Department of **Natural Resources and Mines**

QGN 16
Guidance Note for Fatigue Risk Management

Coal Mining Safety and Health Act 1999
Mining and Quarrying Safety and Health Act 1999

Queensland Government

Foreword from the Commissioner for Mine Safety and Health

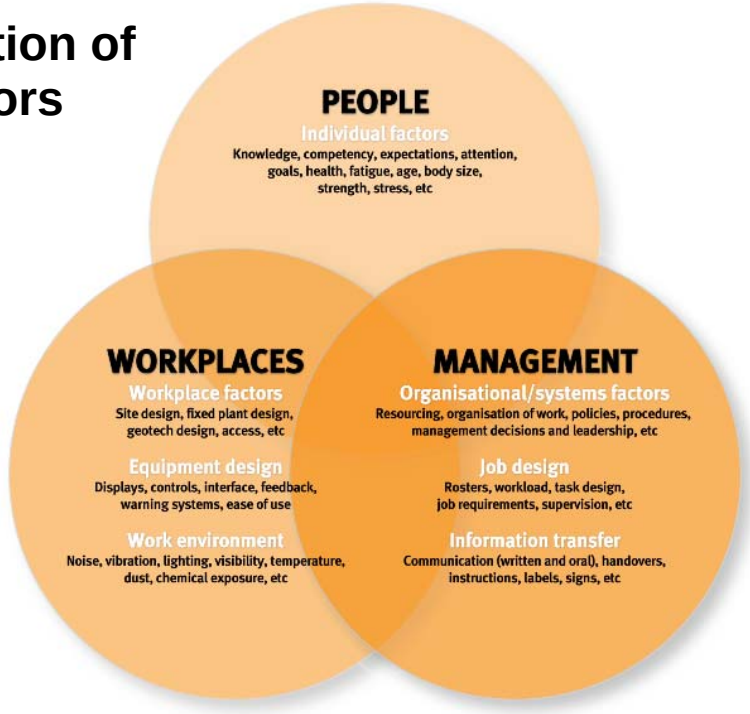
Fatigue has long been recognised as a hazard in the mining industry. There has been a considerable body of research and development work done in this area in recent years. The mining industry in Queensland is aware of the hazards associated with fatigue and is proactively seeking solutions and control strategies.

This document, "*Guidance Note for Fatigue Risk Management*", outlines the various considerations to effectively manage fatigue. It provides mine operators (coal mine operators, mine and quarry operators) and mine workers (coal mine workers, mine and quarry workers) with a comprehensive overview of the factors that contribute to workplace fatigue and how they can be controlled. Fatigue is no longer viewed as an issue only for the individual; rather it is a multi-facetted hazard that requires a multi-facetted approach to manage the risk.

This guidance note supersedes the 2001 *Guidance Note for Management of Safety and Health Risks associated with Hours of Work Arrangements at Mining Operations* produced by the then Department of Natural Resources and Mines.

The knowledge and application of evidence based fatigue risk management practices has increased dramatically since 2001, and this guide incorporates information, research and good practice from a number of sources. It provides a human factors approach acknowledging the inter-relationship between people, workplace and management factors influencing fatigue in the workplace.

The interaction of human factors



This guide addresses the fatigue-related factors in all elements of the system. The goal is to reduce the likelihood of fatigue-related incidents or errors.

This document was prepared to assist mine and quarry operators and workers in taking the necessary measures to control the risks associated with fatigue.

Stewart Bell
Commissioner for Mine Safety and Health

Acknowledgements

This guide is based on the Industry and Investment New South Wales (NSW) document, *Fatigue management plan: a practical guide to developing and implementing a fatigue management plan for the NSW mining and extractives industry*, which has been developed and endorsed by the NSW Mine Safety Advisory Council. The NSW publication also used content from the joint WorkSafe Victoria and WorkCover New South Wales guidance (Fatigue - prevention in the workplace). The Department of Natural Resources and Mines (DNRM) acknowledge the assistance of Industry and Investment NSW in allowing the use of the document in developing this guide.

In the development of this guide a number of other fatigue guidance publications were consulted as well as research on sleep, fatigue, sleep disorders and other related issues.

This guide received input from and review by the Queensland Mine Safety and Health Advisory Committee (QMSHAC) and Queensland Coal Mine Safety and Health Advisory Committee via the joint Fatigue Working Party. Organisations represented on the QMSHAC Fatigue Working Party are: the Australian Workers Union; Construction, Forestry, Mining and Energy Union (Mining and Energy Division); Queensland Mine Safety Advisory Committees; DNRM Safety and Health and Queensland Resources Council (QRC).

Guidance Note – QGN 16

Guide to Fatigue Risk Management

This Guidance Note has been issued by the Mines Inspectorate of the Department of Natural Resources and Mines (DNRM). It is not a Guideline as defined in the *Mining and Quarrying Safety and Health Act 1999* (*MQSH Act*) or a Recognised Standard as defined in the *Coal Mining Safety and Health Act 1999* (*CMSH Act*). In some circumstances, compliance with this Guidance Note may not be sufficient to ensure compliance with the requirements in the legislation. Guidance notes may be updated from time to time. To ensure you have the latest version, check the DNRM website: http://mines.industry.qld.gov.au/safety-and-health/mining-safety-health.htm or contact your local Inspector of Mines.

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Purpose of this document

Guidance on how to systematically manage fatigue risks

The purpose of this guide is to provide guidance to mining (and coal mining) operations on how to systematically manage fatigue risks in the workplace so that the obligation holders comply with the legislative framework. The guide will help sites develop and implement a fatigue risk management plan which will contain strategies to effectively control the risks of fatigue. It sets out a risk management approach based on consultation with the workforce. The approach requires that mine (including coal mine) sites:

- identify the hazards of fatigue
- assess the risks of fatigue using available scientific evidence and current practice*
- implement effective risk control measures
- monitor and review regularly the effectiveness of the controls.

Plans must cover fatigue risk factors, and fatigue contributors as well as site-specific needs

The guide is not prescriptive, which means that individual operators and sites can develop a plan that is specific to their needs. However, all plans should address each of the main areas identified in this document. Some smaller sites and quarries may determine that they do not have the fatigue risk factors that apply to many operations that operate 24 hours. They may find that their planning for fatigue will include a risk assessment indicating that they have a low risk of fatigue, rather than developing a plan. The management of fatigue should also be incorporated in the overall safety and health management system.

* Specific requirements for risk assessment for personal fatigue apply under the *Coal Mining Safety and Health Regulation* 2001(*CMSH Regulation*), *s.42* and *s.10*

Glossary

	Total time spent at work including overtime. This does not include time travelling to or from the work site or rest breaks during shifts.
	BIBO (bus in/bus out) can be used to describe sites where workers are bussed to and from site on a daily basis. This does not necessarily mean that a residential camp is provided – it may be to and from a township.
	Commute is the term given to the journey for a worker to and from their permanent home, or in some cases, the site accommodation to the site. It may involve air travel, driving, company provided bus, car pooling or other means of transport. The commute can involve both a daily commute to the mine site (or coal mine site) and, in some cases, a commute to the worker's permanent home at the beginning and end of a work cycle or roster.
	The commute (or journey) to and from the mine site can involve significant distances of driving, bussing (or flying) for some workers. This can add a number of hours to the period that workers will be awake (see wakefulness). It is important for sites to consider factors such as number of hours driving to and from site on a daily basis, distances travelled, and/or likely number of hours driving before and after rosters. Sites should also have a change management process in place for workers to notify the site designate for changes to their journey plan. This information forms the commute management or journey management plan for workers.
	Consultation with workers is discussion between the site senior executive or supervisors and affected workers about a matter with the aim of reaching agreement about the matter. Further requirements for consultation are specified in legislation and in this guide.
	DIDO (drive in/drive out) is the term for sites where workers travel to site by road, without air travel being provided for access to the site for all workers. There will still be some workers who fly in to the nearest airport and drive to (or are driven to) site.
	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.

Fatigue	Fatigue can be defined as a state of impairment that can include physical and/or mental elements, associated with lower alertness and reduced performance. There are a number of contributing factors to fatigue, but they usually relate to lack of sleep quantity or quality, extending the time someone is awake (see wakefulness and extended wakefulness), or other work related or individual factors. Fatigue due to loss of sleep quality or quantity can be experienced after a short period of exposure to sleep loss (acute fatigue) or over a longer period of time where sleep loss has accumulated (cumulative fatigue).
FIFO	FIFO (fly in/fly out) is the term given to mining operations that have accommodation provided, and have workers flown in.
FFW	Fitness for work as used in the *Coal Mining Safety and Health Regulation 2001* (*CMSH Regulation*), and *Mining and Quarrying Safety and Health Regulation 2001*(*MQSH Regulation*).
Hazard	Hazard (as defined in the *CMSH Act, s.19* and *MQSH Act, s.20*) means a thing or a situation with potential to cause injury or illness to a person. Note: The above definition is not an exclusive description, and sites can include alternate definitions, for example "hazard means a thing or a situation with potential to cause harm, damage, injury or illness to a person."
Operator/site	Any person or organisation responsible for the employment of one or more workers on-site. Site includes both coal mine site and mine site under Queensland mining legislation.
Risk	Risk (as defined in the *CMSH Act, s.18* and *MQSH Act, s.19*) means the risk of injury or illness to a person arising out of a hazard. Risk is measured in terms of consequences and likelihood.
Rostered hours	The hours a worker is rostered to work.
Safety critical task for fatigue-related issues or incidents	Although fatigue will have a potential affect on every worker on-site, the consequences of fatigue will vary depending on the task being performed. In Queensland mining, the following is the preferred definition of safety critical tasks for fatigue or ill health. "Those tasks undertaken by workers whose action or inaction due to ill health or fatigue, may lead directly or indirectly to a serious incident affecting the health and safety of a number of other persons." Sites may also choose to review tasks and identify those workers who are continuously performing safety critical tasks.
Shift	The hours between the start and finish of established rostered hours.
Site Safety and Health Representatives (SSHR) for mines and coal mines	A worker elected or selected (under the *MQSH Act, Part 7*) or a coal mine worker elected (under the *CMSH Act, Part 7*) to represent workers at a mine or coal mine.

Site Senior Executive (SSE) coal and metalliferous	As per *s.25* of the *CMSH Act,* the site senior executive for a coal mine is the most senior officer employed by the coal mine operator for the coal mine who— (a) is located at or near the coal mine; and (b) has responsibility for the coal mine. or As per *s.22* of the *MQSH Act*, the site senior executive for a mine is the most senior officer employed by the operator for the mine who— (a) is located at or near the mine; and (b) has responsibility for the mine.
Time not working	Time outside of working hours. Does not include time travelling to or from the work site.
Wakefulness and extended wakefulness	Wakefulness is the term for the period, in hours, of being awake from the previous block of sleep. Extended wakefulness is the extended period of being awake that can increase the body's desire to sleep, known as homeostatic sleep drive. There is some variability between individuals in the amount of time awake that begins to affect performance, but research[1] suggests that after approximately 16-17 hours of being awake, depending on time of day, performance starts to decline.
Work cycles / rosters	The working period scheduled between any significant break away from work.
Work week	This is the number of actual working hours worked by workers or contractors in any seven day period and is not an 'averaged' figure over a monthly roster.
Worker (including mine worker and coal mine worker)	Any person who works on the mine (or coal mine) site, regardless of their employer. This includes contractors. In this document the term 'worker' applies to mine workers and coal mine unless specific to the legislative context.

[1] Dawson and Reid (1997) *Fatigue, alcohol and performance impairment*. Nature, 388: 235.

Preface

Obligations under Queensland legislative and regulatory requirements

Relevant laws oblige fatigue to be eliminated or controlled

Obligations exist under the *Coal Mining Safety and Health Act 1999* (*CMSH Act*), and the *Mining and Quarrying Safety and Health Act 1999* (*MQSH Act)* to control fatigue risks to as low as reasonably achievable.

The obligations and legislation provided in this guidance note are not exhaustive, and all obligation holders need to refer to the *CMSH Act* or *MQSH Act* and the *Coal Mining Safety and Health Regulation 2001* (CMSH *Regulation*) or *Mining and Quarrying Safety and Health Regulation 2001 (MQSH Regulation*) for the most recent and relevant legislation that may apply. Legislation can be found at: http://www.legislation.qld.gov.au/Acts_SLs/Acts_SL.htm

Obligations for persons

Obligations under Queensland mining and coal mining legislation for fatigue risk management apply to the following

- holder
- operator
- site senior executive
- appointees in the site management structure
- contractor
- an erector or installer of plant at a coal mine
- a person who supplies a service at a coal mine
- supervisor
- mine worker (or coal mine worker)
- service supplier
- persons generally.

Obligations of holders, operators and SSEs

Operators, SSEs must apply systematic risk management to achieve an acceptable level of risk

- ensure the safety and health of mine workers (including coal mine workers) and visitors to the workplace with regard to fatigue
- have a health and safety management system or plan that achieves effective management and control of fatigue
- consult with mine workers (or coal mine workers) and those doing the work on fatigue risks (see Obligations for consultation with workers, on page seven for specific requirements)
- identify, analyse and assess fatigue hazards and resultant risk
- avoid or remove unacceptable risk and control retained fatigue risks
- monitor levels of fatigue risk and the adverse consequences of retained residual risk
- investigate and analyse the causes of serious accidents and high potential incidents with a view to preventing their recurrence
- review the effectiveness of fatigue risk control measures
- take appropriate corrective and preventive action
- mitigate the potential adverse effects arising from residual risk.

