FRMS that will be implemented across the business, it is necessary to obtain buy-in from all relevant stakeholders from the beginning.

This means that supervisors, leaders, operators, shiftworkers, unions, and management representatives should all be included in the team that develops, discusses, and approves the final FRMP. Determining the team will be important in the success of the implementation and acceptance of the FRMP by workers (contractors/visitors) and how it is implemented and evaluated going forward.

4.1.3 How long will it take?

From recognising that fatigue may be a potential workplace risk that should be managed to the implementation of an approved FRMP can take up to 18 months or even longer. However, the time required will be based on the type of organisation, its structure, its size and global/regional/local reach and type of data available to help make and or justify decisions and how much senior management support the project is given.

4.1.4 What resources are necessary?

Resources come in several categories; some or all of these may be necessary. This will depend on the business model, cost restrictions, etc.

Time

1. Person/Team time to undertake FRMP preparation and development work
2. Person time to develop implementation schedule and process
3. Person time to implement and roll out FRMP (includes training)
4. Person time to evaluate implementation and changes based on FRMP requirements
5. Person time to follow-up, keep items current and review as required

Human

1. **Senior Leader Support:** it is suggested that the development of the FRMS has a designated leader and/or sponsor to ensure that the FRMS is developed, implemented, evaluated and reviewed
2. **FRMP Project Lead:** an individual should be made accountable for the development and implementation of the FRMP
3. **Training Specialist:** If a training department exists within the business, then a training specialist should be assigned to assist with the development of a training strategy and rollout plan; if no training department exists, then the accountable person in (2) should fulfil this training requirement
4. **Project Team:** a team responsible for content detail development, oversight and review of the FRMS prior to implementation. The business may consider establishing a Fatigue Management Working Group (FMWG) consisting of representatives from relevant stakeholder groups, including some or all of the following:
 - Workers
 - Workers' representatives
 - Managers/supervisors
 - Health and safety representatives
 - Human Resources representatives
5. **Project Reviewer:** an individual, such as the project sponsor, who has final accountability, who signs off the document prior to implementation
6. **Graphic Designer:** to create/layout of FRM project items such as posters, fliers, newsletter articles, and general communications regarding the FRMS process and outcome
7. **IT professional:** to assist when the FRMS goes live, if websites, etc. need to be developed, launched, and maintained

4.1.5 What is included in an FRMP?

In general terms, an 'effective' FRMP will meet the business needs of the organisation, be practical and functional, and all controls identified (existing and potential) are realistic, implemented, and their effectiveness and adequacy monitored on a regular basis. Nothing should be written into the FRMP that cannot be supported, implemented and/or evaluated. There may be sections in an FRMP from another business that may not be applicable locally and do not include items, actions or processes if there is no intention of practising them at the workplace or within the work team.

An 'effective' FRMP document as deemed applicable for a business is likely to cover, but not be limited to the below (also briefly mentioned in Section 3.2):

- Fatigue Risk Management policy
 - Definitions of terms used
 - Scope - inclusion of workers and contractors (and visitors) as deemed appropriate
 - Roles and Responsibilities – who does what, when
- Fatigue risk management, including collecting information on fatigue as a hazard, analysing its risk, and instigating controls to mitigate that risk
 - Use of risk assessment process (e.g., fatigue risk assessment/bow tie)
 - Fatigue KPIs and how these are reviewed, frequency and by whom
 - Commuting/accommodation if applicable – minimum acceptable standard (e.g., IOGP 541, IOGP 542, American Bureau of Shipping 2002, UK HSE 2010, NORSOK 2006, NOPSEMA 2011)
 - Local/regional specific issues that may influence fatigue (e.g., seasonal, cultural aspects, holiday season, etc.)
 - Hours of work details including call outs and overtime
 - Staffing/workload issues if any
 - Exemption conditions – how and under what conditions, what sign off is appropriate
 - Fatigue counter measures/controls/barriers
- Fatigue reporting system for workers
 - Reporting/self-reporting: How and to whom to report? Is it recorded; if yes, where?
 - Managing a fatigued individual – how to do this
 - Emergency management – how will fatigue be managed during an emergency?



- Training requirements – minimum requirement and timing for refresher
 - Fatigue management training and education for workers, management (and families)
- Fatigue incident investigation
 - Fatigue incident/accident reporting/incident investigations – what to ask and record
- Sleep disorder management
- A process for the internal and external auditing of the FRMS that delivers corrective actions through a continuous improvement process.
- Document review cycle and sign off
- Version control/approval table

4.1.6 What does success look like for an FRMP?

The measures of success for the FRMP may have been defined prior to the development and/or implementation process. If this is the case, then a check via audit or other tracking measures against this definition. If this was not pre-determined, then it may include but not be limited to any of the items below:

- Developing an FRMP that reflects best practice, is understood and actively manages the fatigue risk profile identified
- The FRMS is implemented across the business as planned and followed in accordance with organisational safety management system conformance
- Recognising and accepting that an organisation has a fatigue risk profile and putting identified controls in place
- FRM is discussed at all levels within the business

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- Fatigue is embedded into the organisation/region/asset/business unit/function through Training, HSSE, Risk, Human Factors and Health functions as well as on the ground with contractors, operators, personnel, office workers and crews
- FRM is part of an organisation's formal self-verification, audit and reporting process
- FRM audit finds no major/significant short comings
- FRM awareness training is current, fully rolled out and regularly delivered and recorded
- FRM competency-based training is current, fully rolled out and regularly delivered and recorded
- Reduction in fatigue related errors and events, trends are known and tracked/reported
- Fatigue is on the HSSE agenda and communicated across the organisation
- Fatigue matters to the Board of Directors/Executive and is requested by them as a reporting item
- A system is in place for individuals to report being fatigued and they are actively helped to manage it
- Business travel and related policies includes FRM strategies and requirements
- Available fatigue tools are used and refined for the Business Unit (BU) or asset as required
- Incident investigations routinely include questions about sleep and fatigue
- Individuals understand the importance of sleep and make sleep a priority
- Individuals discuss fatigue and sleep openly at work

4.2 IMPLEMENTING AN FRMP

Once the FRMP has been approved and signed off by a leader it is time to implement it across the workplace or group.

A range of available data and information streams will have already been utilised to develop the FRMP. It is likely that any or all of the following have been conducted or used in that work:

- Document review (internal and external, other FRMPs, older versions, industry templates, science, etc.)
- Surveys, interviews, observations (data/intelligence gathering, talking to the workers, leaders, HSSE professionals, etc.)
- Deliver Fatigue Risk Assessment Workshops related to issues such as schedule, camps, commutes, residential, FIFO, DIDO, BIBO, tasks, population, location

- Gathered objective data using actigraphs, sleep diaries, etc.
- Utilise biomathematical models to assess fatigue levels in working time arrangements
- Consultation with workforce and others (find out what is taking place on the ground and in practice - does it work, does it help, is it effective?)
- Camp/Hotel/Motel and catering assessments (What impact do these potential accommodation types have on sleep and recovery? Is there selection criteria used for accommodation? Is there design criteria for sleeping accommodation in camps and does it include quality sleep?)
- Understand the current safety culture (understand and plan the management of any known obstacles)

There will be a clear understanding of concerns and/or issues that may include but are not be limited to:

- Does work time include travel and under what conditions. How are commutes to be handled (e.g., does the company provide bus or taxi transport, is it self-drive, other?)
- How to determine hours of work?
- How to track actual hours compared to planned hours? (e.g., gate pass access, pay slips, time sheets etc.)
- Maximum number of consecutive shifts
- Minimum hours between finish of one shift and beginning of the next
- Napping in work time, at work etc. (e.g., is it allowed, if so how?)
- Fast vs. slow roster rotation/schedules
- Forward vs backward rotation rosters/schedules
- Camp shift distribution and layout related to night shift and day shift; disrupters to sleep in camp
- Accommodation quality (does it meet a minimum defined standard, e.g., UK HSE 2010, NORSOK 2006, NOPSEMA 2011)
- Commute distances, journey management plans, international and business travel (e.g., impact of time zones, east vs west etc.)
- Shut down, on call, turnarounds, emergency and crisis management
- Teleconferences and time zone concerns.

4.2.1 Before you implement the FRMP

a) Determine leadership

Who will champion the FRMS at the leadership level? Who will be the key person responsible for the successful implementation of the system and any follow-up required in the first 12 months from the implementation date?

b) Identify resourcing

Identify the people who can assist the responsible individual in the implementation and how they can help

Allocate time and activities – recognise and allocate the time required

c) Know the issues and why the FRMS is being implemented

If the business is unable to answer the questions below immediately then it is important to find the answers before implementing the FRMS. It should not be rolled out without knowing the background, current practice and culture.

- i) Is a credible picture of the current state available, as well as how the FRMS moves things forward and will improve the management of fatigue across the business unit /asset etc.?
- ii) What are the current informal and formal FRM practices within the workplace, why did they develop?
- iii) Do people currently report all incidents/events, what is the level of trust between leaders and teams?
- iv) Do individuals report fatigue?

d) What currently contributes to the fatigue issues – what are they, when do they occur, why do they occur or why are they experienced and who is impacted or likely to be impacted by lack of sleep and hence experience and demonstrate fatigue?

e) Develop an Action Plan for the implementation

- i) What needs to be developed? Training materials, posters, assessment forms, reporting templates, management responses to reported fatigue, including fatigue in the incident investigation process, and what questions should be asked, etc.
- ii) When will the implementation take place – at least 6-weeks time may be necessary to create the support and environment for effective implementation.
- iii) Who will assist to roll it out across the BU/Site/Asset/Project? All team leaders should be involved, same message same day (all shifts).
- iv) Where do people go for assistance if they need more information, clarity, support etc. (e.g., EAP, Health professionals, HSSE team, Supervisor, etc.)

4.2.2 Pre-Implementation checklist

- Complete all FRMP components
- Approve all FRMP components
- Sign off all FRMP components
- Confirm FRM reporting process and structure
- Identify FRM lead on site
- Confirm FRM KPIs
- Communicate intent of FRMP to whole of site (warn them it's coming and why)
- Determine implementation date (details of schedule known to leaders and workplace personnel)

4.2.3 Materials for Implementation

Check that everything has been developed and finalised. This may include but is not limited to:

- Fitness for Work (FFW) Standard (only if it includes fatigue as a separate section)
- Fatigue Risk Management Policy (signed copies available)
- Fatigue Risk Management System (have copies available for all persons)
- Presentation for Leadership Team/Senior Management – this talk will provide a high-level overview of the FRMS and Implementation process, what documents are new, what is expected and when specific actions will be undertaken, what their role will be and how they can support FRM in the workplace
- Presentation for Operators/Teams/Individuals - this talk outlines what an FRMS is (or FFW whichever is more appropriate) and will prepare site personnel and contractors/business partners for the changes the FRMS will bring – includes procedures, standard, legal requirements, and basics about fatigue. Allows everyone to adjust to the idea that the FRMS is to commence, what they should do to comply and provides some of the science behind the FRMS
- Presentation for Supervisors/team leaders – this talk will cover the same information as the operator talk as well as what to do with a fatigued individual, what materials are available for use and how to use them, who is available to assist in decision making, how to recognise fatigue, how to assess an individual for fatigue, etc.
- DVD/Video/animation – if available
- Fatigue posters – if using
- IOGP-IPIECA Fatigue Management Questionnaire – if using (see Report 626-3)
- Fatigue Evaluation Matrix – if using (see Report 626-3)
- Fatigue Impairment Checklist for Supervisors – if using (see Report 626-3)

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- Samn-Perelli checklist (see Report 626-3)
- Self-verification checklist (see Report 626-3)
- Shiftwork Advice Sheet (see Report 626-3)

4.2.4 Leadership Team involvement – Pre-Implementation

Before implementation the leadership team should be informed. In addition, any new or unresolved issues should be addressed and the system adjusted if necessary.

