



**IOSH ALBERTA ASSOCIATION**  
Industrial Occupational Safety & Health Association of Alberta

## **INDUSTRY BEST PRACTICE**

### **Fatigue Management**



IOSH Alberta Association  
Industry Best Practice | FM-10152015V2

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# **Fatigue Management**

## **INDUSTRY BEST PRACTICE**

Approved September 1, 2015  
Industrial Occupational Safety and Health Association of Alberta

IOSH Alberta Association

### **Abstract**

This Industry Best Practice has been developed based on the input and collaboration of the contributors listed within this document and provides a framework for managing work force fatigue in an occupational environment.

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## **FOREWORD**

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### **Association Objectives**

The objectives of the Association shall be collectively improving the workplace environment by updating Safety Standards and Loss Control practices by:

1. Promoting the improvement of occupational health and safety programs initiatives through collective sharing of information, experiences, programs and training.
2. Interacting with and supporting other councils in the influencing of legislative bodies in the formulation and application of Occupational Health and Safety legislation.
3. Establishing channels of communication with Safety Professionals, Government Agencies, Member Company Senior Management, other Safety Associations and the public when assistance or guidance is needed.
4. Providing recognition to Member Companies for outstanding Safety Achievements on an annual basis.

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## **1.0 Industry Practice Background**

### **1.1 Definition**

To begin the process of managing fatigue, it is important to define it. The following definition is modified and adapted from the International Civil Aviation Organization's (ICAO) definition of fatigue (*Aviation IFALPA IATA FRMS for Operators, 2011*) – Fatigue is a state of impairment. It is a physiological state of reduced mental or physical performance capability resulting from sleep loss or extended wakefulness, circadian phase, or workload that can impair a worker's alertness and ability to safely perform work related duties.

### **1.2 Rational**

- Fatigue is an under-recognized risk in both the Petroleum and Mining industries.
- Fatigue has numerous detrimental effects on these industries including: negatively impacting worker health and safety, increasing workplace incidents, reducing worker performance, and reducing productivity.
- There is currently a lack of industry best practices for managing fatigue in these industries.
- Identification of fatigue causal factors are not currently a standard part of industry-based incident investigation processes.
- There is a lack of industry metrics with regards to fatigue related incidents.

### **1.3. Development Purpose**

This document has been prepared as a sample of information that could be put forth as an Industry Practice for the oil and gas and mining industries. Input from key stakeholders in these industry sectors would be required to determine what areas of this information would be included in a final Industry Practice document. This document is to be presented for initial consultation to the IOSH Alberta Association.

## **2.0 Scope**

- This industry practice is designed for the downstream petroleum industry and the mining extractives industry.
- Organizations identified as having sufficient risk should have an auditable FRMP in place.
- External contractors are required to have equivalent programs.

## **3.0 Key Concepts**

- Fatigue is addressed through a comprehensive Fatigue Risk Management Framework that includes identification, assessment and mitigation of fatigue risks.
- FRMP's should be data based, science driven and recognize operational issues.
- Key stakeholders shall be consulted in developing and implementing the local application of the FRMP.
- Education and awareness on the risks and management of fatigue is key to the successful implementation of a FRMP.
- Fatigue management should be created in which the shared responsibility of mitigating risk is recognized.

## **4.0 Key Components**

### **4.1 Using a Risk Management Framework**

A Fatigue Risk Management Plan (FRMP) is an integrated set of management practices, beliefs and procedures for monitoring and managing the risks posed to health and safety by fatigue. It is based in safety management system theory with an emphasis on risk management. It is a documented and auditable safety management system.

Fatigue risk management moves beyond the basic level of only using hours of service restrictions for controlling fatigue. It recognizes that only limiting hours of work will not successfully eliminate the hazard of fatigue. Fatigue risk management is a more comprehensive approach that introduces multiple types of controls to manage the hazard of fatigue and to control fatigue risk exposures. Higher risk operations are recommended to examine the components of a Comprehensive 5 Level FRMP.

Underlying Principles of a FRMP

- Based on assessed fatigue risks.
- Designed to effectively control fatigue hazards.
- Based on the principle of shared responsibility.
- Reliant on awareness and understanding of fatigue factors.
- Customized to the organizations and aligned with existing SMS.
- Effectively evaluated (through incident reviews and organizational indicators).