Mining and coal mining legislation obliges

All mining (and coal mining) operations are subject to the Queensland mining (and coal mining) safety and health legislation. This legislation requires all obligation holders, including mining operators and SSEs, to comply with their obligations above to achieve an acceptable level of

operators and SSEs to comply with their obligations and the objects of the legislation

risk. An object of the *CMSH Act* and the *MQSH Act* is to protect the safety and health of persons at mines (or coal mines) and persons who may be affected by mining (or coal mining) operations.

Legislation obliges mine workers and persons generally to comply with the Acts, Regulations and applicable

safety and health management systems

All persons on mining operations (and coal mining operations) are subject to the Queensland mining (and Queensland coal mining) safety and health legislation.

Obligations to ensure an acceptable level of risk is achieved

Fatigue is managed so an acceptable level of risk is achieved

The *CMSH Act,* s.30 and *QMSH Act,* s.27 provides that the systems must incorporate risk management elements (or procedures) and practices appropriate for each coal mine (or mine) to—

(a) identify, analyse, and assess risk

(b) avoid or remove unacceptable risk

(c) monitor levels of risk and the adverse consequences of retained residual risk

(d) investigate and analyse the causes of serious accidents and high potential incidents with a view to preventing their recurrence

(e) review the effectiveness of risk control measures, and take appropriate corrective and preventive action

(f) mitigate the potential adverse effects arising from residual risk.

Obligations for consultation with workers

Consultation with workers according to specific requirements of the legislation

Consultation with coal mine workers regarding fatigue must be in accordance *CMSH Regulation, s.10* and *s.42* developing standard operating procedures that apply to fatigue. This includes, under *CMSH Regulation, s.42 (5)*, that the site senior executive must consult with a cross-section of workers at the mine in developing the fitness provisions and comply with *CMSH Regulation, s.42 (6, 6A)* and *s.8*. In developing the standard operating procedure for fatigue, the requirements of *CMSH Regulation, s.10* apply. Consultation with coal mine workers is also specified under the *CMSH Act, s.64* for changes to the safety and health management system.

Under the mining and quarrying legislation, consultation with mine workers is in accordance with the *MQSH Act, s.56* (changes to the safety and health management system) and *MQSH Regulation, s.5* for risk management practices and procedures that apply to fatigue.

Obligations for planning, organisation, leadership and control

SSEs have obligations for planning, organisation, leadership and control under *s.42* of the *CMSH Act* and *s.39* of the *MQSH Act*

Although there is no specific requirement to develop a fatigue risk management plan, under the *CMSH Act*, s.42 (f) there is a requirement for the SSE: to provide for—

(i) adequate planning, organisation, leadership and control of coal mining operations.

Under the *MQSH Act*, s.39 (f) the SSE is to provide for—

(i) adequate planning, organisation, leadership and control of operations.

Summary

What is fatigue and why is it a problem? (Chapter 1)

Fatigue is a state of physical and mental impairment

Fatigue can be defined as a state of impairment that can include physical and/or mental elements, associated with lower alertness, reduced performance and impaired decision making. There is a direct link between fatigue and increased risk of being involved in an incident or accident.

Who needs a fatigue risk management plan? (Chapter 2)

All sites to conduct a fatigue risk assessment to decide if a fatigue risk management plan is needed

All mines and quarries (under MQHS Act, s.27) and coal mines (under CMSH Act, s.30) are required to identify whether a fatigue hazard is present, and if present to assess the risk of fatigue. A fatigue risk management plan is required if fatigue risk factors are identified during the risk assessment and the fatigue risk factor tables indicate that these factors have a medium or high potential.

An operation's fatigue risk management plan should cover all affected parties, those who work on planned rosters and unplanned work, such as overtime call-outs and involvement in emergency response. Commuting times should also be considered.

Developing and implementing a plan to manage the risk of fatigue (Chapter 2)

Help to develop a site-specific fatigue risk management plan

This document is designed to help the mining industry develop a comprehensive plan to manage fatigue that is specific to their work and site conditions. It proposes a suggested structure and approach however each plan can be expected to be different because it must take into account the specific hazards, risks and tasks at the mine, and surrounding conditions. An implementation and management plan must be developed through a consultative process with stakeholders as required under legislation. The developed plan should be clearly documented, be readily available for use and inspection by all relevant persons, and be reviewed on a regular basis. It should also be integrated into the overall site safety and health management system, contractor management arrangements and the operation's health and safety management system.

Consultation (Chapter 3)

Involve those most likely to be affected by fatigue

Development of the fatigue risk management plan requires consultation with all relevant parties, as per the legislation.

Role clarity (Chapter 4)

Identify everyone's role

The roles and responsibilities of persons within the organisation who will have responsibility for developing and implementing the plan should be identified.

Risk management (Chapter 5)

Risk management is the key to an effective fatigue risk management plan

The key aspect of developing a fatigue risk management plan for a specific workplace is to undertake a thorough risk assessment and implement a risk management plan (or to exercise a sound and comprehensive risk management approach considering the complex multifactorial nature of fatigue). This involves hazard identification and risk assessment, control of the risks and evaluation of the effectiveness of the risk controls. Risk assessment is a dynamic process, and the work environment and systems should be evaluated regularly. The non-work environment must also be considered. To assist the risk management process, tools and guidance are provided in checklists, tables 1-4, and Appendix 3 of this document.

Documentation (Chapter 6)

The plan must be documented

A fatigue risk management plan must be fully documented and integrated as part of an overall safety and health management system. The fatigue risk management system components must be able to be audited and assessed.

Implementation (Chapter 7)

Risk controls must be put into action if the plan is to be a success

The fatigue risk management plan must be implemented. Without adequate risk controls being put in place, the work that has gone into preparing the fatigue risk management plan will not be useful. Key issues to consider in implementing the plan include timeframes, training, roles and responsibilities, resources, communication and participation, and the effectiveness of controls.

Evaluation (Chapter 8)

The plan must be reviewed to make sure it is working

All aspects of the fatigue risk management plan should be audited and reviewed at regular intervals to ensure continuing suitability, adequacy and effectiveness of the controls for managing the risk.

1. Introduction

1.1 Background

What is fatigue?

When fatigued, physical or mental activity becomes more difficult to perform

Fatigue can be defined as a state of impairment that can include physical and/or mental elements, associated with lower alertness, reduced performance and impaired decision making. Signs of fatigue include tiredness even after sleep, psychological disturbances, loss of energy, irritability, moodiness and inability to concentrate. Fatigue can lead to incidents because workers are not alert and are less able to respond to changing circumstances, thereby putting themselves and others at risk. Fatigue can also impair decision making, and therefore cause errors of judgement. As well as these immediate problems, fatigue can lead to long-term health problems.

What causes fatigue?

Fatigue develops directly when there is insufficient sleep quality or quantity

Fatigue is a complex, multifactor problem that can have many contributions. There are a number of 'direct' causes of fatigue, due to insufficient sleep quality or quantity. The quantity and quality of sleep obtained prior to and after a work period can be influenced by:

- activities outside of work, such as family commitments, a second job, or recreational factors
- noise or other disturbances during sleep times
- individual factors, such as sleeping disorders, health issues, or other illnesses.

Fatigue most commonly arises from periods of wakefulness without adequate rest

Fatigue is usually considered to have two presentations, acute fatigue and cumulative fatigue. Acute fatigue is experienced after a one-off or immediate episode of sleep loss. For example, because of an extended period of wakefulness, sleep disturbances or inadequate sleep. Ongoing sleep disruption or lack of restorative sleep can lead to sleep debt and cumulative fatigue, increasing the risk of fatigue-related incidents or errors. Fatigue due to the effects of lack of sleep quality or quantity may be experienced as cognitive (or mental) fatigue, and have affects such as:

- reduced coordination and alertness
- changes in emotional function
- changes in mental performance or decision making
- micro sleeps during tasks.

If sleep loss continues, work performance can deteriorate even further.

Fatigue can result from work related or non work related causes, or a combination of both

Fatigue can result from work related factors, from factors in a worker's life outside work or in combination. Fatigue has known effects on certain tasks or tests, but it is not consistently measurable without specific and verified testing. Work-related fatigue can and should be assessed and managed at an organisational level. The contribution of non-work-related factors varies considerably between individuals. Non-work-related fatigue is best managed at an individual level.

Work-related causes of fatigue

In addition to the previous direct factors affecting sleep quality or quantity, there are additional work related factors that will have an influence on fatigue development. These inter-related causes of fatigue can include:

- the time of day that work takes place
- the length of time spent at work and in work-related duties
- the type and duration of a work task, and the environment in which it is performed
- work design (monotony, highly demanding workloads, mentally challenging work)
- organisational factors leading to stressful work environments, such as bullying, harassment or other psychosocial factors
- roster design (e.g. too many consecutive shifts without sufficient restorative sleep)
- unplanned work, overtime, emergencies, breakdowns and call-outs
- certain features of the working environment (e.g. noise or temperature extremes)
- commuting times.

Non-work-related causes of fatigue

Non-work-related causes of fatigue can include:

- sleep disruption due to issues at home
- strenuous activities outside work, such as a second job or other recreational activities impacting on the person's rest patterns
- sleep disorders, insomnia and other diseases
- use of alcohol, prescription medication or illegal drugs
- stress associated with financial difficulties, domestic responsibilities etc.

Why is fatigue a problem?

Fatigues increases the risk of incidents and long-term health problems

Fatigue most commonly causes an increased risk of incidents due to physical and mental tiredness and lack of alertness. When workers are fatigued they are more likely to exercise poor judgment and have a slower reaction time to signals and demands. Fatigued workers are less able to respond effectively to changing circumstances, leading to an increased risk due to potential human error. Fatigue is known to also increase risks off-site, for instance, when the person is driving back to their home or accommodation.

Cumulative or long term exposure to fatigue, associated with shiftwork, has been linked to long-term health problems, such as:

- digestive problems
- heart disease
- stress and other psychosocial issues.

The most important reason for fatigue risk management in a work place is to get people home safely.

2. Fatigue risk management plan: development and implementation overview

2.1 Introduction

A fatigue risk assessment must be carried out

Every mine (or coal mine) must conduct a fatigue risk assessment. Under the *CMSH Regulation* the risk assessment must comply with *s.42* and *s.10*. Under the requirements of *MQSH Regulation* mine and quarries should incorporate *s.6* and *s.7*. Some sites such as quarries or sites that operate with limited rosters may find after conducting an assessment, that they are at an acceptable level of risk of fatigue once the risk assessment is completed.

A fatigue risk management plan is required if fatigue risk factors (see (Tables 1-4)) are identified during the risk assessment.

What a plan should cover

An operation's fatigue risk management plan should cover managers, professional staff, contractors, those who work on planned rosters and unplanned work such as overtime and call-outs, and involvement in emergency response. As responding to emergencies can often be dependent on a very small number of emergency personnel, the scope of this document does not deal with developing a fatigue risk assessment during emergency situations. Commuting times should also be considered.

How to develop and implement a fatigue risk management plan

This section considers the approach that should be used to develop and implement the fatigue risk management plan in the workplace and to integrate it with the health management plan, contractor management arrangements and with the overall operational health and safety management system or plan.

2.2 Approach

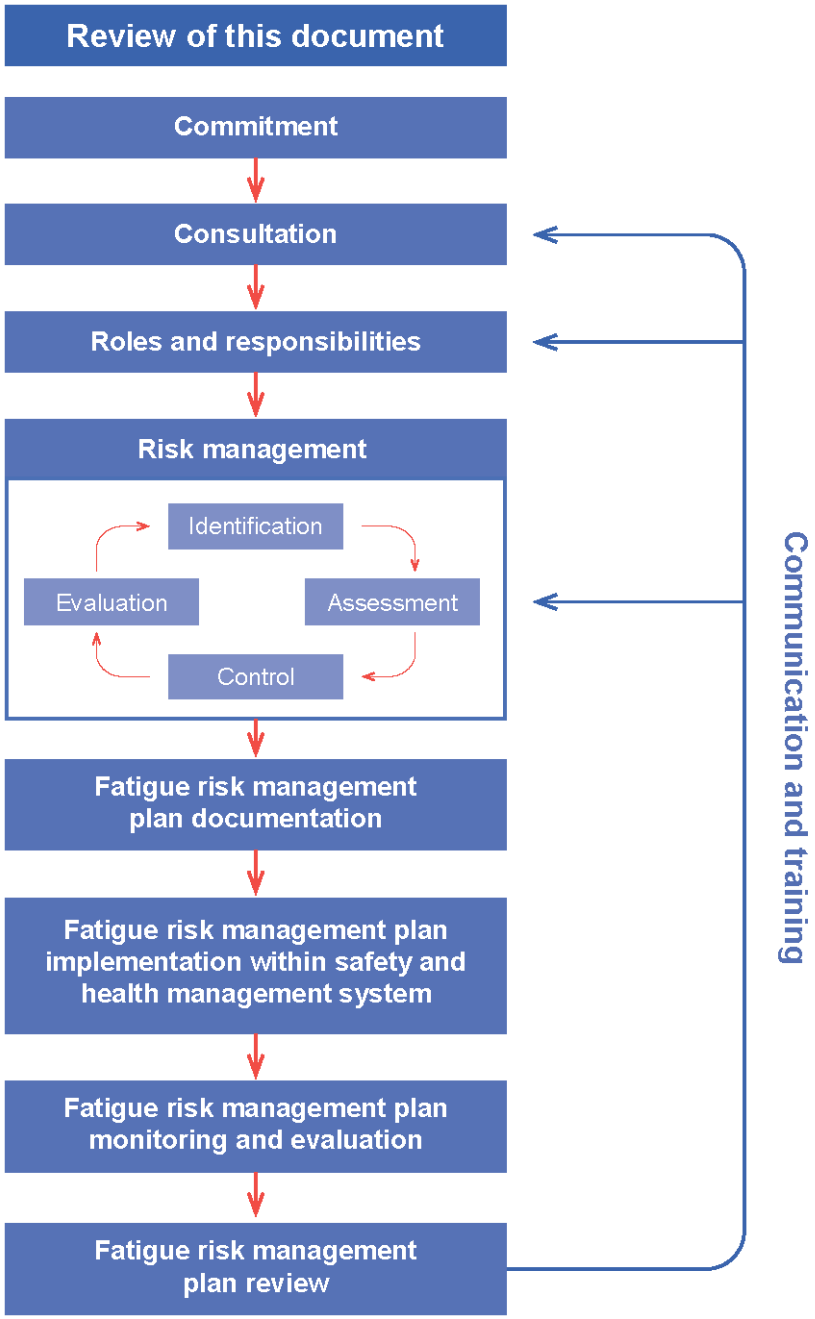
Policy commitment and consultation are central

The development and implementation of an effective fatigue risk management plan should begin with making a policy commitment to the effective management of fatigue risks in the workplace and establishing appropriate consultation. Consultation is central to the development and implementation of an effective plan. The process of development and implementation is described in detail in the various sections of this guideline and is outlined in Figure 1.