4.2.5 Implementation Sequence

There are steps to successfully implementing and evaluating an FRMP, they include:

Step 1: Select an implementation date

Step 2: Deliver FRMP pre-implementation team talks to all personnel (e.g., leaders, supervisors, workers)

Step 3: Check that all the materials, templates, software, devices, posters, etc. to be used or that will be accessed and used by site/ business unit personnel are fully functional and ready for implementation. This should be done at least 14 days before the implementation date, providing ample time to sort out any issues before they are required for use.

Step 4: Implement the FRMP as planned

- Make sure the FRMS and associated documents are on the business unit/site intranet or equivalent and able to go live
- Make sure printed/electronic templates etc. are available as required
- Make sure implementation information is available to leaders and teams – hand outs, posters, what is expected, what has changed, where to go for further information
- Make sure the implementation of the FRMP is covered across the whole of site/business unit through toolbox talks, management meetings, announcement system, health personnel consultations etc.
- To capture all personnel on site and all crews this process may take up to 28 days depending on the size of the workforce and the complexity of schedule rotations
- The entire implementation process should be completed within the duration of the longest roster cycle (usually no more than 28 days) from the implementation date
- Commence formal FRM training

Step 5: Post Implementation: Check that all crews and teams received the necessary information by the end of the 28 day roll out phase allocated for implementation (e.g., walk around and ask individuals, team leaders, check minutes from meetings, etc.). In addition, anyone not present at the time of initial rollout (as a result of leave or official travel)



should have access or be given information about the new FRMS and what it is likely to mean to them.

Assess compliance with FRMS, use of templates, record keeping, training records, assessments undertaken and recorded and kept on file, entry of incident data, report generation, minutes from meetings etc. Begin this process at the end of the 28 day roll out phase allocated for implementation and again at 3 months, 6 months, and 12 months to track progress.

4.2.6 Integration of the FRMS into the other HSSE/ asset functions and activities

Without fully integrating the FRMS into the business unit /site HSSE, the efforts undertaken to date to make this programme work will be lost quickly over time. Therefore, it is vital to the longevity and sustainability of the FRMS to integrate it into all appropriate areas and functions. This means link it to such items as:

- Periodic Health Assessments (Questions about sleep and fatigue)
- Crisis management plans (Sleep and decision making under pressure should be considered)
- Monthly safety reporting (What are the trends?)
- Incident reports (Number/percentage of events that have fatigue as a causal or contributing factor)
- Camp Rules (How is sleep protected?)
- Business unit/site policy directive and KPIs (Are they known, understood, tracked and met?)
- HR Disciplinary process (Has it been used, and if so for what reason(s)?)
- Risk assessment methodology and process (Which tool(s) to use?)
- Roster/schedule reviews (Identify areas of concern)

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- Staffing levels (Are they adequate and realistic?)
- Travel Arrangements and Road Safety (How are long haul flights and driving managed?)
- Employee Assistance Programme (EAP) (Does it include the utilisation of a sleep specialist?)
- Medical Centre (Are sleep questions or tools used during consultations? e.g., KSS, ESS, Sleep diary etc.)
- Training Department and record keeping (Is training undertaken, its frequency and by whom)
- New worker induction programme

4.3 EVALUATING THE FRMS

Any programme requires regular, formal evaluation (e.g., quarterly, annually, etc.) to determine its effectiveness. Programme evaluations measure the success of the programme's goals and objectives. Regular evaluation determines if the programme is working and allows for continuous improvement³. Further details are included in section 4.4.

4.3.1 Fatigue Metrics

Numerous subjective and objective measures are available to assess fatigue and performance although these have mostly been used by researchers. Some, such as the Epworth Sleepiness Scale (ESS)⁴ are suitable for use in monitoring a worker population in a field setting. Others, such as the Samn-Perelli scale, may be used as a subjective tool by individuals⁵. However, most currently available sleep disorder testing and neuropsychological testing will be performed in a laboratory setting. The Occupational Fatigue Exhaustion Recovery scale has been developed specifically to measure work-related fatigue and consists of three subscales that can distinguish between chronic work-related fatigue, acute post-work fatigue and effective fatigue recovery between shifts⁶.

The association between extended duration shifts, sleep deprivation, fatigue and adverse health effects is well known and documented. A National Institute for Occupational Safety and Health (NIOSH) report in the US reviewed studies that examined the association between long working hours and illnesses, injuries, health behaviours, and performance. In general, overtime was associated with poorer perceived general health, unhealthy weight gain, increased alcohol use, increased smoking, increased injury rates, more reported illnesses, increased mortality, and poorer neuropsychological test performance. Extended night shifts were associated with more physical fatigue, smoking and/or alcohol use when compared with shorter or day shifts⁷.

Health care insurance utilisation, prescription drug plan costs, worksite health clinic visits, and sick leave are readily



available metrics for analysis in some countries⁸. Many organisations have also instituted health risk assessments to support and target worker wellness programming. These usually include questions on smoking, alcohol use, weight gain or loss, exercise, perception of overall health status, and presence of specific chronic illnesses. The health risk assessments may also include questions on work-related fatigue, job satisfaction, and interpersonal relations and may also include the Work Limitations Questionnaire⁹.

4.3.2 Fatigue Self-Reporting Procedure

An effective fatigue reporting procedure is critical to the successful management of fatigue risk. The open and honest reporting of information by workers enables immediate fatigue risks to be addressed and systemic fatigue risks to be identified and managed.

The Energy Institute publication 'Viability of using sleep contracts as a potential measure of fatigue management'¹⁰ provides detailed practical information on how to build an effective system for the self-reporting fatigue. To summarise:

- There should be a clear definition of fatigue and how it should be identified
- Workers should be made aware that if they are not fit for work due to fatigue they have a responsibility to inform their immediate supervisor or manager
- Workers should be made aware that if their state deteriorates during work, that is, if they become fatigued whilst at work, they should inform their immediate supervisor or line manager
- Supervisors and managers should be made aware that they have a responsibility to address the worker's reported fatigue in a formal manner utilising the potential actions/outcomes that have been previously agreed and documented
- The fatigue event and how it is managed should be formally recorded to enable trends to be mapped within the organisation

When an individual reports fatigue to their supervisor or line manager, both parties should respond in a formal and structured manner to manage the risk for the remainder of the shift and where relevant on an ongoing basis. Providing supervisors with a checklist to assess the condition of individuals reporting fatigue (see Report 626-3) is one way to ensure that the assessment is conducted in a structured way. In the event of any indication of medical drugs (prescription and or non-prescription) or related issues being associated with causing the fatigue, supervisors or line managers should seek support from a suitably qualified health professional. Supervisors or line managers should not attempt to make any form of clinical judgement or determination on their own regarding medications, medical diagnosis, treatment or follow-up but should provide assistance to enable the worker to obtain the professional help required.

The data collected on the incidence of fatigue may also be utilised to track trends and to identify systemic fatigue risks such as specific shifts or times of day where fatigue is repeatedly reported. In turn, this information can be used to refine the controls that are in place and/or to inform the introduction of further controls.

4.3.3 Fatigue Auditing

Within organisations there are generally internal and external auditing requirements. The auditing for fatigue is traditionally related to either the Health and/or the Safety function for which there will be an established and recognised audit template.

The frequency of FRMS audits will vary between sites as it may be possible for a specific site to select topics to be included in an audit cycle. If the FRMS is new to an asset or business unit it will be useful and advantageous to include fatigue in the next site audit. This will assist to provide stakeholder feedback, effectiveness and adequacy of control measures, training and general functionality of the new FRMS and how it can be supported and improved.

Audit undertaking and subsequent findings will provide an avenue for continual improvement for the FRMS and has the potential to enhance general understanding and acceptance of the importance of the topic across a site.

4.3.4 FRMS Key Performance Indicators (KPIs)

Multiple studies have documented the negative effect of worker fatigue on outcome parameters including safety, productivity, performance, accident rates, work-related injury, and workers' personal health¹¹. Metrics commonly used to measure these outcome parameters include data collected from employer time and attendance systems,

work-related accidents, injury rates, and worker health care cost data, for example. In addition, systems for reporting and investigating accidents and injuries should be in place and followed. Finally, the FRM reporting process should be simple and straightforward and problems identified dealt with in a timely manner.

Each additional control should ideally be allocated to an accountable manager for implementation and a performance indicator identified and developed to measure the FRMS controls' effectiveness, i.e., the extent to which fatigue risk has been effectively controlled. The accountable manager and performance indicator could be recorded in the risk assessment documentation¹² and tracked over time.

Data from the selected KPIs can be collected before the FRMS is implemented and then tracked periodically. This will help set measurable targets and identify if these have been met. Examples of indicators used to determine whether changes due to implementation of an FRMS have helped are outlined below; however, other measures more suited to an organisation should be developed and implemented as required.

A mixture of objective and subjective information is desirable. Employer records on absence, overtime, accidents, productivity, and worker health are valuable sources of objective information but privacy and confidentiality regulations and regional requirements may mean that some data is not available and cannot be used. Data of how shift work characteristics affect a workforce may be done using focus groups, survey questionnaires, interviews, and assessment tools¹³.

Examples of metrics include¹⁴:

- Time and attendance data (absenteeism, hours worked, overtime) are measures often used to estimate productivity downtime, costs, resources, under-utilisation, etc.
- By examining hours worked/overtime and the levels of absenteeism across the facility, it may be possible to identify whether long hours of work and/or high levels of overtime correlate with increased absenteeism and, in turn, estimate productivity losses, costs etc.
- Validated survey instruments such as the Work Limitations Questionnaire (WLQ)¹⁵ may also be used to assess productivity.
 - The WLQ consists of four subscales that measure time management at work, performance (physical and mental), interpersonal interaction, and work output.
- Recordable work-related injury and illness data
 - Such data may include injury rates, lost time incidents, fatalities or the findings of incident investigations,

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- Workers' compensation injury and illness incidence, severity, and costs can be obtained through the workers' compensation insurance carrier
- Root cause or similar analysis during incident investigation of an accident or injury can help identify whether fatigue was a causal and or contributory factor
- Worker health status may be tracked through health risk assessments, health care insurance utilisation data, health care cost data, and worker surveys or questionnaires
- Worker fatigue or sleepiness at work may be measured by a number of assessment tools such as the Standard Shiftwork Index (SSI)¹⁶ or if examining fatigue because of sleep disorders, the Epworth Sleepiness Scale (ESS)¹⁷. Alternatively, the organisation may elect to undertake biomathematical modelling of the working time arrangements.

FRMS KPIs should focus both on:

- Direct contributors to fatigue-related impairment; and
- The individual components of an effective FRMS

Direct contributors to fatigue-related impairment can be either work-related or not work-related (see Table 2 below).