#### **4.1.1 Benefits of a FRMP**

The primary benefit of an FRMP is enhanced safety levels and the prevention of fatigue related incidents and accidents. Compared to prescriptive limits on work hours and other isolated strategies for managing fatigue, the implementation of an FRMP also has a number of other advantages:

- It is a systematic, documented and auditable approach to fatigue management.
- The many different causes of fatigue are considered.
- Fatigue management is a risk-based approach that is more in keeping with provincial safe work approaches.
- It involves both proactive and reactive risk management.
- Fatigue management is tailored to the site, rather than relying on 'generic' fatigue management strategies.
- The unique set of fatigue controls available at a site are recognized and utilized.
- Responsibility for managing the risk of fatigue rests with operating companies, not the regulator.

#### Employee, Production and Regulatory Benefits

- Employee benefits include improved health, work-satisfaction, and well-being.
- Improved employee morale, increased staff retention and a reduction in absenteeism and training, which may lead to reduced operating costs.
- Managing the adverse impact fatigue has on human performance can improve operational reliability and ultimately productivity.
- A FRMP may facilitate compliance with local regulatory requirements regarding the management of health and safety or hours of work.
- If the pre-existing controls are overly restrictive, operational flexibility can be enhanced.

#### 4.1.2 Components of a FRMP

An FRMP should include the following components:

##### FRMP policy and procedures

- a. Management commitment to fatigue awareness
- b. Roles and responsibilities
- c. Organizational processes and controls to deal with fatigue risks assessed

##### Procedures and guidelines for controlling fatigue in the workplace

- a. A listing of scheduling practices and existing schedules
- b. Recommended guidelines for schedules more likely to cause fatigue (i.e. shifts longer than 8 hours, extended rotations, seasonal hours, overtime policies and guidelines, call out procedures, emergency procedures, and other scheduling practices likely to increase the risk of fatigue.)

##### Training and education

- a. Employee fatigue alertness and competency training specific to each level of employee and other stakeholders
- b. Other methods of communicating the plan
- c. Designed to create culture of fatigue awareness
- d. Includes sleep disorder information, screening and associated health information for employees

##### Fatigue evaluation methods

- a. Methods to be used for evaluating an employee's fitness for work with regards to fatigue
- b. Other methods to be used for fatigue hazard identification, assessment and controls

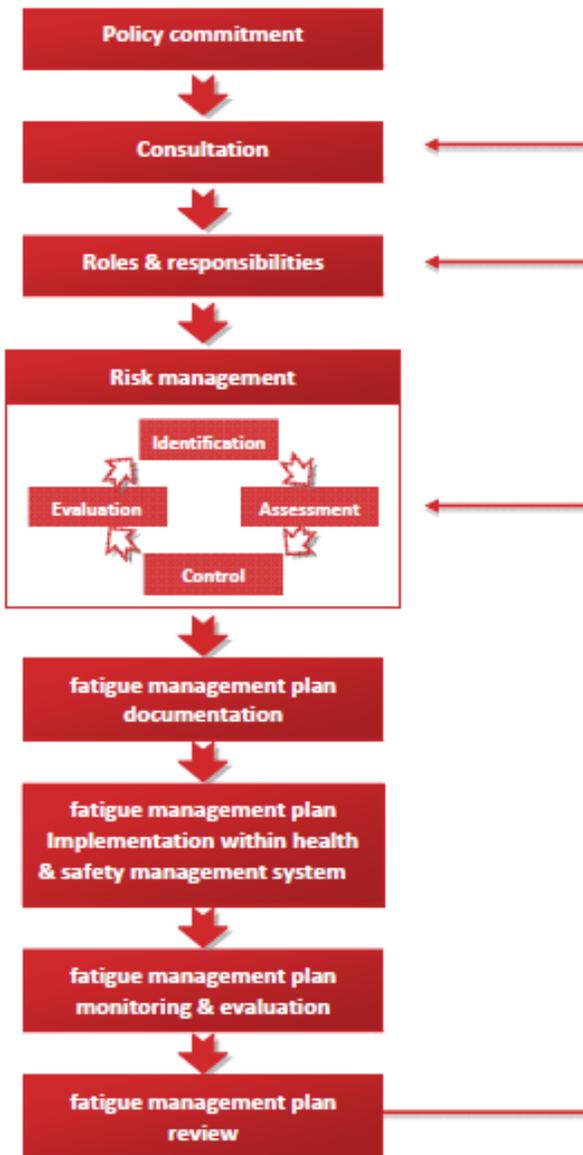
##### Incident reporting and investigation