Everyone's roles and responsibilities must be identified

Having committed to the policy and established the consultation process, it is important to identify the roles and responsibilities of persons within the organisation who will have responsibility for developing and implementing the plan. The risk management approach of identification, assessment, control and evaluation must then be developed and implemented. This will involve training before development and as part of the implementation. The fatigue risk management plan will then need to be documented and implemented. The effectiveness of the various control measures should be monitored and evaluated on an on-going basis and the results used to review the plan on a regular basis. The aim of this process is to produce a fatigue risk management plan, then to implement the plan and to integrate this process with the overall operational safety and health management system. This is illustrated in Figure 1.

Figure 1 Fatigue risk management plan: development and implementation overview.



An effective fatigue risk management plan details a systematic program

In summary, the development and implementation of an effective fatigue risk management plan requires:

- making a policy commitment to effective fatigue risk management
- consultation with mine workers (or coal mine workers)
- establishment of roles and responsibilities
- risk identification, assessment, control and evaluation
- training and review of training at relevant intervals in the process
- documentation of the plan
- implementation of the plan
- development and implementation of assessment and monitoring procedures
- review and resultant modification of the plan if required.

2.3 Resources needed for an effective fatigue risk management plan

Appropriate resources are essential

Those responsible for the development and implementation of the fatigue risk management plan must ensure that appropriate resources are made available as per their legislative requirements under Queensland legislation. In addition, as fatigue is a complex, multifactorial problem, some sites may need to ensure that these resources include those with the appropriate knowledge and understanding of fatigue.

Further advice on accessing external resources is found in Appendix 3.

3. Consultation

3.1 Introduction

Consult with workers most likely to be at risk

Consultation with those workers performing the work is important as they are likely to have the best practical understanding of work processes and the potential fatigue as a result of work-related or individual factors. Such consultation is required under the mining and coal mining Acts as discussed below. In addition, mine workers (or coal mine workers) are the persons most likely to be at risk of developing the longer term health effects associated with ongoing fatigue.

A process of consultation must underpin the fatigue risk management process and plan

Key aspects of consultation relevant to the development of a fatigue risk management plan include:

- consultation by the operator/SSE with the workers to enable them to contribute to decisions affecting their safety and health at work regarding fatigue
- information that must be shared includes matters that affect or may affect the safety and health of workers
- consultation with coal mine workers in accordance with the *CMSH Act, s.64* (changes to the safety and health management system) and *CMSH Act, s.10* and *s.42* for developing standard operating procedures that apply to fatigue
- consultation with all other mine workers in accordance with the *MQSH Act,* s.56 (changes to the safety and health management system) and *MQSH Regulation, s.5* for risk management practices and procedures that apply to fatigue.

There are different ways to consult

Consultation must be undertaken as required by legislation.

4. Roles and responsibilities

4.1 Operator/SSE

Operators and SSEs have the main responsibility for controlling fatigue risks

Operators and SSEs hold the fundamental obligation for managing the risks associated with fatigue. The fatigue risk management plan should nominate those responsible for different actions. Some suggested responsibilities for fatigue risk management is provided in Section 4.3. It is the operator/SSE's responsibility to make sure that fatigue is managed using the risk management approach described in this guidance note, or in another way that achieves the same result. The fatigue risk management plan or policies should be signed off by the most senior appropriate person representing the operator. Adequate resources should be provided to allow the plan to be implemented.

4.2 Mine workers (or coal mine workers)

Mine workers (or coal mine workers) must not put themselves at risk of being fatigued

Mine workers (or coal mine workers) are responsible for ensuring that their actions and behaviour do not create or exacerbate risks. They should ensure that they use the opportunities provided to obtain sleep, report occasions when adequate rest is not obtained and present and remain fit for work.

4.3 Who should be involved in implementation of fatigue prevention and management

In deciding who should be involved in implementing fatigue prevention and management, consider existing roles and responsibilities within the organisation. Not all sites will have or need all of the roles described below or have a legislative obligation to assign these roles.

Suggested roles and responsibilities for an effective fatigue risk management approach are listed below.

Role	Responsibility
Senior managers (operators and SSEs)	• setting realistic timeframes, outcome measures and accountabilities • ensuring the risk management process is followed • ensuring managers accountable for fatigue risk management performance including: o provision of necessary resources and other support o effective implementation of fatigue prevention and management within the safety and health management system o ensuring adequate consultation o ensuring reporting of fatigue risk management issues and outcomes o ensuring that fatigue is identified both proactively in risk assessment processes as well as reactively in incident investigations in a 'no blame' culture o ensuring training and education is conducted.

Safety and health 'manager' or site advisor for fatigue **(can be included in existing Safety and Health portfolios)**	• assisting in developing and maintaining a list of safety critical tasks for fatigue • assisting operational areas to develop realistic schedules for fatigue risk management and control • ensuring that risk assessments and solutions are documented • assisting in the development of controls and recommending appropriate controls for implementation • liaising with operational areas on implementing the integration of fatigue prevention and management into planning and decision making on rosters, call-outs, training, etc • acting as a resource for the risk assessment teams and maintaining knowledge base on fatigue issues • ensuring that appropriate change management systems for changes to worker commuting arrangements is communicated and monitored • reporting regularly on progress.
Those participating in fatigue risk assessment team for each operational area	• assisting with identifying highly fatiguing or safety critical tasks for fatigue • assisting with identifying contributing risk factors for fatigue in the work environment or task conditions • participating in the fatigue risk assessment • assisting with evaluating effectiveness of fatigue risk management implementation • assisting with monitoring and reviewing the systems and maintaining knowledge on fatigue • contributing feedback on effectiveness of training for fatigue.
All mine workers (or coal mine workers)	• participating in fatigue training • following procedures to minimise and manage the risk of fatigue and maintaining FFW • reporting on individual factors or other factors contributing to fatigue • reporting incidents (i.e. where fatigue was a contributing factor) • participating in bringing forward issues to the site safety and health representatives when identified through the site reporting requirements • assisting with fatigue risk assessments and surveys.

Adapted from the Industry and Innovation NSW 2009 publication, *Managing musculoskeletal disorders – A practical guide to preventing musculoskeletal disorders in the NSW mining and extractives industry.*

4.4 Approach

The process should be flexible enough to deal with different views

The fatigue risk management plan must be developed and implemented in a consultative, participative manner involving all affected mine workers (or coal mine workers) throughout the process, and in decision-making about the outcomes. During the consultative process, coal workers should be given the opportunity to consult with industry safety and health representatives if relevant. The plan is likely to be most effective when it is developed through appropriate consultation with workers. The sensitive nature of many of the issues involved in this area means that establishing and communicating the fatigue risk management process is important.

Consultation must accommodate the variable hours people work	Fatigue has a direct influence on the work/life balance of all who work in the industry. Hours of work and fatigue have an affect on the individual at work and off site. Communication, consultation and training should reflect the variability of working arrangements of contractors, and others on site.

5. Fatigue risk management

5.1 Introduction

Risk management is at a minimum a four-step process containing a number of elements.

In the *CMSH Regulation* these elements are described in *s.6* and under the *MQSH Regulation* they are described in *s.6-11*

This chapter considers fatigue risk management in detail. Risk management encompasses identification, assessment, control and monitoring/review of hazards that pose a meaningful risk to the safety and health of mine workers (or coal mine workers) and visitors to the mine (or coal mine). Under the *CMSH Regulation, s.6* the basic elements include:

(a) risk identification and assessment

(b) hazard analysis

(c) hazard management and control

(d) reporting and recording relevant safety and health information and data.

To ensure that the processes followed on-site meet the intent of this document, these steps should incorporate at least:

- **risk identification** - involves identifying the activities that may pose a risk
- hazard analysis **(or risk assessment)** -describes the process of evaluating the extent of the risk arising from exposure to the hazard
- **hazard management and control -** is the process of addressing the risk by eliminating or minimising its affect
- **monitor and review -** is the process of checking the extent to which the control measures have been successful.

In addition, there may be requirements to report and record relevant safety and health information and data.

Assessing risks helps set priorities

Risk assessment is a dynamic process, with risks being assessed and prioritised and the impacts of the controls being evaluated regularly.

Risk assessments must be done by people who are trained and have the knowledge of the hazards

Risk assessment must involve appropriate consultation between relevant parties. In particular it is important that a cross section of workers potentially affected by fatigue hazards have an opportunity to provide input to the risk assessment process. Workers' practical knowledge of the tasks and associated hazards and risks provides an extremely valuable input into the risk assessment process. However, a risk assessment in a complex technical area such as fatigue can be a demanding undertaking and it is essential that those carrying out the risk assessment have sufficient knowledge of the hazards and the direct and contributing risk factors to undertake such an assessment. In some situations this will involve bringing in expertise in fatigue from outside the organisation.

Risk assessments incorporate appropriate techniques or standards

A number of standards exist for undertaking risk assessments. For example, the National Minerals Industry Safety and Health Risk Assessment Guideline (http://www.mishc.uq.edu.au/Resources.aspx) provides guidance on risk assessment that incorporates some risk factors for fatigue. Recognised Standard 02, "Control of risk management practices" *CMSH Act* is also a relevant standard for providing the required documentation for the risk assessment.

Fatigue, along with other complex multifactorial ergonomics and psycho-social hazards, requires more qualitative techniques for risk management and consideration of multiple factors, based on evidence from content experts. Although this guide may present new concepts such as fatigue risk factors and other information that is solely focused on fatigue hazards and controls, most sites will be able to incorporate the contents of this guide into their risk assessment standards. Further recommended considerations for fatigue risk management in line with standards are provided in Appendix 4.

Useful documents to consult when developing the fatigue risk management plan or to incorporate into existing risk assessments can be found in Appendix 3.

Risk control measures follow the hierarchy of control

The key component of the risk management process is to develop effective controls, based on current and best practice, using the hierarchy of controls. There are many forms of the hierarchy, but essentially the control measures, in descending order of preference, consistent with mining and quarrying legislation, are as follows:

- elimination
- substitution
- isolation
- engineering
- administrative approaches
- personal protection.

Emergency situations require consideration

In emergency situations the focus of the site should be on dealing with the emergency. This may mean that it is not possible to fully control all the fatigue risk factors as described or recommended in Tables 1-4. As fatigue can impair decision making in emergencies, it is still important to consider the effects of fatigue on emergency personnel and those dealing with crises. These effects should be considered on an individual basis.

5.2 Hazard identification: identifying factors that may contribute to fatigue

Identifying common factors that contribute to fatigue

Risk factors for fatigue can be identified in a variety of ways. Most sites should start with consulting a cross section of the workforce. In addition, examining records to look at incidents and health concerns that have occurred previously often provides useful information. Other guidance relevant to mining is also available and should be considered for a comprehensive list of fatigue risk factors (see Appendix 3).

Based on a number of different sources, the common factors that can contribute to the development of fatigue include:

- work scheduling and planning
- long or excessive commuting times
- work environment conditions, and mental and physical demands of work
- lack of restorative sleep
- individual and non-work factors.

These factors will potentially influence:

1. sleep opportunity and quality, including recovery or restorative sleep (pre-shift, during roster and post shift)
2. extended wakefulness (length of time individuals are required to be awake) and onset of fatigue (pre-shift, during and at the end of the roster)
3. work tasks, environment and site conditions contributing to fatigue
4. individual and personal factors influencing fatigue.