Performance indicators should also include a mix of leading and lagging indicators:

- Leading indicators are used to highlight areas of system weakness, without relying on the occurrence of an incident or near miss (i.e., they are proactive)
- Lagging indicators, on the other hand, use learnings from the occurrence of incidents and near misses to identify weakness in the system (i.e., they are reactive)

Examples of KPIs include but are not limited to:

- X% fatigue information gathered during incident investigations
- Fatigue assessed for asset/business unit – or – annual review of FRMS (evidence to be provided of assessment/ annual review and outcomes)
- X% to FRM training scheduled is attended (tracking individuals who have been identified as requiring training and who have done training)

- Contractors covered by FRMS if engaged in HSSE critical positions – (provide evidence of inclusion)
- Tracking & recording – overtime/call-outs (reporting structure – provided evidence of overtime/on call data and trends)
- X% utilisation of the Fitness for Work (FFW) process by drivers each shift start
- X% compliance with EU driving and rest requirements
- X% compliance with FRMS
- X% compliance with minimum break between shifts
- No exceptions to the FRMS
- No exceeding of policy parameters
- Hours per day of work (include/exclude travel time)
- Time worked between sign on and sign off
- <X% of working hours more than max daily hours
- Self-reporting of individuals to supervisors documented/ recorded
- FRM as a monthly/weekly/quarterly toolbox talk
- Supervisors to document that they have seen and spoken with everyone on every night shift to assess for fatigue
- Tracking driver behaviour and hours via IVMS – harsh braking, fuel consumption, harsh accelerations, lane deviations
- Other topics may include
 - rostered work hours
 - actual work hours
 - types of work tasks
 - working environment
 - amount of sleep obtained
 - sleeping environment
 - sleep disorders
 - other health issues

Refer to Section 9 of this Report for a worked example of a KPI.

Table 2 – Work related and non-work related contributors to fatigue (IOGP-IPIECA Report 488 - *Performance indicators for fatigue risk management systems*)

Work-related and non-work-related contributors to performance impairment	
Work-related contributors	Non-work-related contributors
<ul style="list-style-type: none"> • Rostered work hours • Actual work hours (including overtime, extra shifts, etc.) • Types of work tasks (e.g. repetitive, mundane, physically strenuous, safety critical) • Working environment (e.g. hot environments) 	<ul style="list-style-type: none"> • Amount of sleep obtained • Sufficient quality sleep obtained • Sleeping environment • Sleep disorders • Other health issues

4.4 MAINTAIN AND REVIEW OF AN FRMS

As with any management system, an FRMS requires formal periodic review to assess its adequacy and effectiveness and to achieve continuous improvement. An FRMS is usually reviewed annually, or in accordance with the existing review schedule for other safety management systems. The purpose is to identify potential improvements to the FRMS and changes to the FRMS to reflect organisational developments, and to keep the FRMS aligned with the latest industry best practice.

An FRMS review seeks to establish whether fatigue risk is being effectively managed and the FRMS is working successfully. The review is specifically designed to assess:

- Whether the FRMS is functioning in accordance with the documented FRMS policy and procedures
- Whether the KPIs are being met
- The extent to which the FRMS is effectively managing fatigue risk and, ideally, continuously enhancing the management of fatigue risk

During programme development, an evaluation plan should be created, which could include, but is not limited to the following (adapted from Enform Canada's *Fatigue Risk Management*¹⁸):

- Pre-determined review dates
 - During the introduction and in the first few years of operation of the FRMS, frequent regular reviews should be scheduled depending on the timescale for programme implementation
- Commitment from senior management to carry out and act on reviews as scheduled
 - It is important to have senior leadership support for periodic reviews and continuous improvement
- A feedback method involving all affected personnel and incorporating management accountability and participation
 - Workers are just one group from whom feedback should be sought. In many cases, a steering group will meet periodically to seek feedback from supervisors, line managers, leaders, shift schedulers, and human resource specialists. This feedback is used for worker relations, learning and development, compensation evaluation, and operational management. Such feedback may be structured or anecdotal

- Identification of key FRMS measures
 - Refer to section 4.3.4 for further details on key metrics
- A reliable data collection method, including anecdotal methodologies and accessible data streams
 - The data collection for safety incidents, overtime, workers' compensation costs (if applicable) etc. will likely be fed into the FRMS review direct from their source
 - Additional data in the form of worker interviews, ad hoc fatigue reports, worker satisfaction scores related to working time arrangements etc. should be collected, collated and analysed specifically for the FRMS review. It may be necessary to utilise biomathematical models in this process.
- A meaningful analysis process with evaluation criteria based on overall programme goals and specific performance objectives
 - The aim of the review will be to highlight areas for improvement in the FRMS. In other words, are there patterns of reporting that indicate that fatigue is not being optimally managed? For instance, do >50% of safety incidents occur after the 10th hour on shift? Do incident reports suggest that certain shifts, days, or times of day may be particularly problematic?
- An efficient programme document revision process
 - Once areas for improvement have been highlighted and agreed, the FRMS should be updated, version controlled and reissued through the appropriate communication channels. Where the changes have been in response to feedback from workers or workers' representatives, those groups should be informed directly
- Any corrective actions should be delivered through a continuous improvement process
 - Each action should be allocated to a responsible person to develop an improvement plan with time bound deadlines

In addition to the internal programme evaluation cycle, the organisation may have an independent audit team who will undertake their own periodic review. This is an important part of the process and, although a formal audit is more likely to be focused on the presence or absence of the elements of an FRMS and its governance rather than its performance, both are equally important.

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Further reading

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IOGP Report 542 - *Temporary onshore accommodation - Design, layout, accommodation, facilities and services*

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Norwegian Technology Centre (NORSOK). *Standard S-002: Working Environment, Revision 4*. Oslo: 2004.

5. Training Programmes

In general, HSE legislation/regulations requires management to supply information on all hazardous workplace risks to workers.

In addition, training in hazard recognition and prevention is required to assist in the minimisation of known and potential risks including fatigue.

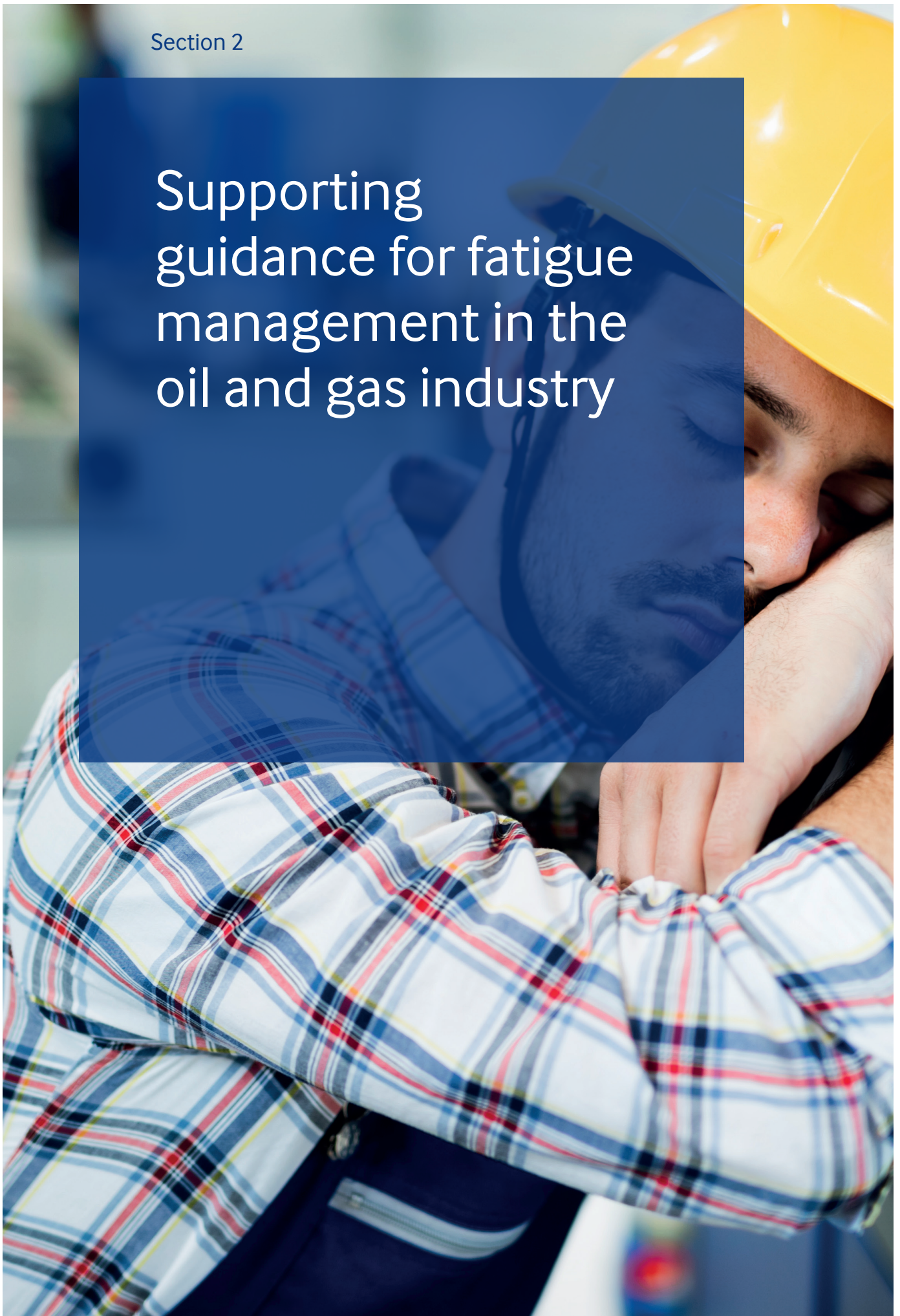
In practice, appropriate training and education is most easily achieved using structured workplace training with, where possible, competency-based assessment. The content of such a training session on fatigue management could include: what is fatigue, causes and consequences of fatigue, signs and symptoms of fatigue, how to maximise sleep, the impact of food and water on alertness, commuting, napping, family and social factors and effects of caffeine and alcohol on sleep, policy and procedures and organisational FRM requirements.

A range of different training approaches, techniques and methodologies should be utilised to assist organisations to meet the training obligations. These may include:

- Toolbox Talks
- E-Learning Modules
- Videos
- TED Talks and YouTube clips
- Competency based training programmes (refer to Appendix 1 for an example of learning outcomes for fatigue risk management training)
- Posters and flyers
- Workbooks and reference materials
- Webinars
- Workshops and face-to-face training sessions

The frequency and style of training will be determined by the organisational culture and based on the risk profile and details within the FRMS. However, some suggested learning outcomes may be found in Appendix 1.

Supporting guidance for fatigue management in the oil and gas industry



6. Sleep and Sleep Disorders

6.1 WHAT IS SLEEP?

Sleep is one of life's essentials, like food and water. However, the actual purpose of sleep is still not completely understood. It is not simply the case that during sleep the body 'switches off'. Sleep is a complex physiological process throughout which the brain is active, and indeed, 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, removal of toxins, improvement in immune function and many others that the scientific community are only just now learning about.

6.2 WHY IS SLEEP IMPORTANT?

Insufficient quality sleep results in a number of performance effects for both work and personal lives. These can include;

- slowed reaction time and reduced motor skills and coordination
- failure to respond to changes in the environment (e.g., a traffic light)
- poor judgment
- difficulties with logic and problem solving skills
- memory issues (both short- and long-term memory)
- forgetfulness
- decreased motivation
- increased risk-taking behaviour
- higher risk of accidents/injury particularly in the workplace
- ill-health effects (e.g., higher risk of gastrointestinal illness and obesity)
- disrupted eating habits/changes in appetite
- effects on mood
- increased irritability
- higher susceptibility to infectious illnesses and associated increase in work absenteeism

These outcomes are possible even after small decreases in sleep time, but are even more prominent when sleep deprivation occurs frequently. That is, the cumulative effects of sleep loss can be even more damaging than one night of disturbed or shortened sleep.