- a. Reporting processes in place for fatigue errors and incidents
- b. Process of incident investigation that include methods of identifying or eliminating fatigue causation factors

##### Program Administration

- a. Embedding/integrating the plan in existing safety management systems
- b. The process used to audit, evaluate, and continuously improve the program

#### 4.1.3 Process to Develop a FRMP



*Figure 1. Fatigue Management Plan (A practical guide to developing and implementing a fatigue management plan for the NSW mining and extractives industry. NSW Mine Safety Advisory Council, 2009.)*

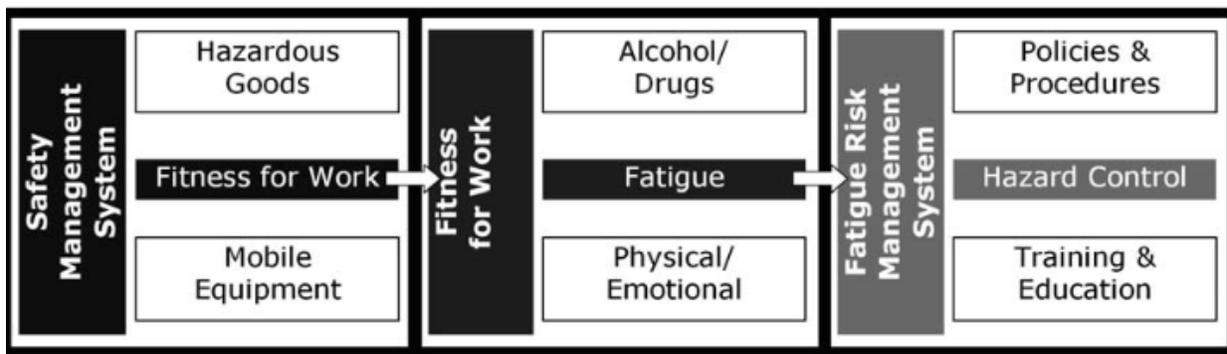
#### 4.1.4 Consultation

Consultation is an integral part of the development of all safety management systems. A FRMP should be developed in consultation with all key stakeholders. A consultive process works to increase the successful implementation of the plan.

#### 4.1.5 Aligning a FRMP

To be effective, a fatigue risk management plan should align with existing safety management systems. Embedding a FRMP into existing SMS frameworks will allow fatigue to be managed within existing organizational procedures and safety structures and help to align stakeholder responsibilities.

The following diagram is an example of how a fatigue risk management plan can be incorporated into an overarching safety management system.



*Figure 2. Fatigue Risk Management System for the Canadian Aviation Industry Developing and Implementing a Fatigue Risk Management (System, Transport Canada, 2007, p. 7. Accessed online April 24, 2013 from: [www.tc.gc.ca/media/documents/ca-standards/14575e.pdf](http://www.tc.gc.ca/media/documents/ca-standards/14575e.pdf))*

#### 4.1.6 Evaluation and Review

A FRMP should be audited, evaluated and reviewed on a regular basis to insure control effectiveness and sustainability of the implemented controls. Deficiencies or needed improvements to the plan can be identified through various performance indicators. Events that could indicate the need to review the plan include: reporting of fatigue related incidents (loss and/or no loss), operational changes, hours of work or rest break changes, anecdotal reporting of fatigue, periodic reviews (i.e. scheduled reviews occurring every three years), identification of fatigue issues during internal/external audits, increased absenteeism (analysis required to determine if it is fatigue related), surveying of staff to determine if additional review of controls is indicated, etc.

#### 4.1.7 Roles and Responsibilities in a FRMP

A key component of a FRMP is the understanding that fatigue management is a shared responsibility between management and workers. The following details key roles and responsibilities under the Plan.