Work scheduling and planning

The way work is planned and scheduled, the time work is performed and the amount of time worked can increase the risk of fatigue. Scheduling work in a way that fails to allow workers enough time for travel to and from work and/or allow for sufficient time for sleep can cause fatigue.

Working at times when workers are biologically programmed to sleep (which can disrupt a worker's body clock) and working for long periods of time can also produce fatigue. Particular issues include:

- night shifts, including the number of consecutive night shifts
- long hours of work in a single shift, or across a shift cycle, or because of on-call duties. This includes travel time especially for remote sites
- short breaks between or within work shifts
- shift start/finish times (e.g. a start or finish time between 10pm and 6am may interrupt usual optimal sleep times)
- changes to rosters
- unplanned work, overtime, emergencies, break downs and call-outs
- less than adequate opportunity for restorative sleep.

Work environment conditions

Working in harsh and/or uncomfortable environmental conditions can contribute to the risk of fatigue in a number of ways. Heat, cold, noise and vibration are some of the environmental conditions that can increase the likelihood of fatigue onset and impair worker performance.

Excessive commuting

Depending on shift lengths, having to travel for long distances before or after work, particularly on a daily basis for a long series of shifts, can be a contributor to fatigue. This will depend on the means of transport and if a person is in control of a vehicle.

Mental and physical demands of work

The mental and physical demands of work can contribute to a worker becoming impaired by fatigue in a number of ways. Concentrating for extended periods of time, performing repetitious or monotonous work or performing work that requires continued physical effort can increase the risk of mental or physical fatigue.

Individual and non-work factors

In addition to the work-related factors that contribute to fatigue, it is important to identify factors that cause fatigue due to lack of sleep quality or quantity. These include:

- lifestyle e.g. children and child-care responsibilities, voluntary work, having more than one job, level of fitness, social life or diet
- home environment e.g. noisy neighbours or a bedroom that is too hot or not dark enough for day-time sleep
- health or medical conditions e.g. insomnia, sleep apnoea, pain or other health problems or alcohol/drug issues
- medication
- other factors e.g. stress.

Effect of exposure for longer periods

When taking a risk management approach to fatigue it is very important to look at how fatigue and long working hours in general can interact with other workplace hazards. Exposure to some hazards can be increased when working extended hours – e.g. heat, whole body vibration (WBV), manual tasks, and exposure to hazardous chemicals, dust and noise.

5.3 Risk assessment

Risk assessments consider two aspects - likelihood and severity

One of the keys to effective risk management is to properly assess the risks arising from a hazard. Assessing hazards related to fatigue means looking carefully at the identified fatigue risk factors to decide whether they have been eliminated or adequately controlled to an as low as reasonably achievable level. These fatigue risk factors have been developed to ensure that relevant research and fatigue knowledge is incorporated into the risk assessment.

Each hazard should be examined in detail to determine its influence sleep opportunity and quality, the length of time individuals are required to be awake, the intensity or monotony of the work, and the work environment contributions. This requires:

- input from a cross-section of workers
- reference to hazards database
- reviewing errors and incidents to determine any contribution that fatigue has made, including use of safety bulletins or other incidents from other sites
- the use of relevant fatigue data and information (such as fatigue guidance material, industry codes of practice, relevant fatigue research and good practice, including this guidance note)
- if necessary, advice from experts in the field.

The results of the risk assessment should be clearly recorded. It is important to remember that fatigue is a multi-factorial problem, and some factors interact to increase fatigue and the risk of a fatigue-related incident or errors.

For example, the combination of poor quality and /or insufficient length of sleep with an extended shift and/or a number of consecutive night shifts and/or performing a monotonous task for long periods, is likely to have a higher risk of fatigue.

The common fatigue risk factors are shown in the **Fatigue risk factor checklist** in four sections, grouped into the factors that have an influence on the following:

1. (Section 5.3.1), sleep opportunity and quality including restorative sleep (pre-shift, during roster and post shift)
2. (Section 5.3.2), extended wakefulness (length of time individuals are required to be awake) and onset of fatigue (pre-shift, during roster and post shift),
3. (Section 5.3.3), effect of the work tasks, environment and site conditions on fatigue
4. (Section 5.3.4), individual and personal factors influencing fatigue.

5.3.1. Fatigue risk factors influencing sleep opportunity and quality

There is a significant amount of fatigue research and guidance relating to the role of work scheduling and planning on sleep opportunity and quality. The main components of the scheduling and planning on fatigue risk deal with:

- opportunity for sleep before first shift and between successive shifts during the roster
- sleep quality, and day sleeping during the roster compared to night sleeping (the body's preference is for night sleep)
- changes to the circadian cycle or 'body clock' due to changes in roster, overtime, call-outs, or split shifts
- commute time influencing opportunity for sleep
- on-site arrangements and off-site accommodation and surrounds affecting sleep quality and opportunity for sleep.

There are a number of fatigue risk factors that will differ between sites, for example, some fatigue risk factors influencing sleep opportunity and quality during the roster will differ between FIFO (fly in/fly out) and DIDO (drive in/drive out).

The information in the table on pages 36 -44 is adapted from the NSW fatigue guidance document, *Fatigue - prevention in the workplace*.

a) Work scheduling and planning

Work scheduling and planning	Aspects to consider	Why consider these issues?
Night shifts, including the number of consecutive night shifts	Are too many consecutive night shifts worked consecutively to allow adequate recovery? For example: • Is more than eight hours work required over night shift? • Are more than four consecutive 12-hour night shifts worked? • Are more than five consecutive 10-hour night shifts worked? • Are more than six consecutive 8-hour night shifts worked? Increased fatigue risk has been found with exceeding some of the above combinations of night shifts (Folkard, 2007)	• Research indicates that sleep during the day (e.g. after night shifts) is not as good quality as during the night (Baker et al, 1999). • The longer the length of the night shift, the more time is spent active and working when the body is designed to be asleep. • A longer series of night shifts can be associated with cumulative fatigue due to lack of restorative sleep.

Shift start/finish times	• Do any shifts start or finish between 10pm and 6am? (See also commute time)	• Research shows that early shifts (especially when people have to wake more than two hours before their normal wake time) can cause shortened periods of sleep (Folkard, 2007). This can be a particular problem on the first day shift of the roster, especially with a long commute.
	• Are split shifts required or offered?	• Split shifts usually require that sleep is broken into two short periods rather than one long period.
Shift rotation during roster	• Is there a switch from day to night or night to day during the same roster? • If yes, does this switch occur after a number of day shifts or after a number of night shifts?	• The body needs time to adapt to changes required to the body clock and sleep between day and night shifts. Research (Baker and Ferguson, 2004) shows that a frequent change in working time can cause even more fatigue as the body tries to find equilibrium.
Long hours of work across a roster cycle	• Do hours of active work (total time spent at work including overtime) exceed 84 hours in any seven days, or 242 hrs in four week period?	• Longer periods at work require longer periods for recovery, with the additional problem of cumulative fatigue. Fatigue can increase as other factors start to affect sleep.
Short breaks between work shifts	• Is there enough time between work shifts to allow for adequate sleep? (Usually, allow for seven hours of sleep per night or 50 hours sleep in seven days) • Is the break between shifts less than 10 hours? • Are there at least two consecutive night time sleep opportunities (48 hours) every seven days?	• Most people need between six to eight hours sleep to be 'adequate' for rest and recovery. Shorter periods of sleep than a person's normal requirement can cause fatigue as well as other problems. Sleep is the time the body regenerates, as well as allowing for memory consolidation, learning and other brain functions. • Most guidance recommends more time to recuperate after night shifts as day sleep is sometimes more fragmented. Ten hours break will allow for a minimum seven hours for sleep, and two hours for wind up/ wind down.

b) Changes in roster, overtime, call-outs, or split shifts

Work scheduling and planning (changes to rosters or scheduling)	Aspects to consider	Why consider these issues?
Long hours because of on-call duties or unplanned overtime	• Are there irregular and unplanned schedules as a result of call-outs? • Is adequate recovery time after call-outs allowed (e.g. a long enough break to get adequate sleep)? • Does unplanned overtime or routine overtime extend the working day or working week beyond 84 hours in any seven days, or 242 hrs in four weeks?	• The body performs best under a routine of waking, sleeping, and eating at certain times. Disruptions and adjustments to routine and the body clock can increase the risk of fatigue. • Unplanned or unscheduled overtime or call-outs can cause more difficulty in scheduling sufficient sleep and cause acute or cumulative fatigue.
Changes to rosters	• Do workers get sufficient notice of roster changes? • Is fatigue risk management taken into account in roster changes?	• This may influence scheduling for sufficient restorative sleep between shifts as well as rosters and the ability of the body to adapt to changes.

Number of 'yes' responses for 5.3.1 ('a' and 'b'): _____

c) Commute time influencing opportunity for sleep

Work scheduling and planning (commute)	Aspects to consider	Why consider these issues?
Long commute for first shift	• Do workers have to travel more than two hours to arrive on-site for the first shift?	• Sites with organised travel (e.g. fly in/fly out) should be aware that those who are commuting for long distances may have already limited sleep opportunity. The first day shift in particular has been found to be difficult due to the transition between the 'normal' sleep wake times of workers at home, and the adapted sleep wake times required for work.
Long commute during roster	• Do workers have to travel more than one hour in each direction?	• Commute times will have an impact on sleep opportunity. If we add in commute times of one hour, with >12 hr shift length, then this can influence the opportunity for sleep and fitting in other daily activities
	• Does this have an influence wake time for day shifts?	• Workers with a longer commute will have to wake in the 'critical zone' before 4 am and this will influence the length of sleep they will have.

Number of 'yes' responses for 5.3.1c: _____

If you have answered 'yes' to a number of questions in the checklist, continue with the other sections in the checklist and then proceed to the risk assessment and control tables 1-3.

5.3.2. Length of time awake and factors influencing onset of fatigue (direct and contributing risk factors)

There is a significant amount of fatigue research showing that extending wakefulness can lead to fatigue and some loss of performance. Dawson and Reid (1997) showed the longer people were awake and not able to sleep, the greater their performance decreased. For a number of participants in the study, when they stayed awake for more than 17 hours they showed performance deficits that were similar to a blood alcohol concentration of .05 g/100ml). The length of time awake is also linked to the time of the circadian phase, but it is important to look at the length of hours worked, breaks and the demands of the actual work. The main components for wakefulness and fatigue onset that interact to change fatigue risk include:

- Length of scheduled shift and breaks
- Commute time influencing time awake and active
- Work organisation and other workload factors
- Task and environmental factors

As with the previous section, there will be differences between FIFO, BIBO and DIDO, as well as other differences between sites.

a) Length of time awake (wakefulness)

Risk factor		
Length of time awake	**Aspects to consider**	**Why consider these issues?**
Long hours of work in a single shift. This includes overtime, call-outs and travel time	• Does one shift involve more than 12 hours in a day (including call-outs)?	• There is an increased risk associated with extended shifts beyond 12 hours. This depends on work performed, number and frequency of breaks during the shift and other factors.
Long daily commutes	• Do workers have to commute for one hour or longer after a 12 hour shift?	• The long daily commute extends the time workers are awake as well as the opportunity for sleep.
Long commute at the end of roster or end of set of shifts	• Do workers have to drive more than two hours to arrive at their home at the end of the roster or set of extended shifts?	• Sites located at significant distances from workers' homes need to consider that workers may have accumulated a sleep debt.

Number of 'yes' responses for 5.3.2a: _____

b) Risk factors influencing onset of fatigue (breaks and workload management)

Breaks and workload management	Aspects to consider	Why consider these issues?
Less than adequate scheduled work breaks	• Are breaks within shifts long enough and frequent enough to allow workers to rest, refresh and nourish themselves?	• Folkard (2007) and other researchers have found that the length of time between breaks (e.g. greater than five hours), and number of breaks has an impact on overall risk of incidents.
Workload, psychosocial and mental demands	• Do jobs involve high demand, but low control? • Are there poor social relations at work, e.g. bullying? • Is there low social support from peers and supervisors at work? • Is there low recognition for the effort involved in the work?	• There are a number of risk factors for stress, and fatigue. Poor work organisation, work relationships and other factors can create significant mental or cognitive 'overload'. This will influence fatigue and performance.
Workload management of complex physical or mental tasks	• Are complex or prolonged physical or mental tasks undertaken on night shift? • Are complex, difficult or strenuous tasks required at the start or end of night shifts or extended shifts? • Is high vigilance and/or concentration required? • Are there different demands that can be difficult to combine? • Are tasks requiring sustained physical or mental effort undertaken on night shift?	• Mental, physical and psychological workload is influenced by circadian rhythm as well as other factors. • It is more likely errors will be made and influenced by fatigue under certain situations, especially for high risk tasks.

Number of 'yes' responses for 5.3.2b: _____

If you have answered 'yes' to a number of questions in the checklist, continue with the other sections in the checklist and then proceed to the risk assessment and control tables 1-3.

Some risk factors are considered 'Direct' risk factors and will require additional controls. If you are not sure on the answers, gather more information and then proceed to the risk assessment and control tables.

5.3.3 Effect of the work tasks, environment and site conditions on fatigue and other influences on health (contributing risk factors)

The interaction between the work performed, the work environment and the task needs to be considered when designing rosters and considering control measures.