To avoid these negative outcomes, it is important for workers to be aware of their own sleep habits and requirements to make sure they are not negatively impacted by their work and non-work life.

6.3 HOW MUCH SLEEP DO WE NEED?

Just as individuals vary in how quickly alcohol affects them and how easily they lose or gain weight, individuals also differ in the amount of sleep that they need to perform optimally. Most adults need 7 to 9 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 individuals obtain less than they need. While humans can function to some degree on less sleep, they will not be capable of our optimal performance. Getting less sleep than needed is not a recommended practice and should be avoided whenever possible and practical.

6.4 HOW TO DETERMINE PERSONAL SLEEP NEED

For a worker to determine how much sleep they need to perform optimally, they can do so next time they are on holiday by following these steps:

- Put their alarm clock away and arrange their daily schedule so that they 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 they go to bed at night and what time they naturally wake up in the morning.
- Calculate the average amount of sleep they obtain these three or four days. This is the amount of sleep they require for optimal alertness, performance, and well-being.

6.5 GET TO KNOW SLEEP

- Sleep occurs in a number of distinct stages:
 - **Stages 1-2: light sleep.** This is the first type of sleep in each cycle. This is a non-dreaming stage of sleep.
 - **Stages 3-4: deeper sleep.** These stages come after the first two, and are harder to wake from. Individuals are less likely to be woken from outside noise/light.
 - **REM: dreaming sleep.** REM stands for rapid eye movement, and is an indicator of dreaming. In this kind of sleep brain activity is similar to being awake, but it has been suggested that this kind of sleep is particularly restorative and helpful in solidifying learning and memory.

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Supporting guidance for fatigue management in the oil and gas industry

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- During each night of sleep, the body will go through a number of approximately 90 minute cycles, which include these stages of sleep. If an individual wakes up during lighter sleep or REM, they are more likely to wake up feeling refreshed.
 - The times of day when an individual feels the need to sleep or be awake are governed by an internal process called the circadian rhythm (or “body clock”). This can be altered by external factors, such as light and body temperature, but is generally reasonably stable under routine conditions.
 - For example, a regular 9am – 5pm worker will generally start to feel sleepy around the same time each night before bed.
 - Jet lag can be a serious issue which is caused when the internal circadian rhythm does not match the local time zone because of travel.
 - Fatigue levels and therefore performance are particularly negatively affected during times when the body desires sleep.
 - Keep the routine consistent across the week. This includes both bedtimes and the time to awaken each morning. Try not to sleep in on weekends as this can make it even harder to get up and feel rested on workdays.
 - Make sure the bed is comfortable. Having an appropriate mattress and pillow can make a significant difference to sleep.
 - Avoid looking at the clock when trying to get to sleep as this tends to increase stress and anxiety relating to the inability to sleep.
 - Staying in bed for hours when unable to sleep can make it even harder to relax and fall asleep, and may result in the individual beginning to associate being in bed with being anxious and unable to sleep. If unable to sleep, the individual should get up and engage in a quiet activity for twenty minutes, then try again.
 - Make the bedroom a place for sleep and intimacy only.
 - Listening to relaxing music or white noise when falling asleep can be helpful.

6.6 HAVE THE RIGHT ENVIRONMENT SET UP TO PROMOTE SLEEP

- Efforts should be made to make the bedroom as dark as possible. This is a cue to the body that it is time for sleep and can promote falling asleep quicker and being able to stay asleep.
- Set the temperature of the bedroom to be comfortably cool. Being too hot or too cold can interfere with sleep.
- Free the bedroom from clutter and unnecessary distractions.
- Make sure the activities undertaken before bed help to promote sleep. This may include reading a little before bed, listening to some relaxing music or spending relaxation time with family.
- Try and avoid television, computer, tablet or smartphone screens in the hour or so before bed. Research has shown that the blue light from screens can interfere with sleep.
- Avoid exercise for a few hours before sleep, as this can raise the body temperature and make sleep more difficult.
- Establish a bedtime routine that is followed each night. This may include very simple activities such as showering or reading, but can act as a cue that the body will learn means it is time for sleep.

7. Common Sleep Disorders

There are over 95 identified and classified sleeping disorders according to the International Classification of Sleep Disorders (ICSD)¹. The following are some well recognised disorders.

7.1 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, unable 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.

7.2 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 sufferers often 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
- personality changes or difficulties with thinking

7.3 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.

7.4 NARCOLEPSY

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

NB: If the worker or his/her sleeping partner is worried about the way they sleep it may be beneficial to seek medical advice.

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8. Other Common Factors that Impact Sleep

Substances such as nicotine, caffeine, alcohol, and some medications have the potential to affect the quality of sleep.

8.1 MEDICATIONS (PRESCRIPTION AND NON-PRESCRIPTION)

- Prescribed medications can also influence sleep. Workers should discuss their options with their doctor when starting any new medication, and be aware of any potential side effects.
- 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.
- Avoid the use of any illegal or recreational drugs.
- Sleeping tablets, herbal supplements and other prescribed medications can be useful in certain situations when advised by a doctor. However, it is important to be aware of the potential hazards of their use.
- Long-term use of any type of medication or supplement can be potentially harmful, so workers should discuss any usage with their doctor.
- Be aware that any supplements, particularly sleeping tablets, can interfere with the natural progression of the sleep cycle, and may result in sleep that is less restorative and of a lower quality. Also, there may be issues with dependency that can develop with long-term use; workers should discuss the use and impact of supplements and sleeping tablets with their doctor.

8.2 CAFFEINE

Caffeine is one of the world's most popular and frequently consumed drugs but can remain in the body for up to 6 hours and may therefore affect sleep.

- Caffeine can be useful during the day if you are having trouble with fatigue or are not feeling totally alert.
- However, try and avoid caffeine, including coffee, tea, caffeinated soft drinks and/or chocolate in the hours before bed as it can disrupt the ability to fall and stay asleep¹.

8.3 ALCOHOL

Alcohol may not only shorten the time to fall asleep, but also disrupts subsequent sleep.^{2,3}

- Try and avoid alcohol before sleep as it can have a negative impact on the quality of sleep
- Even though alcohol may help you fall asleep, the sleep you get after drinking alcohol is not as restorative and can result in multiple awakenings during the night
- REM sleep is known to be disrupted by alcohol, generally in the second half of the sleep period

8.4 NICOTINE

Nicotine is a stimulant that can disrupt sleep and reduce total sleep time⁴.

8.5 INTERNATIONAL TRAVEL AND TIME ZONES (JET LAG)

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.



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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 for business travellers and workers impacted by them. 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 body clock.

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 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 body clock does adjust to local time but it can take a number of days. For each time zone crossed it takes approximately one day to adjust although the exact rate will depend on the direction of travel. In fact, the body clock adjusts by an average of 92 minutes/day after westward flights, but only 57 minutes/day after eastward flights⁵. It is therefore likely that it could take more than 1 week before the traveller is fully adjusted to their destination time zone, be it work or home.

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 necessary.

The severity and duration of the jet lag symptoms will depend on the following factors⁶:

- 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
- individual differences

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 transmeridian travellers have little or no difficulty adjusting to the temporary desynchronisation of their internal body clock, another 30% do not adjust well at all^{7,8}.

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9. Fatigue Risk Mechanisms

9.1 THE IMPORTANCE OF SENIOR MANAGEMENT

Programmes that deliver tangible improvements to worker health outcomes and productivity cannot simply be 'added on'. Rather, they require a systemic change in an organisation'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 organisation and what is done at subsequent levels by their strategic decisions and behaviours.

One of the key enablers in the success of this FRMS approach is therefore the integration of the company's health, safety and well-being strategy into wider management systems and business plans. A senior leader should 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 should be actively engaged. Thus, a positive organisational culture where workers 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 should be developed in response to the needs of the industry, the regulatory environment, and the organisation in which it applies.

9.2 COLLABORATION WITH OTHER FUNCTIONS WITHIN THE ORGANISATION

Any organisational or operational changes that are made to minimise 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.

Identify which functions should be involved early and include them throughout the FRMS process.

9.3 BIOMATHEMATICAL MODELS

Several research groups have developed models for estimating the work-related fatigue associated with working time arrangements¹.

Biomathematical models that quantify the effects of circadian and sleep/wake processes on the regulation of alertness and performance have been developed to predict the magnitude and timing of fatigue-related responses in a variety of contexts (e.g., transmeridian travel, sustained operations, shift work)². They have proved a useful adjunct in the management of what has been typically referred to as fatigue-related risk³.

Biomathematical models have been advocated to provide another means to determine the level of risk associated with working time arrangements and whether a given schedule is better or worse from a fatigue perspective from another. Furthermore, the biomathematical models have been used primarily to quantify the degree of sleep opportunity afforded by a schedule and, by inference, the relative likelihood of a fatigue-related error. In conjunction with an assessment of the consequence of a fatigue-related error and the mitigations in place, the net risk can then be determined in a semi-quantitative manner⁴.

The most common way that biomathematical models have been used to determine a 'safe' working time arrangement has been by establishing an upper safe level for fatigue or sleepiness. A working time arrangement found to have a fatigue risk score below this critical threshold is considered 'acceptable'. This has been intuitively appealing as most biomathematical models provide a single numerical output over time that integrates the multiple dimensions associated with prescriptive regulations of working time arrangements.

There are a number of these models available for use by organisations, for example (NB: order does not denote priority):

- CAS – Circadian Alertness Simulator
- FACTS – Fatigue Accident/Incident Causation Testing System
- FAID - Fatigue Audit InterDyn
- SAFE – System for Aircrew Fatigue evaluation
- The Three Process Model of Alertness
- UK HSE Fatigue Index Calculator

They generally are used for:

- Pairing/Roster Comparisons
- New Routes or Scheduling options
- Evaluation of Mitigations/Strategies
- Incident Investigation
- Complaint Resolution (related to working time arrangements and or practices)
- Evaluation of New Regulations

They are generally not used for decision making purposes alone but in collaboration with other risk evaluation methods and data such as incident and injury data, absenteeism data, staff satisfaction surveys etc. Hence they contribute to the decision-making process when determining risk levels, controls and mitigation strategies.

9.4 CONTROLS AND COUNTERMEASURES

There are a number of levels of control for managing fatigue risk; specifically organisational, individual, behavioural, error and incident level and a successful fatigue management system will address each of these levels of control by organising defence systems or countermeasures around these layers.

How an organisation or site does this will be determined largely by regulation, legislation, higher level organisational requirements and strategies, workplace population(s) and union(s), workplace awards and/or agreements, the environment/region, type of work activities, risk assessment methodologies utilised and practical functional solutions that can potentially reduce the identified risk.

9.4.1 Fatigue Reducing and Proofing Strategies

Fatigue-reduction strategies are the techniques for reducing the likelihood that a fatigued individual is operating in the work place, for example improved working time arrangements.

Fatigue-proofing strategies are techniques for decreasing the likelihood a fatigued individual operating in the workplace will make an error that leads to a process safety incident, accident or injury, for example task rotation, supervision, working in teams and checklist.⁵

9.4.2 Examples of Potential Controls

There are many potential controls or barriers an organisation may implement to assist in the reduction of fatigue risk within the workplace (see Table 3 below).