### Management

- Assessment of fatigue risk factors within the organization
- Development and implementation of appropriate fatigue risk management plans
- Providing appropriate resources for necessary training, equipment, or other related expenditures
- Assessment of fatigue risk factors within the organization
- Development and implementation of appropriate fatigue risk management plans
- Ensuring scheduling is reviewed to assess fatigue risks while balancing organizational needs
- Ensuring appropriate performance indicators, such as organizational metrics, incident reports, investigations, and reviews are occurring
- Ensuring the FMRP is evaluated and updated on a regular basis

### Workers

- Attending company fatigue competency training
- Ensuring priority is given to reporting fit for duty
- Identifying fatigue concerns to a Supervisor
- Adhering to the controls of the FRMP

### Contractors

- Contractors must adhere to the controls within the FMRP while on site
- Contractors with indicated risks should have equivalent FMRP policies

### Supervisors

- Monitor worker behavior
- Identify when fatigue behaviours are present and creating risk
- Implement controls from company FMRP

**Supervisors have key responsibilities under the plan. They are the key role responsible for identifying fatigue risks and implementing company controls.**

If worker fatigue is indicated, and workers are unable to manage the fatigue through identified controls, Supervisors must assist in determining the level of impairment and what control measures need to be put in place to reduce safety risks. There are a number of tools available to assist supervisors in making this judgment.

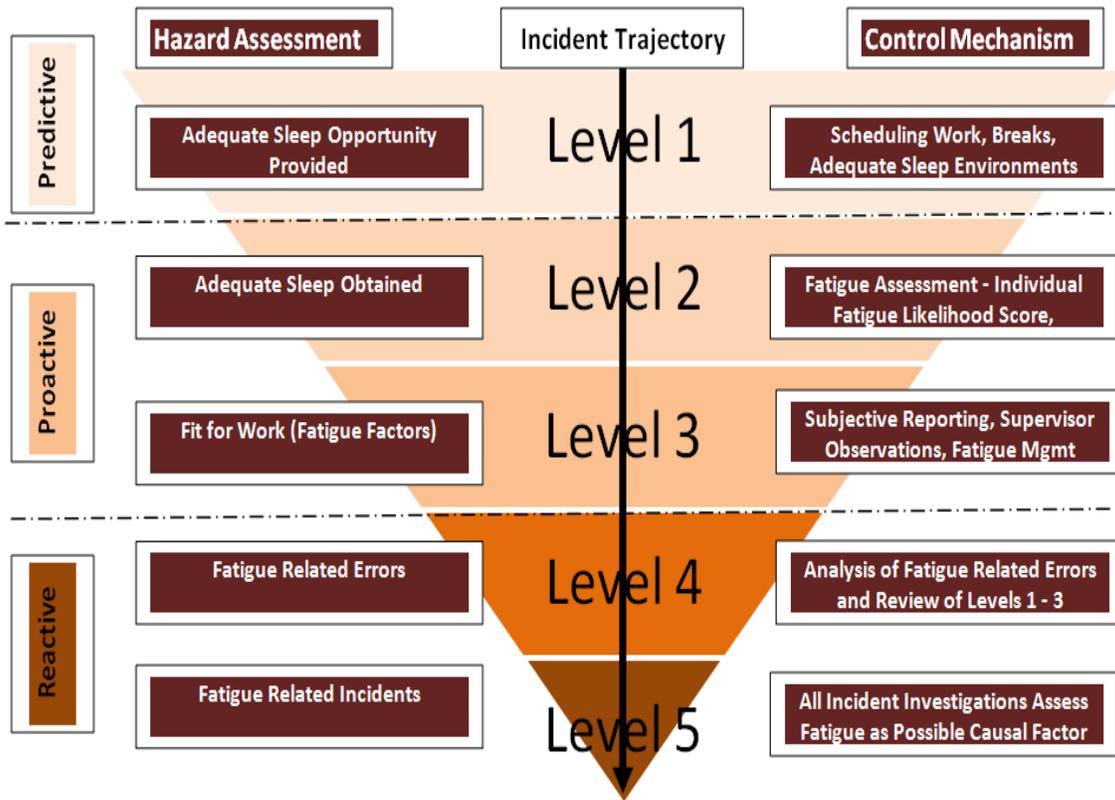
When a supervisor determines fatigue is impairing a worker's ability to conduct his/her job safely, the supervisor must then, in consultation with the employee, employ organizational, individual, and team-based controls as appropriate. This is where having a comprehensive fatigue management plan becomes essential as it defines both the supervisor and worker's rights and responsibilities regarding fatigue controls.

An example of how responsibilities could be allocated based on risk factors and strategies is found in Appendix A.

**4.2 A Comprehensive Five Level Fatigue Risk Management Strategy**

Organizations with moderate to high levels of fatigue risk will require multiple levels of controls to adequately manage the fatigue risks identified. The following is an example of a FRMP that is based on the theories of James Reason (see background information for more explanation). In essence, this FRMP incorporates corporate and worker responsibilities, behavioral indicators, and the continuous improvement process into a multi-levelled comprehensive plan.