A number of differences can exist for a fatigue-related incident (both in opportunity and consequence) between occupations or jobs on-site. For example, Larue et al. (2009) demonstrated that very monotonous tasks including driving for long periods on straight stretches of road increased the onset of micro sleeps, loss of concentration, drifting between lanes, etc. The main components for fatigue onset that can increase fatigue risk include:

- mental, physical and physiological demands of work
- adverse working conditions and prolonged exposure to health hazards.

Risk factor	Aspects to consider	Why consider these issues
Mental, physical and physiological demands of work		
Repetitive or monotonous work	• Do jobs involve repetitive or monotonous work, e.g. haul-truck driving and control room operations.	• Monotonous tasks such as driving can increase fatigue.
Sustained physical or mental effort	• Is the work physically and or mentally demanding? • Is there time pressure due to a heavy workload? • Is work fast paced? If yes, can workers vary work pace or work tasks as desired? • Is work intensive? • Are workers provided with sufficient fit for purpose equipment to carry out the task?	• Certain jobs or tasks can increase physical or mental fatigue and the onset of fatigue during the day. • Some work may require longer breaks or recovery from fatigue inducing conditions.
Adverse working conditions	• Do adverse working conditions exist, e.g. exposure to: o Noise? o Heat or dehydration? o Sunlight or UV? o Cold? o Dust? o Whole body vibration or hand arm vibration?	• Many health hazards influence fatigue onset or increase the need for breaks for recovery/rest between shifts.
Effect of exposure during extended shifts		
Increased exposure to health hazards	• Do the adverse working conditions above require adjustments to exposure time or further monitoring? • Are workers exposed to hazardous substances such as fumes, chemicals etc? Note that exposure	• Exposure to a number health hazards will cause an onset of fatigue. • Consider overall health effects as well as fatigue with extended exposures.

	standards will need to be adjusted for working more than eight hours (see Tiernan and van Zanten, 1998)	

Number of 'yes' responses for Section 5.3.3: _____

5.3.4. Affect of individual and personal work factors (Direct risk factor)

Fatigue is experienced differently between individuals, and there is a significant amount of research addressing the impact of individual health and other factors on fatigue. A number of health issues can have a negative influence on sleep quantity and quality. Some common conditions include insomnia, obstructive sleep apnoea, chronic pain, and depression. Some conditions may have an influence sleep over a longer period, and some are short term (e.g. insomnia due to personal or family life issues).

A number of non-health related issues can also have a negative influence fatigue and the onset of fatigue as well. The main components to consider include:

- individual factors
- non work-related factors.

Risk factor	Aspects to consider	Why consider these issues
Individual		
	Is there a possibility of individual factors influencing sleep, including: • Insufficient quality of sleep due to health issues? • Sleeping disorders? • Psychological issues? • Alcohol and drug use?	• Health or medical conditions can affect sleep quality or quantity. Fatigue can be a consequence. • Other issues, including psychological, use of medication, drugs or alcohol use will influence quality and quantity of sleep.
Non-work factors		
	Is there a possibility of workers having outside commitments impacting on sleep, including: • Second job/non-paid work? • Family commitments?	Non-work factors influence opportunity for sleep and recovery during non-work periods. Even if the roster is designed to allow for adequate rest and recovery, workers' outside commitments may have a negative influence their ability to recover.

Number of 'yes' responses for Section 5.3.4: _____

If you have answered 'yes' to a number of questions in the checklist, proceed to the risk assessment and control tables 1-3. If you are not sure on the answers, gather more information and then proceed to the risk assessment and control tables.

5.4 Risk control

Risks that arise from hazards must be controlled according to the 'hierarchy of control'

The key aim of any fatigue risk management plan is to ensure that hazards that pose an important risk to the health of the worker or to others who may come into contact with occupational hazards are properly controlled. An important concept in developing this control is the "hierarchy of control".

Although general applications of the hierarchy of control can be used, when applied to fatigue they should be aimed at the underlying causes of the fatigue. Information on the effectiveness of controls for fatigue due to lack of sleep quality or quantity, or from work design contributors is provided in the risk control tables in tables 1-3.

Examples of hierarchy of control for fatigue risks

Examples of the use of the hierarchy for control of fatigue risks include:

Eliminate:	eliminating some high risk tasks on night shifts.
Substitute:	reschedule more fatiguing tasks or activities to the day or substitute bussing for workers driving their own vehicles.
Engineering:	improving ventilation to reduce the potential of heat increasing fatigue. improve or increase lighting levels to assist with maintaining a higher level of alertness.
Administrative:	providing comprehensive training including refresher training to workers and supervisors, and using a checklist to help supervisors identify and assess fatigue impairment.
PPE:	ensuring appropriate equipment is used for length of shifts or exposure- for example ensuring respiratory protection is suitable for extended shifts and under physiological load.

Note: Isolation has not been included in these examples because it is not directly applicable to fatigue risk.

Potential risk assessment results and suggested controls for the most common direct and contributing fatigue risk factors are shown in Table 1-4, and in Appendix 2. A list of tips for individuals on how to help avoid fatigue is provided in Appendix 2.

When using worker accommodation as a control measure, consider the following in 'What is a well designed camp?'

Well designed camp or residential accommodation

A number of sites use residential accommodation for operational requirements. For effective fatigue management, it is important to ensure that there are a sufficient number (and quality) of available rooms for workers (including contractors) to allow for sleep quality.

Determining if there are sufficient available rooms at the site should involve some scenario planning. For example, when the site determines that workers must arrive the night before the first day shift, extra allowance for accommodation is required. This will also be the case if sites want workers to sleep prior to leaving site for the commute to their permanent residence at the end of the series of shifts. As a well designed camp is a control measure for a number of fatigue risk factors, sites need to consider if they have met both quantity and quality requirements for workers to sleep.

Good design principles

There are certain characteristics that have been found to assist workers in obtaining the best possible sleep during blocks of shifts, both for night and day work.

Some of these 'optimal' characteristics include:

Accommodation

- Individual ensuite to allow for workers to limit exposure to sunlight during the day (e.g. after night shifts).
- Air conditioning that is quiet and sufficient for the conditions.
- Complete block out shades for all windows (including ensuite).
- Sufficient insulation from noise.
- Clear indications (signs etc) that workers are sleeping to minimise disruption from housekeeping.

Site design

- Day shift and night shift workers' accommodation separated whenever possible.
- Accommodation located at sufficient distance from bar/food or other entertainment areas to control noise.
- A good range of fitness equipment and/or facilities.
- Internet and sufficient phone service for workers to be in contact with family and outside contacts.
- Medical and health facilities at camp or accessible.
- Use of synthetic grass and other low maintenance designs (when possible, to eliminate mowing).

Site management of alcohol and entertainment

- Sites may need to examine the availability and use of alcohol as well as hours that loud entertainment is impacting on worker sleep.

Site management of day activities at the camp

- There have been a number of worker complaints about noise, such as lawn mowers, disturbing sleep during the day. Locating night shift workers away from the usual day time work activities may assist with day time sleep.

Process for using the risk factor and control tables (Tables 1-4)

Fatigue risk factors and controls have been separated into ‘direct’ risk factors for fatigue and contributing risk factors. All factors have the potential to interact with others, and the tables will assist with an overall systematic approach to fatigue risk management, rather than a single control measure.

Direct risk factors include:

Risk factor 1: Number of consecutive night shifts.

Risk factor 2: Number of hours in a shift.

Risk factor 3: Number of working hours in a work week.

Risk factor 4: Shift start times (should be considered with commute time).

Risk factor 5: Commute time or journey time (Daily).

Risk factor 6: Commute at the beginning and end of a series of shifts.

Risk factor 7: Individual factors influencing sleep.

In using the tables, those potential factors associated with low, medium and high to extremely high potential of fatigue are at the top of the table, with suggested controls in columns below.

The direct risk factors above (and in Table 1) need to be assessed first and each factor should be considered individually to assess the risk. Direct factors that are listed as high potential risk of fatigue in dark orange (or listed as **High to extremely high potential for fatigue**) require the higher order controls in the ‘dark orange’ column in addition to controls listed for lower and medium risk factors.

A suggested approach is as follows:

Start with Table 1: Direct Risk Factors. These risk factors directly contribute to fatigue due to a:

- ☑ direct effect on sleep opportunity and quality
- ☑ direct effect on extending wakefulness and increasing likelihood of onset of fatigue
- ☑ direct effect of known individual and personal factors influencing sleep quality or opportunity.

Consider Direct Risk Factor 1: Number of consecutive night shifts

If applicable, implement appropriate controls in order of hierarchy of control recommendations.

Consider Direct Risk Factor 2: Number of hours in a shift

Implement appropriate controls (note that if Direct Risk Factor 1 is an issue, some controls may already be in place).

Consider Direct Risk Factor 3: Number of working hours in a work week

If applicable, implement appropriate controls in order of hierarchy of control recommendations.

Consider Direct Risk Factor 4: Shift start times (should be considered with commute time)

If applicable, implement appropriate controls in order of hierarchy of control recommendations.

Consider Direct Risk Factor 5: Commute time or journey time

If applicable, implement appropriate controls in order of hierarchy of control recommendations.

Consider Direct Risk Factor 6: Commute at the beginning and end of a series of shifts

If applicable, implement appropriate controls in order of hierarchy of control recommendations.

Consider Direct Risk Factor 7: Individual factors influencing sleep

If applicable, implement appropriate controls in order of hierarchy of control recommendations.

Go to Table 2: Contributing Risk Factors

Consider Contributing Risk Factor 8: Scheduling of work

If applicable, implement appropriate controls in order of hierarchy of control recommendations.

Consider Contributing Risk Factor 9: Breaks during a shift

If applicable, implement appropriate controls in order of hierarchy of control recommendations.

Consider Contributing Risk Factor 10: Breaks between work periods

If applicable, implement appropriate controls in order of hierarchy of control recommendations.

Consider Contributing Risk Factor 11: Total hours in four week period

If applicable, implement appropriate controls in order of hierarchy of control recommendations.

Go to Table 3: Contributing Risk Factors (Work design and task specific factors contributing to cumulative fatigue and potential health issues)

Consider Contributing Risk Factor 12: Mentally demanding work

If applicable, implement appropriate controls in order of hierarchy of control recommendations.

Consider Contributing Risk Factor 13: Monotony of tasks

If applicable, implement appropriate controls in order of hierarchy of control recommendations.

Consider Contributing Risk Factor 14: Physically and/or physiologically demanding work

If applicable, implement appropriate controls in order of hierarchy of control recommendations.

Consider Contributing Risk Factor 15: Environmental conditions (health and other hazards)

If applicable, implement appropriate controls in order of hierarchy of control recommendations.

Go to Table 4: Contributing Risk Factors (Individual or site specific factors contributing to cumulative fatigue)

Consider Contributing Risk Factor 16: Split shifts or variable shifts

Put appropriate controls in place in order of hierarchy of control recommendations.

Consider Contributing Risk Factor 17: Seasonal work arrangements – hours worked

Put appropriate controls in place in order of hierarchy of control recommendations.

Table 1: Direct risk factors

Direct risk factors have a direct influence on fatigue (a number of factors are inter-related, see information for each fatigue risk factor)

Direct influence on fatigue due to:

- ☑ direct effect on sleep opportunity and quality
- ☑ direct effect on extending wakefulness and increasing likelihood of onset of fatigue
- ☑ effect of known individual and personal factors influencing sleep quality or opportunity.

Risk factor 1: Number of consecutive night shifts Note: Night shifts will always carry more potential for fatigue, due to circadian rhythm.		
< 4 consecutive night shifts	4 consecutive night shifts	5 to 7 consecutive night shifts
Lower potential for fatigue	Medium potential for fatigue	**High to extremely high potential for fatigue**

Increase in higher order controls with increasing potential for fatigue

Controls for any period of extended night shifts require a comprehensive risk assessment

Risk factor 1: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue**
• Regular and frequent breaks • Optimal sleeping conditions for day sleep • Workload management and self pacing of work • Specific management of safety critical tasks • Journey plan / commute management • Comprehensive fatigue education for all workers	All of the previous column plus: • Journey plan / commute management to include the home journey after roster. Consider bussing or other arrangements • Restrictions on overtime and call-outs • Comprehensive supervisor fatigue training • Controlling other work environment hazards (heat, WBV, dust, etc)	All of the previous columns plus: • Well designed residential camp (see section on 'What is a well designed residential camp?') • Journey plan must limit driving time after roster – bussing may be an alternative or • Shorten last shift if DIDO • Increasing breaks (number, length and duration) • Break after roster should be equal to roster length for 7 nights, (<7 should be 80%) • No overtime or call-outs

Risk factor 2: Number of hours in a shift Allowances for unplanned overtime or call-outs extending hours are dealt with in risk factor 7. Night shifts specifically are discussed in Risk factor 1.		
8 hours worked in a single shift	>8-12 hours	> 12 hours
Lower potential for fatigue	Medium potential for fatigue	**High to extremely high potential for fatigue**

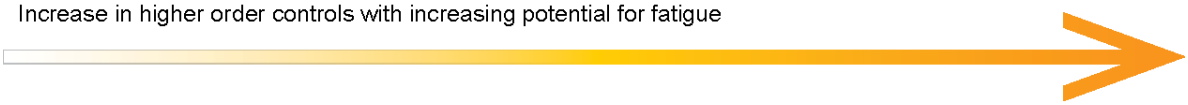
Increase in higher order controls with increasing potential for fatigue