Some of these may include but not be limited to the following (NB: order does not denote priority):

Table 3: Examples of potential control split across fatigue reduction and proofing strategies

	FATIGUE REDUCTION STRATEGIES	FATIGUE PROOFING STRATEGIES
Workplace system based	<ul style="list-style-type: none"> • Adequate and appropriate rostering (use of a biomathematical model to assist the development) • Appropriate working hours for tasks being undertaken • Appropriate and adequate breaks within and between work periods • Ensuring high risk activities are conducted during the day rather than at night where possible • Reduce highly complex tasks 	<ul style="list-style-type: none"> • Check lists • Rotation of tasks • Appropriate lighting levels • Car-pooling (minimise driving alone on commute) • Provision of air conditioning • Radio contact • Provision of transport (bus, taxi, etc.) for personnel for commutes after overtime (extended shifts; call-ins etc.) • Adequate ventilation • Access to drinking water facility
Workplace team based	<ul style="list-style-type: none"> • Appropriate staffing levels • Team work/group, reduce working alone 	<ul style="list-style-type: none"> • Close supervision • Working in pairs or teams dependent on the task • Self-checklists to assess for signs and symptoms of fatigue • Experienced personnel to support new personnel • Communication at shift handover (e.g., written, verbal, face to face) • Conversation • Reporting of other who may be fatigued

Table 3: Examples of potential control split across fatigue reduction and proofing strategies (*continued*)

	FATIGUE REDUCTION STRATEGIES	FATIGUE PROOFING STRATEGIES
Individual based	<ul style="list-style-type: none"> • Know how much sleep they need and get it • Set up sleep environment to promote and protect sleep • Fatigue awareness/competency training 	<ul style="list-style-type: none"> • Self-selected break times when appropriate • Self-checklists to assess for signs and symptoms of fatigue (e.g. Samn-Perelli) • Self-reporting for fatigue • Easy access to family/friends via communication modes when working away from home
Sleep promotion/protection based	<ul style="list-style-type: none"> • Training/awareness on how to maximise sleep & alertness • Provision of information to families/housemates to facilitate sleep at home/camp/hotel/other • Sound proofing on accommodation in camps/accommodation • Adequate coverings for windows in accommodation to block light • Beds suitable for size and weight of occupants • Parking rules and vehicle movements limited in and around accommodation facilities • Common areas for rest, recreation and social interaction • Single accommodation (no sharing of rooms, unless workers are on separate shifts - only one person trying to sleep in a room at any one time) • House those on night shift in one area of the camp to reduce disturbance during the day from cleaning crews • Schedule camp activities such as lawn mowing, moving of bins etc. to times when less likely to disturb those trying to sleep during the day (i.e., early or late) • Signs to put on door to say sleeping during the day to reduce disturbance. 	<ul style="list-style-type: none"> • Access to the Prior Sleep Wake Model

9.5 FATIGUE RISK ASSESSMENT

Every organisation undertakes hazard and risk assessment in slightly different ways but the outputs of such can generally be viewed as a formal document detailing existing and potential scenarios and controls, an action list to strengthen barriers and controls. It may also include a bow tie diagram to demonstrate flow trajectories and control sequences, a list of top risks for the workplace and a risk owner.

Undertaking a risk assessment with a focus on fatigue is no exception to this workplace practice. Fatigue can be integrated into other hazard bow tie outputs as a line item for activities such as driving of light vehicles, driving of heavy goods vehicles, international long haul flights, control room operations, health states or it can be done as a standalone factor. Either is acceptable, the idea is to understand, identify and capture the actions necessary to reduce the fatigue risk within the workplace.

9.6 KEY PERFORMANCE INDICATOR – WORKED EXAMPLE

Table 4 below provides a worked example of a Key Performance Indicator (KPI). It details training as a KPI and which factors and elements to consider, measure and track.

Table 4: Training as a potential KPI for fatigue (IOGP-IPIECA Report 488)

2. Training and competence	
<p>Training provides personnel with new knowledge and skills, but people need to apply and practise these to become competent. Competence is a combination of practical thinking skills, knowledge and experience.</p>	
<p>Desired outcomes</p> <ul style="list-style-type: none"> Personnel are able to recognize the effects of fatigue and to use alertness strategies effectively to enable them to maintain fitness for work/duty. 	<p>Critical elements</p> <ul style="list-style-type: none"> Personnel are able to recognize fatigue in themselves and others. Personnel are able to use alertness strategies effectively to overcome the effects of fatigue associated with extended hours of work or continuous operations involving shift changes.
<p>Possible leading indicators</p> <ul style="list-style-type: none"> Existence of a competency-based fatigue management training programme for relevant target employee groups. Evidence of application of the learning in the workplace. 	<p>Possible lagging indicators</p> <ul style="list-style-type: none"> Incident investigations identify lack of awareness of the risks of fatigue in the workforce as a contributing factor leading to: <ul style="list-style-type: none"> people involved in incidents being in a significantly fatigued state; and/or failure to intervene to prevent a seriously fatigued individual performing safety-critical work.
<p>Possible assessment questions</p> <ul style="list-style-type: none"> Are processes in place for training and periodic assessment of employees? Are employees aware of measures to improve sleep? Are training programmes updated to reflect lessons learned from incidents? Do systems exist for additional training for those employees and supervisors who require it? Is the training 'fit for purpose' (is it the right type of training for the organization's needs, including practical management strategies)? Is the training validated (did it deliver what it was supposed to)? Are training records available? How is the impact of training on worker performance evaluated? 	
<p>Possible supporting leading metrics</p> <ul style="list-style-type: none"> Percentage of employees trained per period as compared with schedule. Percentage of supervisors who have received additional specific training regarding their responsibilities per period as compared with schedule. Percentage of occupational drivers who have received additional specific training per period as compared with schedule. Percentage of employees completing refresher training per period as compared with schedule. Percentage of training records completed. Percentage of employees assessed to be competent in the application of their knowledge of fatigue and its application in the workplace based on post-training knowledge/competency tests. 	
<p>Possible supporting lagging metrics</p> <ul style="list-style-type: none"> Percentage of incident investigations in which a lack of adequate training in fatigue management is identified. Percentage of incident investigations in which a lack of competence in the management of fatigue is identified. Percentage of incident investigations in which recognized alertness strategies were not used effectively. 	

References and further reading

1. Roach G, Fletcher A, Dawson D. "A model to predict work-related fatigue based on hours of work." *Aviation, Space, and Environmental Medicine* 75 (Supp 3). 2004. A61–A69
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4. Dawson D et al. "Modelling fatigue and the use of fatigue models in work settings." *Accident Analysis & Prevention* 43 (2). 2011. p549-564.
5. Dawson D, Chapman J, Thomas MJ. "Fatigue-proofing: a new approach to reducing fatigue-related risk using the principles of error management." *Sleep Medicine Reviews* 16(2). 2012. p167-75.

10. Incident Investigations

10.1 INCIDENT REPORTING

Should an incident occur, it is essential to determine whether fatigue was a causal or contributing factor. Managing fatigue through an effective FRMS requires time, resources, budget and management support. To ensure that the FRMS is appropriately prioritised and resourced, accurate and reliable information about the contribution of fatigue to work-related incidents is necessary. Feedback from incidents will help to indicate where the FRMS can be improved. Using the findings from robust investigations to strengthen the FRMS is a key aspect of effective fatigue risk management.

Even though the reporting of incidents, accidents, near-misses and errors is common, the contribution of fatigue to these events is not always considered in a structured manner. The symptoms of fatigue may not be evident to witnesses or investigators; investigators often don't have sufficient understanding of fatigue, and so information needed to assess the influence of fatigue is not collected. In the past, the contribution of fatigue to incidents may have been determined by the observation of a person being asleep, self-reporting tiredness during an investigation, or being heard by others to report that they were experiencing fatigue symptoms.

In an investigation, it is not sufficient, or even appropriate, to simply ask "Was the worker fatigued? – YES/NO". Such a question is subjective, and the answer depends largely on the training and expertise of the person asking the question and the person answering. Different opinions by investigators will lead to inconsistent and inaccurate data. Furthermore, an individual's ability to determine whether their performance has been degraded by fatigue is not reliable. Research also shows that fatigue with no observable symptoms can have significant effects on human performance.

API Recommended Practice 755 states that:

*"The investigation of incidents should be conducted in a manner that facilitates the determination of the role, if any, of fatigue as a root cause or contributing cause to the incident. Information collected should include the time of the incident, the shift pattern, including the number of consecutive shifts worked, the number of hours awake, the number of hours of sleep in the past 24 hours by the individuals involved; the shift duration (and any overtime worked); whether the incident occurred under normal operations or an extended shift; whether an outage was occurring; and, other fatigue factors"*¹

This section outlines a structured approach to assist in determining whether fatigue adversely affected human performance in an incident. It brings together material from previous sections on the factors that are known to influence fatigue, together with what is known about the effects of fatigue on human performance to help the organisation to understand:

1. The percentage of events that have a fatigue contribution
2. The cost of fatigue-related events
3. The causes of the organisation's fatigue-related events
4. The aspects of the FRMS that require attention to increase its effectiveness.

10.2 INVESTIGATOR SKILLS AND EXPERIENCE

Determining whether fatigue is a contributory factor in investigations requires an understanding of what causes fatigue and how fatigue influences human performance, as well as the ability to collate and assess relevant information. Extracting the information necessary from those involved and witnesses, requires skill and care; 'leading' questions should be avoided. Investigators should ask open questions, such as "Describe your typical sleep pattern?", or "Was your sleep pattern different or disrupted in the days leading to the accident?"

10.3 DEFINING AN EVENT AS 'FATIGUE-RELATED'

When an incident or near-miss occurs, the investigation team will need to gather information that enables them to address two key questions:

1. Was the individual(s) experiencing fatigue?
2. Did the individual(s) behave in a manner that is consistent with what we know about how fatigue degrades human performance?

If the answer to these two questions is affirmative, and there are no other explanations for the behaviours, then the incident can be defined as fatigue-related. It is important to note that if there is evidence that individuals were fatigued, this on its own is not sufficient to conclude that the event was fatigue-related, unless it can also be determined that their performance was impaired by fatigue in a way that contributed to the event.

10.4 ESTABLISHING THAT FATIGUE WAS PRESENT

For an investigation to conclude that individuals were fatigued at the time of the event, several aspects of the FRMS should be addressed. The aim of this step should be to ask the right questions to enable the investigation team to form an objective assessment. The key aspects in making such a determination are whether the work arrangements provided sufficient sleep opportunity, and whether sufficient sleep was obtained. These two aspects together play the largest role in determining fatigue; only some factors will be work-related.

Factors would include:

- insufficient sleep during the last sleep opportunity
- a loss of sleep in the preceding days potentially leading to 'sleep debt'
- an extended time awake since the last sleep opportunity
- disruption of circadian rhythm due to shift work or travel
- time of day

Data will usually be gathered from interviews with individuals involved as well as those who have knowledge about the individual. Other sources of information are company records such as work schedules, timesheets, logbooks, handover notes, swipe-card records, risk assessments, annotated procedures, IVMS, etc. In major investigations, access to hotel records, mobile phones and other personal devices, CCTV recordings, medical or pharmacy records, toxicology reports, alarm clock settings and receipts may also be obtained to build a full picture.

10.5 ESTABLISHING WHETHER HUMAN PERFORMANCE WAS DEGRADED BY FATIGUE

This involves understanding whether the observed behaviour(s) of those involved in the incident were consistent with fatigue-impairment recognising that there may be physical and/or cognitive symptoms of fatigue. Section 3.1.2 outlined the main behavioural indicators that human performance has been degraded by fatigue. Some of the main cognitive impairments that can lead to incidents include delayed reaction times, decreased vigilance, poor communications, flawed decision making and forgetting task steps. It is important to recognise that certain tasks are more sensitive to the effects of fatigue, such as monitoring, prolonged attention, reasoning, high levels of skill, interpretation, reliance on memory, diagnosis and decision-making. Also, the effects of fatigue tend to be more marked if the task is monotonous or repetitive.

10.6 DEFINING WHO WAS INVOLVED

In understanding the impact of fatigue (or indeed other contributory factors) during investigations, it is necessary to consider not just those individuals present at the worksite at the time of the event, but to also consider the actions and decisions of those removed from the incident in space and time. The focus should not just be on the front line, but also consider supervisory and management contributions, and the potential for fatigue to have impaired their actions and decisions. The investigation should consider how others may have created the conditions and environment that made fatigue impairment more likely.

10.7 CULTURAL ISSUES

A 'just culture' or 'fair culture' is an important pre-requisite for the consideration of fatigue in accidents and incidents. It helps to ensure that staff are willing and comfortable in reporting fatigue issues. However, care must be taken when responding to incidents where fatigue was a factor, as fatigue related behaviours may not be the fault of a worker and 'blaming' an individual may have an impact on the future reporting of fatigue issues or concerns. Individuals may still become fatigued even when following the fatigue management procedures.

10.8 OTHER FACTORS

Incidents are usually the result of a combination of factors and it is unlikely that fatigue will be the only factor. Besides fatigue, the contribution of other factors that may affect human performance should also be considered. These include, but are not limited to, inadequacies in workload, staffing levels, competency, supervision, training and procedures. Unless the contribution of these other influences can be assessed, the importance of fatigue in an incident may be over or under stated.

10.9 INVESTIGATION QUESTIONS

To assist in gathering information to determine whether fatigue was a causal or contributory factor, investigators should consider forming questions around the factors detailed below. These are largely aimed at understanding whether there was an opportunity for sufficient sleep prior to the event, and whether this opportunity was taken; however, they also examine the nature of the work activities being undertaken.



10.10 ESTABLISHING THAT FATIGUE WAS PRESENT

Addressing the following items are likely to provide insight and or evidence in determining if fatigue was involved. Some questions may not be able to be asked based on privacy and or confidentiality regulations.

10.10.1 Date, time and place of the incident

- The day into the shift schedule
- Hours into the current shift
- Time of day
- Day of week

10.10.2 Sleep opportunity

- The schedule of actual work hours in the previous two weeks
- How long awake since last sleep period
- Commuting times to and from work (and distance and how travelled)
- Major travel in the previous 24 hours, particularly over different time zones
- Working time arrangement pattern
- Day vs Night sleep duration, quality

10.10.3 Sleep quantity and quality (sleep hygiene)

- Individuals 'normal' sleep pattern (e.g., hours and day/night, to enable a comparison)
- Had the individual obtained the sleep they need in this rest period?
 - i) Review the individual's actual sleep/wake history over the 48 hours preceding the incident using the prior sleep/wake model (Dawson 2005)
 - ii) Timing and duration of actual hours' sleep obtained in the previous 72 hours
- How long since the individual had two good nights of sleep in a row (i.e., more than 6 hours per sleep period or as much as their body needs routinely to be well rested and alert)
- Sleep interruptions (e.g., noise, light, phone calls, life stressors, new baby)
- Medications taken (prescription and non-prescription) in the week prior to the incident
- Awareness of sleep disorders that may have affected sleep (i.e., professionally diagnosed and or treated)
- Presence of illness or injury that disrupted sleep
- Any personal, financial or other stress that may have affected sleep or alertness
- Use of prescription or over-the-counter medication
- Inappropriate use of alcohol or recreational drugs that impact sleep and or behaviour

10.10.4 Work activity

- Is the task being performed sensitive to impairment by fatigue?
- Work environment conditions (e.g., excessive heat or noise, low lighting)
- Mentally or physically demanding work
- High workload
- Repetitive, mundane or monotonous
- Working alone, remotely, isolated, team
- Task rotation and frequency
- Breaks – frequency and duration, scheduled or self-selected

10.10.5 Incident information

- Self-reported primary signs of fatigue prior to the incident (e.g., rubbing eyes, yawning, frequent blinking, difficulty keeping eyes open, head nodding, micro-sleeps)
- Details of any previous fatigue assessments undertaken on involved persons prior to the incident
- Was the individual exhibiting any of the primary signs of fatigue in the time leading up to the incident (e.g., rubbing eyes, yawning, frequent blinking, micro sleep)? (see Figure 2 below)
 - i) Obtain evidence from those involved and witnesses about symptoms of fatigue
 - ii) Primary signs of fatigue observed by witnesses
 - iii) Individual expressed fatigue concerns to others
- Are the errors that caused the incident indicative of fatigue? (e.g., did the worker(s) have difficulty concentrating on tasks, exhibit lapses in attention, difficulty remembering tasks being performed, fail to communicate important information, fail to anticipate events or actions)

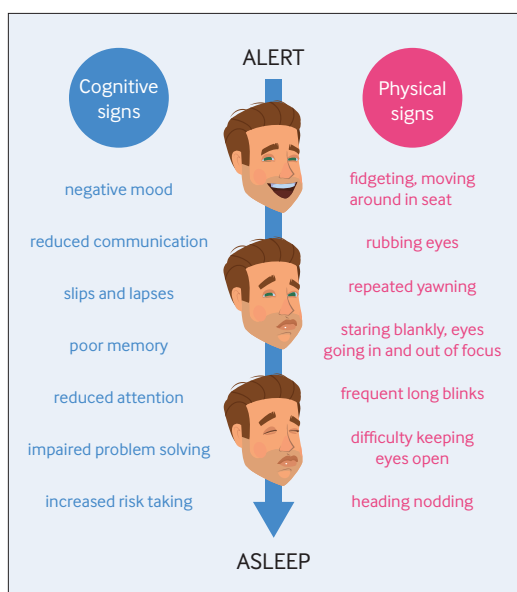


Figure 2
The physical and cognitive signs of increasing fatigue

If the assessment of the above factors suggests that individual(s) were fatigued or had a potential for sleep loss, then the next step is to examine behaviours to understand whether degraded human performance was present and consistent with the influence of fatigue.²

10.11 ESTABLISHING WHETHER HUMAN PERFORMANCE WAS DEGRADED

Individuals may unintentionally do the wrong thing or unintentionally not do the right thing. If it has been identified that fatigue was present, the investigation should look for evidence of one or more of the following impairments:

- Attention lapse (i.e., overlooked task steps or warning signs; preoccupation with certain tasks or problems; easily distracted)
- Impaired memory (i.e., recall problems; forgetting task steps)
- Reactions (i.e., respond slowly or not at all)
- Impaired problem solving (i.e., flawed logic, arithmetic, interpretation or judgement; loss of the 'big picture')
- Negative mood (i.e., irritable, impatient, frustrated, reduced interactions)
- Increased risk-taking, corner-cutting or a 'don't care' attitude

If the degradation in human performance is consistent with fatigue-induced behaviours, then the final step is to exclude other reasons for the behaviours as performance may be degraded by a combination of fatigue and other issues.

10.12 LESSONS LEARNT

By considering whether fatigue or a failure of the FRMS was causal or contributory will enable lessons to be learned and changes to processes and procedures made as necessary. Also, an understanding of how and when human performance was degraded will enable improvements to activities that are prone to fatigue-impairment.

10.13 MAKING IMPROVEMENTS TO THE FRMS

The information gained through a specific investigation may provide pointers as to how the FRMS can be improved. However, it is also necessary to identify and analyse trends over time, reviewing the contribution of the range of fatigue indicators as well as the behavioural degradations observed.

References and further reading

1. American Petroleum Institute. *Fatigue Risk Management System: RP 755*. p4.
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Abbreviations

Abbreviation	Meaning
BIBO	Bus in Bus Out
BU	Business Unit
CAS	Circadian Alertness Simulator
DIDO	Drive In Drive Out
EAP	Employee Assistance Programme
ESS	Epworth Sleepiness Scale
EU	European Union
FACTS	Fatigue Accident/Incident Causation Testing System
FAID	Fatigue Audit InterDyn
FFW	Fitness for Work
FIFO	Fly In Fly Out
FMWG	Fatigue Management Working Group
FRMS/FMRP	Fatigue Risk Management System/Fatigue Risk Management Plan
HOS	Hours of Service
ICSD	International Classification of Sleep Disorders
ILO	International Labor Organisation
IVMS	In Vehicle Monitoring System
KPI	Key Performance Indicator
KSS	Karolinska Sleepiness Scale
MHSWR	Management of Health and Safety at Work Regulations
NIOSH	National Institute for Occupational Safety and Health
IOGP-IPIECA	International Association of Oil and Gas Producers - IPIECA
REM	Rapid Eye Movement
SAFE	System for Aircrew Fatigue evaluation
SAFTE-FAST	Sleep, Activity, Fatigue and Task Effectiveness – Fatigue Avoidance Scheduling Tool
SMS	Safety Management System
UK	United Kingdom
US	United States of America

Glossary

TERM	MEANING/COMMENTS/USE
FRI (Fatigue Risk Index)	<p>A biomathematical model developed for the UK Health and Safety Executive by Mick Spencer and Simon Folkard.</p> <p>The Fatigue and Risk Index (FRI) is designed primarily for comparing different work schedules, or for examining the potential impact of a change to one feature of a given work schedule (e.g., shift change-over times). It can also be used to identify the fatigue or risk associated with any particular shift within a given schedule that may be of concern.</p> <p>To compare different shift schedules on the probability of high levels of sleepiness (the Fatigue score), and on the relative risk of an error that might result in an accident/injury (the Risk score).</p>
FAID (Fatigue Audit InterDyne)	<p>A biomathematical model developed by the Centre for Sleep Research, South Australia in the mid-1990s. It can be used to determine fatigue scores for each hour of duty in a schedule based on:</p> <ul style="list-style-type: none">• the duration of duty and rest periods.• the time of day that duty and rest periods occur.• the history of duty and rest periods over the previous seven days.• the biological limits to recovery
CAS (Circadian Alertness Simulator)	<p>Is a biomathematical model developed by USA based Circadian and AD OPT division of Kronos in the mid 1990s. The latest version of CAS (CAS-5) is specially optimised for airline FRMS to assess fatigue risk in crew pairings, bidlines, and day of operations data.</p> <p>Some of the key features of CAS-5 are:</p> <ul style="list-style-type: none">• Designed for Short haul/commuter, Long haul, Freight and Corporate operations• Can track Pilots, Flight attendants, and Ground crew• Supports crew planning, crew pairings, bidlines, crew requirements• Scientifically optimised with sleep/fatigue data• Full featured: Crew type, Duty type, Rest type, Time zone shifts etc.• Personalised to individual sleep
INN (Interactive Neurobehavioral Model)	<p>A USA based biomathematical model. This model has been developed based on laboratory studies examining both fatigue factors and adaptation of circadian phase to light exposure.</p>
FACTS (Fatigue Accident/Incident Causation Testing System)	<p>Fatigue Accident/Incident Causation Testing System (FACTS™) is a web-based biomathematical model developed by Circadian in the mid 1990s. It calculates the probability of whether a person was impaired by fatigue at the time of an accident or incident.</p> <p>FACTS can assist an organisation answer the following questions:</p> <ul style="list-style-type: none">• What is the probability that a worker was fatigued at the time of an incident/accident or operational deviation?• What was the source of excess fatigue risk (if any)?• What percent of the company's incidents/accidents/operational deviations are caused by a fatigue impaired worker?• What is the cost of worker fatigue impairment?