Risk factor 2: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue**
• Comprehensive fatigue education for all workers	All of the previous column plus: • Workload management and self pacing of work • Specific management of safety critical tasks • Comprehensive supervisor fatigue training • Controlling other work environment hazards (heat, WBV, dust, etc) • Restrictions on overtime and call-outs	All of the previous columns plus • allow 10 hours for sleep, wind down and recovery Additional controls during the shift • Regular and frequent breaks • Sufficient resources to allow for all workers to have necessary breaks particularly on nightshifts Additional controls after the shift • No overtime and call-outs • Limits on driving time after a series of 12 + hour shifts

Table 1: Direct risk factors

Risk factor 3: Number of working hours in a work week (day shifts)*		
40 hours in a work week	>40 and ≤ 60 hours in a work week	>60 hours hours in a work week
Lower potential for fatigue	Medium potential for fatigue	**High to extremely high potential for fatigue**

Increase in higher order controls with increasing potential for fatigue

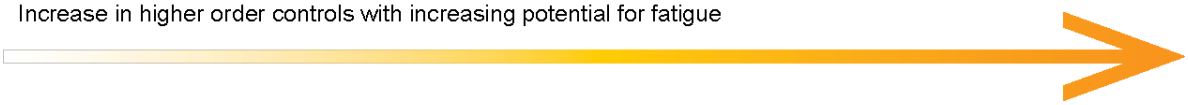


Risk factor 3: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue**
• Journey plan and commute management plan for workers as required • Specific management of safety critical tasks	All of the previous column plus: • Restrictions on overtime and call-outs • Regular and frequent breaks • Comprehensive worker fatigue education • Comprehensive supervisor fatigue training • Controlling other work environment hazards (heat, WBV, dust, etc)	All of the previous columns plus: • Well designed and controlled residential camp* (see section on 'What is a well designed residential camp?') • Journey plan must limit driving time after roster – bussing may be an alternative • Break after roster should be equal to roster length if possible (i.e. equal time off for recovery but minimum of 80%)

*Note: Work week is not an 'averaged' figure over a monthly roster, this is the number of actual working hours worked by workers or contractors in any 7 day period

Risk factor 4: Day shift start times (must be considered with commute time factors 5 and 6)		
Start after 7 am	Start 6:15 to 7 am	Start before 6:15 am
Lower potential for fatigue	Medium potential for fatigue	**High to extremely high potential for fatigue**

Increase in higher order controls with increasing potential for fatigue



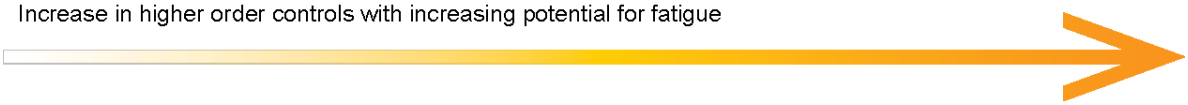
Early start times (or waking before 4 am for commute to work) require a number of higher order controls

Risk factor 4: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue**
• Journey management plan if longer commute – see Risk factors 5 & 6 • Specific management of safety critical tasks • Regular and frequent breaks • Comprehensive fatigue education for all workers	All of the previous column plus: • Comprehensive supervisor fatigue training • Opportunity for breaks, naps or later start if restriction due to commute • Control of overtime and call-outs (particularly on the first shift back)	All of the previous columns plus: • Limiting consecutive early starts • Monitoring and rescheduling work • Well designed and controlled residential camp* (see section on 'What is a well designed residential camp?')

Table 1: Direct risk factors

Risk factor 5: Daily commute time or journey time		
Less than 30 minutes	31 to 45 minutes.	46 minutes to 2 hours
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue**

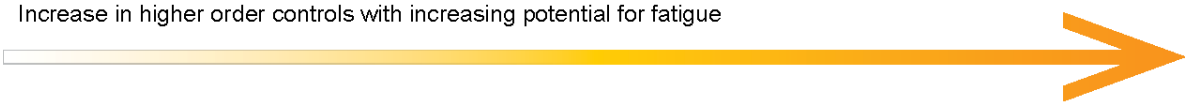
Increase in higher order controls with increasing potential for fatigue



Risk factor 5: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue**
• Comprehensive fatigue education for all workers	All of the previous column plus: • Review of travel arrangements by site including driver fatigue awareness reviews • Restrictions on overtime and call-outs • Comprehensive supervisor fatigue training • Controlling other work environment hazards (heat, WBV, dust, etc)	All of the previous columns plus: • Site provided travel arrangements including bussing, car pooling, etc • Site monitoring of all road safety issues

Risk factor 6: Commute at the beginning and end of a series of shifts		
Less than 1 hour drive **or** no drive required	1 hour to 2 hours drive or no drive- e.g. BIBO/FIFO	More than 2 hours drive
Lower potential for fatigue	Medium potential for fatigue	**High to extremely high potential for fatigue**

Increase in higher order controls with increasing potential for fatigue



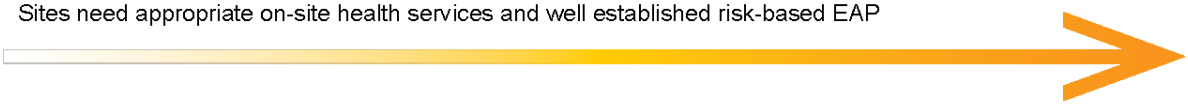
Sites need to consider FFW with long commutes and safety on the roads post roster

Risk factor 6: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue**
• Comprehensive fatigue education for all workers	All of the previous column plus: • Journey management/commute management plan for those workers with longer commutes • Journey management/commute management plan in FIFO or BIBO situations • Comprehensive supervisor fatigue training • Review of safety critical tasks	All of the previous columns plus: • Review of site arrangements for length of first and last shift • Review of site arrangements for residential accommodation usage before and after shift

Table 1: Direct risk factors

Risk factor 7: Individual factors influencing sleep		
Minimal FFW or health issues influencing sleep	Some FFW or health issues influencing sleep	A number of FFW or health issues influencing sleep or unknown number of FFW and sleep issues
Lower potential for fatigue	Medium potential for fatigue	Higher potential for fatigue

Sites need appropriate on-site health services and well established risk-based EAP



Risk factor 7: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue**
• Comprehensive FFW mine worker education • Well managed health systems on-site • Clear policies for drug and alcohol use outside work (in residential accommodation settings) • Supervisor FFW training	All of the previous column plus: • Screening for sleep disorders and other medical conditions affecting sleep in high risk populations • Well publicised, accepted and easy to access EAP services • 'No blame' culture that supports early intervention for legitimate health issues and alternate duties	All of the previous columns plus: • Review need for training of onsite health workers • Consider need for medical or other health advice for FFW issues (See Appendix 3 for resources)

Table 2: Contributing risk factors

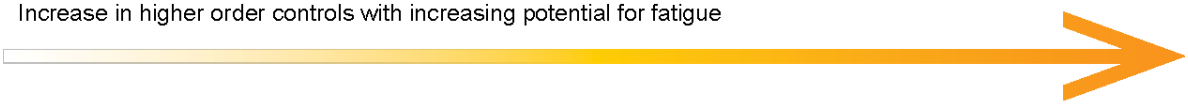
Contributing risk factors have a contributing affect on fatigue (a number of factors are inter-related, see information for each fatigue risk factor)

Contributing affect due to:

☑ affect on sleep opportunity and quality
☑ affect on extending wakefulness and increasing likelihood of onset of fatigue
☑ affect of known individual and personal factors influencing sleep quality or opportunity.

Risk factor 8: Scheduling of work		
Regular and predictable hours	Irregular or unpredictable hours	Irregular and unpredictable hours Extended overtime
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue**

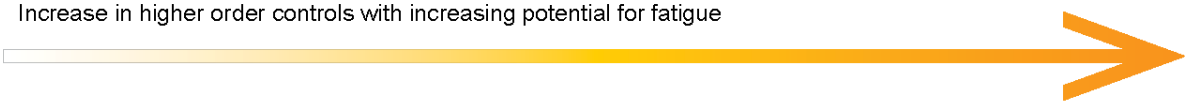
Increase in higher order controls with increasing potential for fatigue



Risk factor 8: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue**
• Journey management/commute management plan • Comprehensive fatigue education for all workers	All of the previous column plus: • Review of travel arrangements by site including driver fatigue awareness reviews • Restrictions on overtime and call-outs • Comprehensive supervisor fatigue training • Controlling other work environment hazards (heat, whole body vibration, dust, etc)	All of the previous columns plus: • Site provided travel arrangements including bussing, share or car pooling, etc • Site monitoring of all road safety issues

Risk factor 9: Breaks during a shift		
< 3 hours between breaks at night or < 5 hours between breaks during day and > 30 min main break	3 hours between breaks at night or 5 hours between breaks during day and 30 min main break on 8hr+ shift	**> 3 hours between breaks at night or > 5 hours between breaks during day and < 30 min main break on 8+ hour shift**
Lower potential for fatigue	Medium potential for fatigue	**High to extremely high potential for fatigue**

Increase in higher order controls with increasing potential for fatigue

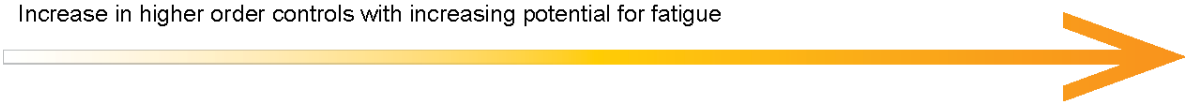


Risk factor 9: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue**
• Specific management of safety critical tasks • Comprehensive fatigue education for all workers • Controlling other work environment hazards (heat, WBV, dust, etc)	All of the previous column plus: • Comprehensive supervisor fatigue training • Workload management and self pacing of work	All of the previous column plus: • Job rotation for safety critical tasks and/or monotonous work and/ or heat and other environmental conditions • Provision of breaks to be in optimal conditions (away from heat sources etc) • Review of number and timing of breaks if direct risk factors are at high potential for fatigue

Table 2: Contributing risk factors

Risk factor 10: Breaks between work period This risk factor should also be considered in conjunction with the commute time and Risk factor 8 on overtime and callouts		
Adequate time for sleep and recovery		Inadequate time for sleep, travel, meals, and recovery (< 8 hours)
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue**

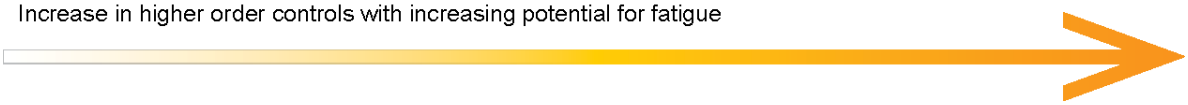
Increase in higher order controls with increasing potential for fatigue



Risk factor 10: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue**
Controls still need to incorporate: • Journey plan and commute management (including home journey after successive night shifts) • Specific management of safety critical tasks • Comprehensive fatigue education for all workers	All of the previous column plus: • Regular and frequent breaks • Comprehensive supervisor fatigue training • Controlling other work environment hazards (heat, WBV, dust, etc)	All of the previous columns plus • Well designed and controlled residential camp* (see section on 'What is a well designed residential camp?') • Limitations on driving time after the series of shifts • Consider bussing or other arrangements

Risk factor 11: Total hours in 4 week period		
< 224 working hours (in 4 weeks)	224 working hours (in 4 weeks)	**>>224 to 242 hours in 4 wks**
Lower potential for fatigue	Medium potential for fatigue	**High to extremely high potential for fatigue**

Increase in higher order controls with increasing potential for fatigue



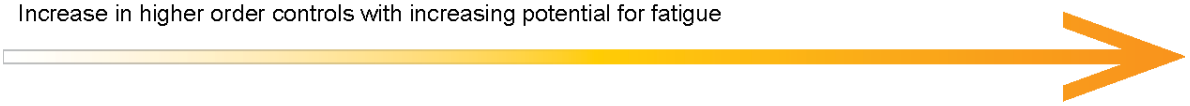
Risk factor 11: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue**
• Specific management of safety critical tasks • Journey management/ commute management • Comprehensive fatigue education for all workers	All of the previous column plus: • Review of travel arrangements by site including driver fatigue awareness reviews • Restrictions on overtime and call-outs • Comprehensive supervisor fatigue training • Controlling other work environment hazards (heat, WBV, dust, etc)	All of the previous columns plus • Site monitoring of all potential travel if hours are condensed into long blocks of work • Site provided travel arrangements including bussing, share or car pooling, etc if workers have long commutes post flight

Table 3: Contributing risk factors - work design and task specific factors contributing to cumulative fatigue and potential health issues

Risk factors in this section will contribute to likelihood of fatigue onset or cumulative fatigue and health effects.