TERM	MEANING/COMMENTS/USE
SAFE (System for Aircrew Fatigue Evaluation)	<p>SAFE is a biomathematical model, commissioned by the UK Civil Aviation Authority as a regulatory tool assist with the assessment of likely fatigue in airline rosters. The underlying fatigue model was created from studies commissioned by the UK Ministry of Defence in 1980 and the UK CAA funded subsequent research for its application and use with aircrew. It is purpose built for the aviation industry.</p> <p>SAFE describes and predicts the likely fatigue and sleep patterns experienced by pilots for a given schedule of duties. It is validated for describing the fatigue experienced by commercial passenger jet pilots assigned to complete any given schedule of duties.</p> <p>SAFE can be used to assess planned or actual rosters; exploration of new routes or operations such as Ultra long haul; or used as an investigative tool after an incident to determine the likely fatigue of the aircrew at the time of the incident.</p>
FAST (Fatigue Avoidance Scheduling Tool)	<p>The primary application of the model is to aid operator scheduling by using work schedule information to estimate fatigue and cognitive effectiveness. FAST can be used to examine specific schedules to determine vulnerabilities, to select optimal schedules and to plan napping and recovery sleep strategies.</p> <p>The FAST software has been specifically designed for applications in industrial settings and transport, e.g., for aviation, rail, and shift workers.</p> <p>The outputs of the model include both workload fatigue and cognitive fatigue.</p>
SAFTE (Sleep, Activity, Fatigue and Task Effectiveness)	<p>SAFTE is a USA based biomathematical model. This model includes a sleep reservoir, circadian rhythm and sleep inertia component and has an auto sleep function that calculates likely sleep times based on work schedules and sleep physiology.</p> <p>It is designed to simulate the underlying physiological system that causes degradations in cognitive performance</p>
SWP (Sleep/Wake Predictor)	<p>The Sleep/Wake Predictor model (based on the original Three-Process Model of Alertness) was originally developed by Professor Åkerstedt at the academic Karolinksa Institute and Professor Simon Folkard, University Paris Descartes.</p> <p>The software is designed to predict alertness by determining the level of sleepiness associated with changes in circadian rhythms and time awake or asleep. This calculation is used to evaluate the potential for obtaining restful sleep and for a person remaining alert during a specified time period.</p> <p>The SWP program is used to assist schedulers and planning staff in evaluating the fatigue and performance effects of particular work schedules. It has been used in a variety of domains including navy, aviation, rail, trucking, nuclear power and military work environments</p>
Sleep Debt	<p>Sleep debt is the cumulative effect of not getting enough sleep. There are two kinds of sleep debt: the results of partial sleep deprivation and total sleep deprivation</p>
Long working hours	<p>Working for a period of time that is longer than the usual, regular, or routine for a given activity. The UK HSE define long working hours as 48hrs and above per week. Not a rolling week.</p>
Extended working hours	<p>Generally, working beyond eight hours is considered to be extended working hours in other industries and guidance. In mining, working hours in excess of established rostered hours, including overtime would be considered extended working hours.</p>

TERM	MEANING/COMMENTS/USE
Biomathematical model	<p>A tool designed to predict worker fatigue levels, based on scientific understanding of the factors contributing to fatigue. Biomathematical models are an optional tool (not a requirement) for predictive fatigue hazard identification, as within an FRMS. All biomathematical models have limitations that need to be understood for their appropriate use in an FRMS.</p>
SSS (Stanford Sleepiness Scale)	<p>The SSS was first presented in 1972 by Hoddes and associates. It is one of the oldest subjective sleepiness scales still in use today.</p> <p>It is a totally subjective rating subjects where give evaluating how they feel – from 1 to 7. 1 means totally alert (vigilant) and 7 means really struggling to stay awake and dream-like thoughts are occurring.</p> <p>It can be used in pinpointing the person’s circadian rhythms by tracking a person’s sleepiness and wakefulness throughout the day. It is a subjective measure of sleepiness, frequently used for both research and clinical purposes. It evaluates sleepiness at specific moments in time.</p> <p>Consists of only one item, the scale requires respondents to select one of seven statements best representing their level of perceived sleepiness. As a single-item measure, the scale is best suited for repeated use over the course of a research study or treatment intervention.</p> <p>Knowledge of personal circadian rhythms could allow shift workers to work during hours in which they are least sleepy/most alert.</p> <p>In addition, administering the test may prevent inappropriate dozing by placing raising awareness of sleepiness in the subject.</p> <p>While it is still used in sleep studies, the scale’s general applicability suffers from its lack of detail and requires the patient to have some awareness of their fatigue. Criticism of the SSS is that sleepiness is not a unidimensional construct (which the scale implicitly assumes) and that there are equivalent ways of quantifying sleepiness.</p> <p>It is convenient, if imprecise and unreliable, and good for repeated queries over the course of a test period or day. It can’t differentiate between people with sleep disorders and healthy people who are just sleepy. However, many doctors use it because it is so easy to use in the office and doesn’t require equipment.</p> <p>The SSS uses the following numeric scale:</p> <ol style="list-style-type: none"> 1: Feeling active, vital, alert, and wide awake. 2: Functioning at a high level but not at peak performance. Able to concentrate. 3: Relaxed and awake, but not fully alert. Still responsive. 4: Feeling a little foggy and let down. 5: Foggy and beginning to lose track of things. Difficult to stay awake. 6: Sleepy and prefer to lie down. Woozy. 7: Almost in reverie and cannot stay awake. Sleep onset is imminent.

TERM	MEANING/COMMENTS/USE
KSS (Karolinska Sleepiness Scale)	<p>The KSS is a self-report scale that measures the subject's drowsiness and is frequently used in studies measuring subjective sleepiness.</p> <p>It has been extensively validated and high scores are known to be associated with a high frequency of micro sleeps.</p> <p>It is a 9-point verbally anchored scale going from 'extremely alert' to 'extremely sleepy-fighting sleep'.</p> <p>Karolinska Sleepiness Scale</p> <p>1: extremely alert</p> <p>2: very alert</p> <p>3: alert</p> <p>4: rather alert</p> <p>5: neither alert nor sleepy</p> <p>6: some signs of sleepiness</p> <p>7: sleepy, no effort to stay awake</p> <p>8: sleepy some effort to stay awake</p> <p>9: very sleepy, great effort to stay awake, fighting sleep</p>
ESS (Epworth Sleepiness Scale)	<p>The ESS is a self-administered questionnaire with 8 questions. It provides a measure of a person's general level of daytime sleepiness, or their average sleep propensity in daily life. It has become the world standard method for making this assessment.</p> <p>The ESS asks people to rate, on a 4-point scale (0 – 3), their usual chances of dozing off or falling asleep in 8 different situations or activities that most people engage in as part of their daily lives, although not necessarily every day. It does not ask people how often they doze off in each situation. That would depend very much on how often they happened to be in those situations. Rather it asks what the chances are that they would doze off whenever they were in each situation. This requires a mental judgment which, it seems, most people are able to make in a meaningful way. The total ESS score is the sum of 8 item-scores and can range between 0 and 24. The higher the score, the higher the person's level of daytime sleepiness. Most people can answer the ESS, without assistance, in 2 or 3 minutes.</p> <p>The total ESS score provides an estimate of a general characteristic of each person – their average level of sleepiness in daily life. This can be influenced by many factors, and the ESS does not distinguish which factor(s) have caused any particular level of daytime sleepiness. It is not a diagnostic tool in itself, but is a very useful tool for measuring one important aspect of a person's sleep-wake health status.</p> <p>There are other subjective and objective methods for measuring sleepiness, but the ESS has several advantages, not the least of which is the fact that it is very cheap to use and very simple to administer to large numbers of people.</p>

TERM	MEANING/COMMENTS/USE
Sleep Diary	<p data-bbox="464 443 1430 501">A sleep diary is a record of an individual's sleeping and waking times with related information, usually over a period of several weeks. It is self-reported or can be recorded by a care-giver.</p> <p data-bbox="464 521 1430 613">The sleep diary, or sleep log, is a tool used by doctors, researchers and individuals. It is a useful resource in the diagnosis and treatment of especially circadian rhythm sleep disorders, and in monitoring whether treatment of those and other sleep disorders is successful.</p> <p data-bbox="464 633 1430 692">Sleep diaries may be used in conjunction with actigraphy. Sleep diaries are used in field based and lab based research studies.</p> <p data-bbox="464 712 1406 770">A sleep diary can help make individuals more aware of the parameters affecting their sleep. This data alone can help people self-diagnose what helps them get a good sleep.</p> <p data-bbox="464 790 1358 817">The information contained in a sleep diary includes some or all of the following points:</p> <ol data-bbox="464 837 1430 1697" style="list-style-type: none"><li data-bbox="464 837 1075 864">1. The time the person had wanted or intended to wake up<li data-bbox="464 884 796 911">2. The time the person woke up<li data-bbox="464 931 1382 990">3. Whether the person woke up spontaneously, by an alarm clock, or because of another (specified) disturbance<li data-bbox="464 1010 855 1037">4. The time the person got out of bed<li data-bbox="464 1057 1417 1115">5. A few words about how the person felt during the day (mood, drowsiness, etc.), often on a scale from 1 to 5 and the major cause<li data-bbox="464 1135 1098 1162">6. The start and end times of any daytime naps and exercises<li data-bbox="464 1182 1406 1240">7. The name, dosage and time of any drugs used including: medication, sleep aids, caffeine and alcohol<li data-bbox="464 1261 975 1288">8. The time and type/ heaviness of evening meal<li data-bbox="464 1308 1430 1335">9. Activities the last hour before bedtime, such as meditation, watching TV, playing PC-games<li data-bbox="464 1355 1299 1382">10. Stress level before bedtime, often on a scale from 1 to 5 and the major cause<li data-bbox="464 1402 903 1429">11. The time the person tried to fall asleep<li data-bbox="464 1449 1010 1476">12. The time the person thinks sleep onset occurred<li data-bbox="464 1496 983 1523">13. Activity during aforementioned two moments<li data-bbox="464 1543 1345 1601">14. The presumed cause, number, time, and length of any nighttime awakenings and activities during these moments<li data-bbox="464 1621 663 1648">15. Quality of sleep<li data-bbox="464 1668 1046 1695">16. Level of comfort of any recalled good or bad dreams

Appendix 1: Learning outcomes for fatigue management training

Learning outcomes for fatigue management training

If implementing a fatigue management training programme, companies should design the curriculum to consist of the following ten parts and create an assessment that evaluates whether course attendees, upon completion of the course, are able to:

1. Introduction to fatigue management

- Identify the main components of a Fatigue Risk Management System.
- Distinguish management's role in managing fatigue from workers' roles.
- Identify and understand the aims of this fatigue management-training programme.
- Understand the approach to fatigue risk management in the workplace

2. Causes and consequences of fatigue

- Understand what fatigue is.
- Identify the primary causes of fatigue.
- Describe the main causes of fatigue in their lives.
- Identify the effects of fatigue on safety.
- Identify the skills that are impaired by fatigue.