Risk factor 12: Mentally demanding work		
Varied work with minimal periods of mentally demanding work		Long periods of mentally demanding work or high concentration work (particularly on night shift or at the end of shifts)
Lower potential for fatigue	Medium potential for fatigue	**High potential for mental or cognitive fatigue**

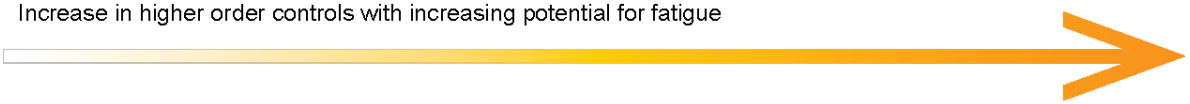
Increase in higher order controls with increasing potential for fatigue



Risk factor 12: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential**
Control the design of work and workloads to manage cognitive or mentally demanding work. Additional controls may involve: • Specific management of safety critical tasks • Comprehensive fatigue education for all workers	All of the previous column plus: • Comprehensive supervisor fatigue training • Controlling other work environment hazards (heat, WBV, dust, etc) • Regular and frequent breaks	All of the previous columns plus • Monitoring and rescheduling mentally demanding work • Restrictions on overtime and call-outs involving this type of work • Workload management and self pacing of work

Risk factor 13: Monotony of tasks		
Varied work with minimal periods of monotonous tasks		Long periods of monotonous tasks such as driving on long haul roads, monitoring in control rooms, etc
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue or errors due to distraction**

Increase in higher order controls with increasing potential for fatigue

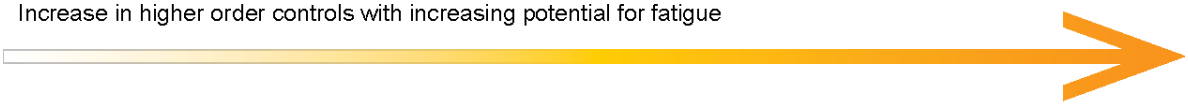


Risk factor 13: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential**
• Specific management of safety critical tasks • Comprehensive fatigue education for all workers	All of the previous column plus: • Comprehensive supervisor fatigue training • Controlling other work environment hazards (heat, WBV, dust, etc) • Workload management and self pacing of work • If monotonous tasks done during night shift, additional supervision or monitoring may be required.	All of the previous columns plus • Limiting duration of monotonous work • Regular and frequent breaks • Fatigue monitoring and rescheduling or rotating work as required • Increased breaks from work

Table 3: Contributing risk factors - work design and task specific factors contributing to cumulative fatigue and potential health issues

Risk factor 14: Physically and/or physiologically demanding work		
Varied work with minimal periods of physically demanding work and regular breaks		Long periods of physically demanding work (including working in heat due to physiological demands) particularly at night
Lower potential for fatigue	Medium potential for fatigue	**High potential for physical and general fatigue**

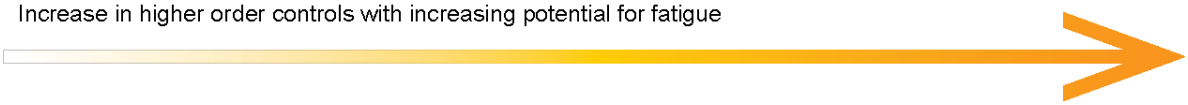
Increase in higher order controls with increasing potential for fatigue



Risk factor 14: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential**
• Controlling other work environment hazards (heat, WBV, dust, etc) • Specific management of safety critical tasks • Comprehensive fatigue education for all workers	All of the previous column plus: • Comprehensive supervisor fatigue training • Control of overtime and call-outs (for certain higher risk work)	All of the previous columns plus:: • Monitoring and limiting periods of physically demanding work performed at night during circadian low phases • Schedule additional breaks for recovery and address any dehydration issues

Risk factor 15: Work area conditions (health and other hazards)		
Limited exposures to health hazards		Less than adequate control or high exposures to health hazards
Lower potential for fatigue	Medium potential for fatigue	**High potential for cumulative fatigue or other health effects**

Increase in higher order controls with increasing potential for fatigue

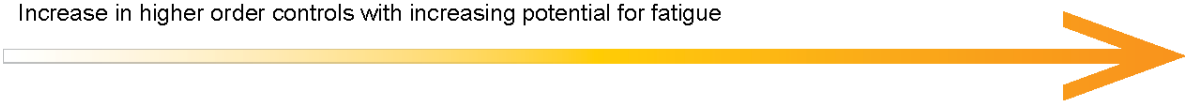


Risk factor 15: Controls		
Lower potential for fatigue	Medium potential for fatigue	**High potential**
• Well managed health systems on-site • Effective monitoring to ensure exposures are limited and higher order controls are used when available • Comprehensive fatigue education for all workers	All of the previous column plus: • Specific management of safety critical tasks • Comprehensive supervisor fatigue training • Workload management and self pacing of work • Additional breaks as required to reduce exposure to an acceptable level	All of the previous columns plus • Additional monitoring of health hazard exposures identified by HIAC or other DNRM sources • Health hazard management plans to control exposure to the health hazards • Appropriately skilled internal resources to deal with interaction of health hazards and fatigue

Table 4: Contributing risk factors - individual or site specific factors contributing to cumulative fatigue (some factors are inter-related, see information for risk factors)

Risk factor 16: Split shifts or variable shifts Sites need to identify if some support workers, contractors or suppliers are working variable or split shifts.		
No split shifts or variable shifts		Split shifts in safety critical tasks such as bus driving in camps
Lower potential for fatigue	Medium potential for fatigue	**High potential for fatigue and fatigue-related incidents**

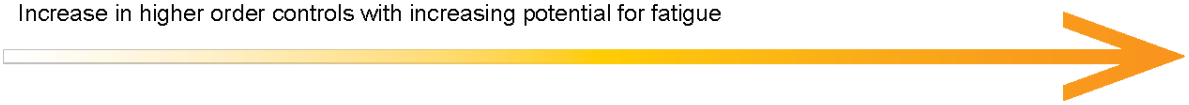
Increase in higher order controls with increasing potential for fatigue



Risk factor 16: Controls		
Additional controls may involve: • Specific management of safety-critical tasks • Comprehensive fatigue education for all workers	All of the previous column plus: • Comprehensive supervisor fatigue training • Workload management and self pacing of work • Additional breaks as required	All of the previous columns plus: • Limitations on driving activities with split shifts or variable shifts • Review of scheduling arrangements to allow for more opportunity for sleep during any periods of split shifts

Risk factor 17: Seasonal work arrangements – hours worked Sites need to identify if some particular jobs or tasks are more likely to be influenced by seasonal peaks or high workload periods.		
Regular hours over 12 months		Long hours during peak season or high workload periods
Lower potential for fatigue	Medium potential for fatigue	**High potential for cumulative fatigue or other health effects**

Increase in higher order controls with increasing potential for fatigue



Risk factor 17: Controls		
• Specific management of safety critical tasks • Journey plan and commute management (including the home journey after successive night shifts) • Comprehensive fatigue education for all workers	All of the previous column plus: • Comprehensive supervisor fatigue training • Workload management and self pacing of work • Additional breaks as required during peak workload periods	All of the previous columns plus: • Limitations on driving activities • Review scheduling arrangements to allow for more personnel during peak periods

Some risk controls may need to be trialled before introduced

Some control measures may need to be trialled for their effectiveness before they are permanently introduced. For example, if a roster is re-designed, it could be piloted with a work group before it is finalised. The testing will often identify any unexpected problems and give the workforce a chance to trial the new arrangements without the normal day-to-day work pressures.

5.5 Evaluation

Risk controls must be regularly evaluated

As part of the risk management process, the control of risk factors should be evaluated on a regular basis. The evaluation forms part of the overall monitoring and evaluation of the fatigue risk management plan, as described in Section 8.

6. Fatigue risk management plan documentation

The plan should be integrated into the Safety and Health management system

A fatigue risk management plan should be integrated as part of an overall health and safety management system. It should be:

- specific to the site and type of work being performed by the individuals covered by the plan
- developed in consultation as required by legislation
- available to workers and visitors and be clearly on display
- communicated regularly to staff (e.g.through inductions)
- reviewed to take account of changes in site needs and knowledge about the risks.

The plan should be fully documented

The fatigue risk management plan should be fully documented and include:

- a statement of the principles for managing fatigue
- roles and responsibilities and accountabilities for all levels of the organisation
- the risk assessments that have been undertaken
- the risk controls that are and will be in place, along with an implementation strategy
- the support systems that already exist and that will be set up along with an implementation strategy (such as hours-of-work monitoring, employee assistance programs, training programs, monitoring systems)
- monitoring and reviewing the plan.

The plan should be written clearly and concisely and make use of diagrams where appropriate.

The plan should be audited and assessed

The plan must be able to be audited and assessed by appropriate authorities and be structured in a way that allows it to be evaluated and monitored by internal and external bodies.

7. Fatigue risk management plan implementation

7.1 Introduction

Risk controls must be put in place

The fatigue risk management plan must be implemented. Without adequate risk controls being put in place, the work that has gone into preparing the fatigue risk management plan will not be useful. Key issues to consider when implementing the plan include timeframes, training, roles and responsibilities, accountabilities, communication and participation, and assessment of understanding of the plan.

7.2 Timeframes

Actions should be monitored regularly to make sure that the agreed timeframes are being met. Progress on the plan's implementation is necessary.

7.3 Training

Training gives people the knowledge and skills to implement risk controls

Many of the risk control measures will involve workforce training to promote understanding. Training is essential to good risk control by giving the workforce the skills and knowledge they need to work with the identification of and risk controls for fatigue. It also provides appropriate information about the fatigue hazards and risks on-site. All site personnel, including contractors, must be informed about the fatigue risk management plan and have the skills and knowledge they need to fulfil their roles and responsibilities. Coal mine sites have obligations for an education program under the *CMSH Regulation, s.42 (2).*

In addition, operators/employers must provide education and awareness about the site's fatigue policy and procedures whenever:

- new workers are appointed
- induction or refresher training is provided
- contractors or other on-site service providers are engaged (as part of the contractor management plan)
- changes are made to the fatigue risk management plan which necessitates re-training.

The education and awareness training should cover:

- the nature of fatigue
- the warning signals of fatigue
- the possible effects of fatigue
- the factors that decrease or exacerbate the likelihood or effects of fatigue, and
- the control measures, including the fatigue risk management plan or standard operating procedures (as required by the *CMSH Regulation*).

Further training components incorporated in a number of programs can be found in Appendix 1. Training must be arranged so it is available to all workers on all shifts.

7.4 Communication

The workforce including contractors must know about the fatigue risk management plan

The entire workforce, including contractors, need to know about the fatigue risk management plan. When communicating the requirements of the plan, the different needs of various groups on the mine site should be taken into account. Some workers may have limited reading and writing skills, whereas others may come from non-English speaking backgrounds. Different communication methods should be employed to accommodate the different groups and maximise understanding across the entire workforce.

Once the plan is implemented, each worker has an obligation to monitor their own fatigue levels and communicate any issues to their immediate peers and supervisors.

7.5 Responsibilities

The whole workforce to participate in implementing the plan

All workers on-site, including contractors and other on-site service providers, must be involved in implementing the fatigue risk management plan and in making sure it is followed.

7.6 Supervision

Adequate supervision is required

Legislation requires proper supervision of workers (including contractors) and appropriate supervision is an essential part of the fatigue risk management plan.

Supervisors need to be able to identify when fatigue is a problem so that they can initiate immediate control measures and report problems that need to be addressed. This will usually require specific training, and suggested training components are found in Appendix 1.

7.7 Reporting

Reporting fatigue should be encouraged, not criticised

It is essential that workers (including contractors) are able to readily and effectively report fatigue problems affecting themselves or others without attracting criticism. This will require understanding and support from supervisors and colleagues. Reporting is more likely in a working environment where fatigue is recognised by all levels of the organisation as being an important health and safety issue that should be properly managed, and there are support systems in place to deal with non-work causes.

It is also important that the site methods and tools for investigating incidents where fatigue is a potential factor include the systematic identification of fatigue as an underlying cause of errors or incidents, including near misses.

8. Fatigue risk management plan: monitoring and evaluation

The plan should be regularly audited and reviewed to make sure it is still relevant

All aspects of the fatigue risk management plan should be audited and reviewed to ensure the controls remain suitable, adequate, effective and relevant. The hours worked by all workers, including professional staff and management, should also be monitored and evaluated as part of the fatigue risk management plan. Incident investigation tools should be reviewed to ensure that they assist to identify the contribution that fatigue may make to incidents.

Specific review factors must be considered

Specific factors to consider include:

- Have control measures been implemented as planned?
- Are they working?
- Are there any new problems?
- Do you have sufficient systems in place to identify fatigue in incident or near miss investigations? If yes, the number of incidents, near misses, injuries and other relevant data.

Appendix 1: Suggested components of worker (and supervisor) fatigue risk management training

A number of organisations and providers offer fatigue awareness training for workers and supervisors. The training can be delivered in a variety of ways, with some training (such as training to comply with transport regulations) competency based and accredited.

Some typical components of most fatigue prevention and management training include:

- information on fatigue, what causes it and how it can affect people in a variety of ways
- information on health effects of shiftwork, fatigue and health factors that influence sleep
- common terminology including circadian rhythm, wakefulness, and other technical terms used in the fatigue risk management plan at the site
- practical information on how to get better sleep
- how to report fatigue problems and use the recommended Employee Assistance Program (EAP) or health services on-site
- information on countermeasures such as caffeine, naps, lighting – as recommended on-site
- information on-site management of fatigue and mine (or coal mine) worker responsibilities
- considerations for a safe and healthy diet and eating habits while working shift work
- managing fatigue and alertness levels
- balancing work and home life.

Supervisors may require further skills to identify and manage fatigue in their crews, as well as dealing with individual issues, and planning or changing rosters or work hours. For example, if a supervisor is scheduling overtime or making decisions on who will be working overtime (or scheduling call-outs) they will need to have further training in fatigue risks involved with overtime and call-outs.

If supervision is a key component of site control measures for worker fatigue, the supervisor is a key component of the fatigue risk management system and they require skills and competency on how to:

- identify the signs and symptoms of fatigue in crews and individuals
- communicate policies, procedures and systems of fatigue risk management to workers
- identify workers who require referrals to EAP or occupational health services for conditions (or situations) that may influence their FFW due to fatigue
- identify fatigue causal factors in their investigation of incidents or near misses
- manage potentially fatiguing conditions such as overtime, scheduling changes, rostering, etc according to site policies and risk management processes.

Appendix 2: Tips for individuals on avoiding fatigue

These tips are meant for workers who are at risk of fatigue due to work or non-work factors.

Sleep	• The best sleep is night sleep. • If sleeping during the day, completely darken the room and allow more time than normal to fall asleep. • Choose a quiet, peaceful place to sleep and adhere to a routine. • Seven to eight hours uninterrupted sleep is adequate. • Establish and maintain a routine around work, exercise, rest and sleep. • Seek medical advice for excessive snoring, irregular breathing and insomnia.
Drugs and alcohol	• Avoid excessive consumption of alcohol – it affects quality of sleep. • Avoid stimulants – they delay the need for sleep. • Do not consume coffee or tea before going to bed.
Health and medical conditions	• Schedule six-monthly medical checkups. • If you have a medical condition, seek advice from your doctor if you are in a job that involves shift work or long working hours. • Tell your employer about any medical conditions that may limit your ability to work or make you susceptible to fatigue. • Ask your doctor for an alternative medication if it causes you drowsiness when you need to be awake.
Fitness	• Maintain a basic level of fitness. • Exercise regularly but do not exercise immediately before going to bed. • Keep your weight in check – obesity contributes to sleeping disorders and general discomfort.
Nutrition	• Obtain dietary advice particularly for diet when on night shift (dieticians who provide specific advice can be found at the Dieticians Association of Australia) http://daa.asn.au/ • Maintain a healthy diet and healthy diet routine. • Avoid large and or heavy meals before going to bed. Further information on nutrition and diet for shiftwork is available from the Tasmanian Eat well guide from: http://www.eatwelltas.com.au
Mental health	• A number of psychological conditions as well as personal issues can disrupt sleep. • Some work problems can also influence fatigue and stress at work. • Seek help from site Employee Assistance Program services, a supervisor or on-site occupational health nurses if you feel that you have issues influencing sleep or fatigue. • Depression • Anxiety

Modified from WorkSafe Victoria 2008. Fatigue prevention in the workplace.

Other information sources for workers for managing shift work or general information on sleep and fatigue include:

- WorkCover New South Wales 1996, How to manage shiftwork: guide, WorkCover New South Wales, Gosford, N.S.W., accessed at: http://www.workcover.nsw.gov.au/formspublications/publications/Documents/how_to_manage_shiftwork_guide_0224.pdf
- CCOHS (Canada) website http://www.ccohs.ca/oshanswers/psychosocial/fatigue.html
- National Sleep Foundation (USA) website http://www.sleepfoundation.org/

Appendix 3: Accessing further resources and references

Some enterprises or mine sites may not have the internal resources required to develop, implement, maintain and review effective fatigue risk management. Instead, operators and other executives, such as SSEs may need to identify qualified specialists in various areas to assist with certain aspects of the plan and possibly the training. The sources listed below provide some useful resources and publications.

Resources

Occupational Physicians:

Australasian Faculty of Occupational and Environmental Medicine: http://www.racp.edu.au/page/racp-faculties/australasian-faculty-of-occupational-and-environmental-medicine

Ergonomists:

Human Factors and Ergonomics Society of Australia: http://www.ergonomics.org.au/

Other sources

Construction, Forestry, Mining and Energy Union: http://www.cfmeu.com.au/
Australian Workers Union http://www.awu.net.au/
Minerals Industry Safety and Health Centre: http://www.mishc.uq.edu.au/

References and other guidance on fatigue

Research presentations or publications

Åkerstedt, T., Czeisler, C. A., Dinges, D. & Horne, J. A. 1994, Accidents and sleepiness: a consensus statement from the International, Conference on Work Hours, Sleepiness and Accidents, Stockholm, 8-10 September 1994, Journal of sleep research, vol. 3, no. 4, pp. 195, accessed at http://www3.interscience.wiley.com/cgi-bin/fulltext/121643099/PDFSTART on 13 July 2010.

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Baker, A. & Ferguson, S. 2004. Work design, fatigue and sleep: a resource document for the minerals industry [report], Minerals Council of Australia

Baker, A., Fletcher, A. & Dawson, D. 1999, Policy guidelines for a risk management approach for shiftwork, accessed at http://www.drewdawson.com/downloads/reports/shiftworkpolicy_wmk.pdf on 13 July 2010.

Baulk, S.D., Fletcher, A., Kandelaars, K.J., Dawson, D., Roach, G.D. 2009, A field study of sleep and fatigue in a regular rotating 12-h shift system. Applied Ergonomics, vol 40: pages 694–698

Carter, T. & Muller, R. 2008, Occupational fatigue in the mining industry: diagnosis, interpretation, management, presentation to the Committee on Occupational Fatigue in Queensland Mining of the Queensland Health Improvement and Awareness Committee, accessed at http://mines.industry.qld.gov.au/assets/hiac/dr_anthony_carter_occupational_fatigue_in_the_mining_industry_200808.pdf

Crummy, F., Cameron, P.A., Swann, P., Kossmann, T., Naughton, M.T., 2008. Prevalence of sleepiness in surviving drivers of motor vehicle collisions. Int Med J, vol 38, no 10 pages 769-775

Dawson, D. & Reid, K. 1997, Fatigue, alcohol and performance impairment, Nature, vol. 388, pp. 235, Accessed at http://www.fatiguescience.com/assets/pdf/Alcohol-Fatigue.pdf on 13 July 2010.

Fatigue and Performance Modeling Workshop, June 13-14, 2002 (2004) Aviat Space Environ Med vol 75 no 3 (Suppl)

Folkard, S. 2007, Assessing work schedules by means of injury rate, paper presented at the Ageing and working hours: 18th International Symposium on Shiftwork and Working Time, 28-31 August 2007, Yeppoon, Qld, accessed at http://shiftwork.cqu.edu.au/downloads/presentations/Folkard%20Asessing%20work%20schedules.pdf on 13 July 2010.

Ingre, M., Kecklund, G., Akerstedt, T., Soderstrom, M., Kecklund, L, 2008, Sleep length as a function of morning shift-start time in irregular shift schedules for train drivers: self-rated health and individual differences. Chronobiol Int, vol 25, no 2, pgs 349-58.

Kecklund, G., Åkerstedt, T., Lowden A., 1997, Morning work: Effects of early rising on sleep and alertness. Sleep, vol 20, no 3, pages 215– 223.

Larue, G. S., Rakotonirainy, A, & Pettitt, A. 2009, Driving performance on monotonous roads, in Proceedings of the 19th Canadian Multidisciplinary Road Safety Conference, Saskatoon, Saskatchewan, June 8-10, 2009, Canadian Association of Road Safety Professionals, accessed at http://www.carsp.ca/documents/844 .

Rogers, N.L., Whitwell, B.G., 2009, Fatigue and commuting in mine shiftworkers. Sleep, vol 32 (Suppl):A148.

Williamson, A. 2002, Fatigue, in National Heavy Vehicle Safety Seminar: 22-23 October 2002: Radisson on Flagstaff Gardens Hotel, 380 William Street Melbourne, Melbourne: National Road Transport Commission, accessed at http://www.ntc.gov.au/filemedia/Publications/FatigueAnnWilliamson.pdf on 13 July 2010.

* The above papers are a small sample only of the extensive published work on sleep and fatigue. Most of these papers are publically accessible. Many research papers on sleep and fatigue are copyright and must be accessed via the journal directly.

Guidance

Baker, A. & Ferguson, S. 2004,.Work design, fatigue and sleep: a resource document for the minerals industry [booklet], Minerals Council of Australia, Kingston, A.C.T.

NSW Mining Industry Health Working Party 2009, Health management plan: a guide to the development and implementation of a health management plan in the NSW mining and extractives industry, version 1.0, Industry and Investment NSW, accessed at http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0015/303063/Guide-to-the-development-and-implementation-of-a-Health-Management-Plan.pdf on 13 July 2010.

Tiernan, G. & Van Zanten, D. 1998, Development of an extended shift exposure limit adjustment factor for coal mine dusts. Joint Coal Board Health and Safety Trust, Singleton, N.S.W., accessed at http://www.hstrust.com.au/MessageForceWebsite/Sites/326/Files/SIMTARS_Tiernan_1998_Development_of_an_Extended_Shift_Exposure_Limit_Adjustment_Factor_for_coal_mine_dusts_20081.pdf on 13 July 2010.

Western Australia. Commission for Occupational Safety and Health. Mining Industry Advisory Committee 2006, Code of practice: working hours 2006, Mining Industry Advisory Committee, West Perth, W.A., accessed at http://www.commerce.wa.gov.au/worksafe/PDF/Codes_of_Practice/COPworkinghours.pdf on 13 July 2010.

WorkSafe Victoria 2009. Fatigue in mines: a handbook for earth resources, WorkSafe Victoria, Melbourne, Vic., accessed at http://www.worksafe.vic.gov.au/wps/wcm/connect/4b8f6a004071f2a18be1dfe1fb554c40/fatigue_handbook.pdf?MOD=AJPERES on 13 July 2010.

WorkSafe Victoria 2008. Fatigue prevention in the workplace, WorkSafe Victoria, Melbourne, Vic., accessed at http://www.worksafe.vic.gov.au/wps/wcm/connect/d98656004071f370932edfe1fb554c40/vwa_fatigue_handbook.pdf?MOD=AJPERES on 13 July 2010.

Appendix 4: Principles for risk management scoping and review to assist with planning the fatigue risk assessment *

Scoping checklist for a risk assessment

A good scope should include the following:

1. An objective based on the expected deliverable
2. A description of the system to be reviewed and clear identification of the boundaries
3. An inventory of the potential hazards
4. A statement of external threats
5. A listing of assumptions
6. Identification of consequences of interest
7. The risk assessment method – the means of identifying the unwanted events
8. The risk analysis method – the means of calculating and examining the level of risk
9. The facilitator for the risk assessment
10. The scribe for the risk assessment
11. The risk assessment team or work group (identifying reasons for inclusion)
12. The time required (and venue)
13. The means of providing risk assessment results and the desired deliverable.

Risk Assessment Review Checklist

A review of a risk assessment should consider the following issues

1. Is the reason for the review defined?
2. Are the objectives of the review stated?
3. Is there a description of the system being assessed?
4. Are the boundaries clearly and unambiguously defined?
5. Is the documentation provided sufficient to understand the scope and function of the system?
6. Is there a summary of the strategic, corporate and risk management context?
7. Are the participants identified together with their organisational roles and experience related to the matter under consideration?
8. Is the range of experience/expertise of the team appropriate?
9. Is the facilitator identified together with related experience?
10. Is the facilitator appropriate?
11. Is the method of identifying the risks clearly identified?
12. Is the reason for the choice of methodology explained?
13. Is the method of assessing likelihood and consequence of the risks identified?
14. Is the reason for the choice of methodology explained?
15. Is there a hazard inventory table?
16. Is there a listing of external threats?
17. Are all the direct assumptions identified?
18. How was the acceptability of the risks determined?
19. Is the determination of the acceptability of the risks justifiable?
20. Are all the risks prioritised by risk magnitude and consequence magnitude?
21. Was the hazard identification process comprehensive and systematic?
22. Has the approach to each part of the study been consistent?

23. Have all the existing controls and performance indicators been identified and their function determined accurately?
24. Have all potential new controls been identified, adequately assessed and assigned performance indicators if adopted?
25. Is there a recommended action list giving actions, responsibilities and timelines for completion?
26. Is there a review process to ensure the assessment is consistent with others completed at the same facility/business?

From: Joy, J. & Griffiths, D. 2007, National minerals industry safety and health risk assessment guideline, version 6, Minerals Council of Australia, http://www.mishc.uq.edu.au/Resources.aspx

* Fatigue risk factors and interaction of risk factors may not be fully addressed by current risk assessment approaches. Some risk assessment tools, assumptions and methodologies are less applicable to complex interactions of risk factors, hence the risk factor tables in this document.

Appendix 5: Key points for journey management or commute management plan

As a minimum consideration for all sites:

Workers should complete and document a journey management or commute management plan if they:

- permanently reside more than one hour from site
- regularly work 12 hour shifts

  or

- may exceed 16 hours of wakefulness while in control of a vehicle, or
- are identified as requiring a plan in QGN16 risk factor tables.

Monitor and review journey management or commute management plans

Use QGN16 or other guidance to ensure that workers are aware of their responsibilities to notify site contact if there are changes to the journey.

Workers have obligations under *MQSH Regulation, s.36* as follows:

“If the worker or other person has information that other persons need to know to fulfil their obligations or duties under this Act, or to protect themselves from the risk of injury or illness—to give the information to the other persons.”

Similar obligations exist under *CMSH Regulation, s.39*.