3. Sleep, sleep loss and the body clock

- Estimate their personal sleep need.
- Understand sleep loss and describe how it builds up.
- Identify the times of day at which alertness and sleepiness peak.
- Identify how the body clock influences fatigue on their roster.
- Recognise how being a 'morning' or an 'evening' person can affect alertness.

4. How to improve your sleep

- Identify behaviours that interfere with their sleep.
- Recognise effective strategies for improving sleep habits.
- Recognise the most effective napping strategies.
- Recognise strategies to help if they are having difficulty falling asleep.
- Recognise when they should consult a doctor if they are having difficulty sleeping.

5. Recognising the signs of fatigue

- Identify the signs of fatigue.
- Rank the signs of fatigue according to severity.
- Recognise the signs of fatigue in specific operating environments.

6. Managing fatigue at work

- Identify short-term countermeasures for managing fatigue at work.
- Estimate how much caffeine they consume each day.
- Be aware of how to reduce their caffeine intake if necessary.
- Recognise which substances can affect alertness.

7. Managing driver fatigue

- Recognise the risk of drowsy driving.
- Identify effective preventative strategies against drowsy driving.
- Distinguish effective short-term countermeasures from those that are not effective.
- Recognise effective emergency countermeasure against drowsy driving.
- Recognise when an emergency countermeasure should be applied.

8. Managing fatigue during travel

- Recognise strategies to help if they are suffering from jet lag or the effects of long journey time from home to work.
- Understand the pros and cons of sleep during international flights of long journey time to work.

9. Reporting fatigue

- Identify when they should report fatigue.
- Recognise why it is necessary to report fatigue.
- Supervisors understand appropriate response to fatigue reports.
- Understand the process used for recording fatigue-related incidents.

10. Self-verification and audit

- How to do it
- When to do it
- Frequency
- Continuous improvement

Appendix 2: Tools

Tools

TOOL/TEMPLATE	WHEN AND WHY TO USE
Report 626 – 1 – Fatigue Information Sheets	The IOGP-IPIECA Health Committee has prepared a series of information sheets covering specific issues likely to have an impact on worker fatigue and how to cope with them. These sheets are available as 626-1 – <i>Fatigue Information Sheets</i> .
Available in the 626-3 package. Sheets are listed in order of priority	
10.1 IOGP IPIECA Fatigue Management Questionnaire	This is a static document that does not require any modification or customisation prior to use. It is used by the fatigue focal point supported by HSSE and operational stakeholders. This will document your primary fatigue risk areas and where to allocate resources.
10.2 Fatigue Evaluation Matrix	This is a useful reference document regarding hours of work and allocation of a fatigue risk level. To be used if concerns have been raised or highlighted around working time arrangements. Science based document. Not to be changed
10.3 Fatigue impairment checklist for supervisors	This is an active document that is to be used by a supervisor if an individual reports fatigue (self-reporting) or has been identified by a colleague as potentially experiencing fatigue in the workplace. This is to be used as a formal record of an interaction between a worker and a supervisor/ leader and retained for tracking and reporting purposes. NB: Confidentiality/Privacy Regulations may restrict the way this document is accessed, stored and utilised within the workplace – it is important to check local and regional legal requirements with the organisations legal team prior to use. This document is not to be changed
10.4 Samn-Perelli checklist	This is an informal means for individuals to check their own fatigue levels when they may question their fitness for work/duty. This is a simple guide and should be used in conjunction with other assessment processes such as speaking to your supervisor/lead re sleep/wake and signs and symptoms of fatigue; working time arrangements (e.g., overtime, on call, extended hours etc.), commutes (e.g., FIFO /DIDO/ BIBO arrangements) and any changes that influence the worker’s sleep/wake behave.
10.5 Self-verification checklist	This is an example of a spreadsheet based document that enables a site to assess their conformance with the requirements of their own FRMS. It will need to be customised to the site and updated accordingly to provide the basis of a meaningful assessment against site focused fatigue elements.
Shiftwork Advice Sheet	Provides guidance on structuring shift work and mitigating its negative impacts on sleep
FRMP template example	
10.6 Generic Fatigue Risk Management Plan	This is an example of a starting point for the development of a site specific FRMP that is part of the greater FRMS. This example is generic and may not cover all aspects that a particular site may require. It is meant to enable a site to see what to cover and how it may be sequenced. This needs to be updated, changed and customised for each specific site based on their fatigue risk profile and the population for which it is being developed. It also needs to reflect the FRMS within which it sits.

Further Reading & Live links

FATIGUE AND INDUSTRY

- Parliament of Australia House of Representative Standing Committee on Communications, Transport, and the Arts. "Beyond the Midnight Oil: Managing Fatigue in Transport." October 2000. http://www.aph.gov.au/parliamentary_business/committees/house_of_representatives/committees?url=cita/manfatigue/mfcontents.htm Accessed 13 December 2018.
- Minerals Council of Australia: Design, Fatigue and Sleep https://books.google.nl/books/about/Work_Design_Fatigue_and_Sleep.html?id=kE2jmwECAAJ&redir_esc=y
- Digging Deeper <http://www.nswminesafety.com.au/projects/digging-deeper-project>
- NIOSH <https://www.cdc.gov/niosh/topics/workschedules/default.html>
- Health and Safety Executive. The development of a fatigue/risk index for shiftworker (2013) s. RR446. Available at: <http://www.hse.gov.uk/research/rrhtm/rr446.htm>
- Health and Safety Executive. Human factors: fatigue. Why is fatigue important? 2016. Available at: <http://www.hse.gov.uk/humanfactors/topics/fatigue.htm> Accessed August 15 2016
- Worksafe Tasmania, 2015, Fatigue Management. Available from http://worksafe.tas.gov.au/__data/assets/pdf_file/0004/288202/Fatigue_management_fact_sheet.pdf
- ACOEM Guidance Statement Fatigue Risk Management in the Workplace ACOEM Presidential Task Force on Fatigue Risk Management JOEM Volume 54, Number 2, February 2012. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.593.2465&rep=rep1&type=pdf>
- Advisory Circular US Department of Transportation Federal Aviation Administration AC No 120-103A Fatigue Risk Management Systems for Aviation Safety. https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_120-103A.pdf
- Circadian White Paper Evolution of Fatigue Risk Management Systems: The "Tipping Point" of employee fatigue mitigation Martin Moore-Ede MD, PhD. http://www.nkffa.org/Evolution_of_Fatigue_Risk_Management_Systems_-_The_Tipping_Point_of_employee_fatigue_mitigation.pdf
- Gertler, J., Popkin, S., Nelson, D., O'Neil, K. Transportation Research Board for the Federal Transit Administration. Toolbox for Transit Operator Fatigue. TCRP Report 81. Washington, DC: National Academies Press; 2002. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_81.pdf
- Railways and Other Guided Transport Systems (Safety) Regulations. London, UK: Stationery Office; 2006. <http://www.legislation.gov.uk/ukxi/2006/599/contents/made>
- Federal Aviation Administration. Advisory Circular: Introduction to Safety Management Systems for Air Operators. AC No: 120-92; 2006. Available at: [http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/6485143d5ec81aae8625719b0055c9e5/\\$FILE/AC%20120-92.pdf](http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/6485143d5ec81aae8625719b0055c9e5/$FILE/AC%20120-92.pdf)
- Civil Aviation Safety Authority. Safety Management Systems: Getting Started. Canberra, Australia: Civil Aviation Safety Authority; 2002 https://www.casa.gov.au/file/157246/download?token=r_a53pLF
- Air Line Pilots Association, International. ALPA White Paper. Fatigue Risk Management Systems: Addressing Fatigue Within a Just Safety Culture. Washington, DC: Air Line Pilots Association, International; 2008. https://www.alpa.org/~media/ALPA/Files/pdfs/news-events/white-papers/FatigueRiskMSWP_6-2008.pdf?la=en
- UK HSE link Managing Shiftwork HSG 256 ISBN 978 0 7176 6197 8 <http://www.hse.gov.uk/pUbns/priced/hsg256.pdf>
- Offshore working time in relation to performance, health and safety: A review of current practice and evidence. Prepared by the University of Oxford for the Health and Safety Executive (2010), RR772. <http://www.hse.gov.uk/research/rrpdf/rr772.pdf>
- SUPREME COURT OF QUEENSLAND CITATION: *Kerle v BM Alliance Coal Operations Pty Limited & Ors* [2016] QSC 304 <http://archive.sclqld.org.au/qjudgment/2016/QSC16-304.pdf>

SLEEP

Sleep tools

Epworth Sleepiness Scale <https://web.stanford.edu/~dement/epworth.htm>

Karolinska Sleepiness Scale (KSS) https://link.springer.com/chapter/10.1007/978-1-4419-9893-4_47

Applications and practical resources:

- The National Sleep Foundation website has a Sleep Diary that workers can use to track their sleeping habits and sleep quality. <https://sleepfoundation.org/sleep-diary/SleepDiaryv6.pdf>
- There are a number of smartphone applications available or assistance in tracking your nutrition, exercise, sleep cycles, levels of physical activity, and to assist with relaxation techniques.
- Relaxing music or even white noise can be helpful in falling asleep. There are many free smartphone applications that can provide these.

Links and resources:

- Informational videos and articles on sleep are available at <https://sleepfoundation.org/>
 - Including 'Build a better bedroom' - <https://sleepfoundation.org/video-library>
- Information on optimising sleep and having a healthy lifestyle for sleep promotion <http://sleephub.com.au/sleep-resources/>
- Information about insomnia and sleep hygiene, and an example of a sleep diary http://www.cci.health.wa.gov.au/resources/minipax.cfm?mini_ID=25
- There is a great deal of relevant information available from the Australian Sleep Health Foundation, including:
 - Tips on getting better sleep <http://www.sleephealthfoundation.org.au/tip-of-the-week.html>
 - Fact sheets <http://www.sleephealthfoundation.org.au/fact-sheets-a-z.html>
 - Information for educating and discussing sleep with children <http://www.sleephealthfoundation.org.au/childrens/world-sleep-day.html>

RISK

Biomathematical Models

FAID

<https://www.interdynamics.com/about-interdynamics/>

CAS

<http://www.circadian.com/247-industries/aviation/cas-5-fatigue-risk-model.html>

FACTS

<http://www.circadian.com/software/accident-incident-analysis-with-facts.html>

SAFE

<https://www.firmsc.com/the-safe-suite/the-safe-model/>

FIC

<http://www.hse.gov.uk/research/rrpdf/rr446g.pdf>

SAFTE

<http://ibrinc.org/sleep-activity-fatigue-and-task-effectiveness-safte/>

The above biomathematical models have taken many years to develop, validate, and use. The IOGP-IPIECA Health Committee has prepared a comprehensive reference list of the sources used in modelling, as well as investigative reports that have utilised these models. This list, IOGP Report 626-2, is available as a companion resource to Report 626.

IPIECA

IPIECA is the global oil and gas industry association for environmental and social issues. It develops, shares and promotes good practices and knowledge to help the industry improve its environmental and social performance, and is the industry's principal channel of communication with the United Nations.

Through its member-led working groups and executive leadership, IPIECA brings together the collective expertise of oil and gas companies and associations. Its unique position within the industry enables its members to respond effectively to key environmental and social issues.



IOGP 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, IOGP is the industry representative to the European Commission and Parliament and the OSPAR Commission for the North East Atlantic. Equally important is IOGP's role in promulgating best practices, particularly in the areas of health, safety, the environment and social responsibility.

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