This is one method in which required controls within a FRMP can be organized. Organizations may use this framework or develop one that is more in keeping with their existing SMS.



*Figure 3. In-Scope Solutions (Based on the concepts of a 5 level Fatigue Risk Management Strategy adapted from research conducted at The Centre for Sleep Research, University of Southern Australia)*

A Visual Representation of a Five Level Fatigue Risk Management Plan

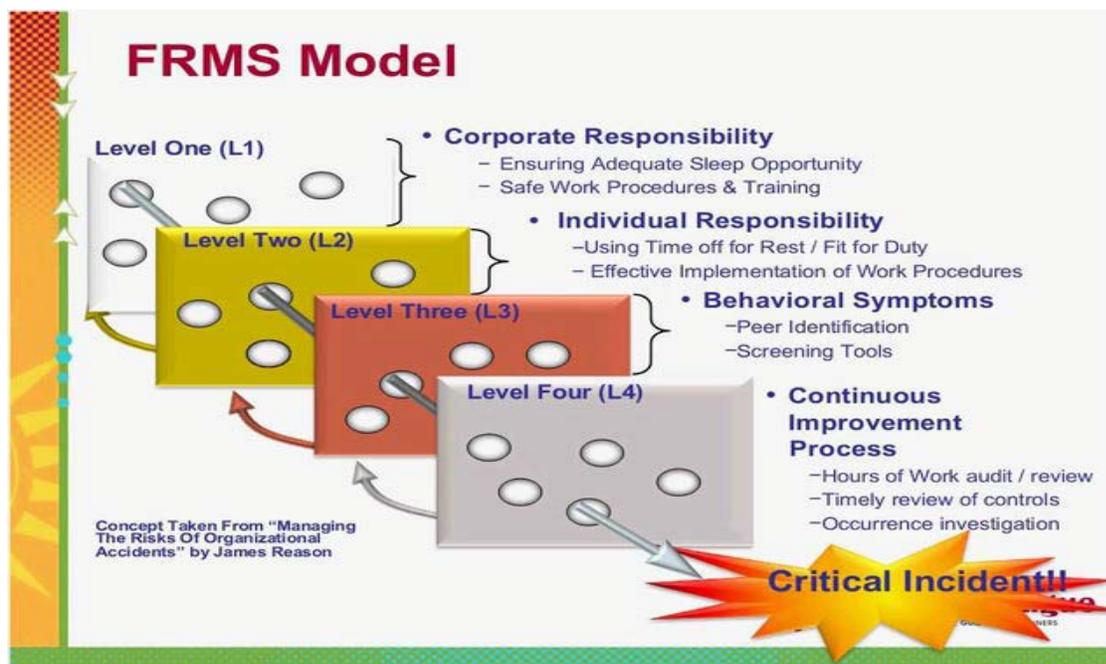


Figure 4. Managing Fatigue (A Practical Guide for Pipeliners, US Pipeline and Hazardous Materials Safety Administration)

The five-level fatigue risk management model has been used in multiple industries as a way of effectively managing the risks of fatigue. Guidelines for successful implementation can be found in many industries including the mining industry, the health care industry, the rail industry and the aviation industry.

Further detailing on the components of this plan can be found in Appendix B.

### 4.3 Assessing Organizational Risk

#### 4.3.1 Sufficient Risk

Organizations are considered to have sufficient risk factors requiring the implementation of a FRMP if one of the following conditions exists:

- Shifts exist outside of regular daytime hours (6:00AM to 7:00PM)
- Do not have a minimum of two consecutive days off in any seven day period
- Have shift lengths exceeding 10 hours (excluding a shift change of maximum 30 minutes)
- Have workers who regularly work more than 50 hours in a 7-day period.
- Have workers commuting 1 hour or more to the worksite
- Have regular call out and overtime occurring (including those that occur only in certain seasons)
- A fatigue hazard is identified during a fatigue risk assessment

#### 4.3.2 Assessing Organizational Fatigue Risks

When assessing an organization it is important to determine the fatigue organizational risk factors. These are factors within an organization that make it more susceptible to fatigue hazards and more likely to incur fatigue related incidents. Key areas to focus on are:

1. Work Scheduling
  - a. Work shifts and schedules
  - b. Rotations
  - c. Weekly/monthly hours
  - d. Seasonal fluctuations
  - e. Break schedule
2. Work Tasks
  - a. Driving/long commutes
  - b. Safety sensitive work
  - c. Monotonous tasks
3. Work Environment
  - a. Physical or mental demands
  - b. Environmental exposures (temperature, noise, vibration)
  - c. Exposure to contaminants
  - d. Types of PPE (ex. respirators)
4. Off-Duty Factors
  - a. Are workers obtaining adequate levels of sleep?
  - b. Health concerns (i.e. sleep disorders impairing the worker's fitness for work with regards to fatigue).
  - c. Social/personal factors (factors influencing the worker's ability to obtain adequate sleep)
5. Other Factors
  - a. Worker commutes to/from the worksite
  - b. Camp facilities or accommodations
  - c. Circumpolar effects

#### Fatigue Risk Assessment

An initial first step in deciding on and justifying the need for fatigue management would be to conduct a Fatigue Risk Assessment. This assessment involves careful examination of the organization's key factors to determine fatigue hazards and risks. Overall organizational factors should be examined, and fatigue should be included when conducting task hazard analysis (THA) within the organization.

Other information that can be used to assess fatigue in an organization include: absenteeism, access to employee health and safety programs, review of incidents to note time of day and likely fatigue causal indicators, questionnaires, surveys or other feedback methods allowing employee feedback on the issue, observation of employee behaviour, a review of existing hazard assessment tools (FLA, JSA, FLHA) to determine if fatigue could be contributing to issues, and a review of existing schedules to determine if they are likely to cause fatigue.

#### Fatigue Risk Matrix

Fatigue, along with other hazards encountered in the workplace, should have a rating scale assigned to understand the likelihood and severity of the hazard causing harm. A sample of a Fatigue Risk Matrix can be found in Appendix C.

#### Developing Controls Based on Risks Identified

When fatigue risks are identified, there are numerous controls that can be developed and implemented to mitigate these risks. Controls should be based on worker and operational needs. Effective controls that easily integrate into existing safety culture could be identified and included.

A sample of identified fatigue hazards and a list of possible controls that could be introduced are found in Appendix D.

### **5.0 Education and Training Requirements**

One of the most important components required for the successful implementation of a FRMP is adequate awareness and knowledge of fatigue. Fatigue hazards are currently under-recognized in North America. Education and training to raise understandings of fatigue risks and increased knowledge on methods of controlling these risks will be essential to the implementation of a FRMP.

#### **5.1 Required Personnel**

Training should exist for:

- Management
- Supervisors
- Workers
- Other key stakeholders (contractors, professionals on-site, etc)
- Family members (awareness only)

Training should focus on these key elements:

- Understanding organizational requirements for fatigue mitigation (controls of the frmp)
- Understanding fatigue health and safety risks
- Understanding roles and responsibilities for fatigue management
- Competency building in managing personal fatigue

## **5.2 Required Training Content**

These are the required components of a fatigue competence building training program and should include the following key components:

1. How fatigue effects safety
2. How fatigue effects health
3. Fatigue science
  - a. Sleep science
  - b. Acute and cumulative sleep loss
  - c. Circadian rhythms
4. Causes of fatigue
5. Fatigue risk factors in an organization
6. Roles and responsibilities for fatigue management
7. Managing fatigue: organizational controls
8. Managing personal fatigue
  - a. Lifestyle factors
  - b. Preventing fatigue
  - c. Symptoms of fatigue
  - d. Assessing fatigue impairment
  - e. Managing fatigue
    - Sleep
    - Sleep disorders
    - Naps
    - Caffeine
    - Nutrition and meal timing
    - Exercise
    - Hydration
    - Medications (pros and cons)
  - f. Fatigue and driving

Manager and Supervisor Training Should also Include:

1. Assessing and documenting worker fatigue
2. Monitoring and enforcing the FRMP
3. How to integrate FRMP into existing safety programs and culture
4. How to plan work recognizing fatigue issues
5. Fatigue incident reporting
6. Fatigue in incident investigations
7. Fatigue metrics

## **5.3 Benefits of Training**

Training is a required component of a fatigue risk management program. The following are some noted benefits of fatigue training.

- Increased awareness of fatigue as a health and safety risk
- Increased understanding and compliance to company based Fatigue Risk Management Plan

- Increased worker competency in managing personal fatigue
- Increased management awareness and mitigation of fatigue risks in the workplace
- Increased supervisor competence in assessing fatigue risks and implementing company FRMP

## **6.0 Legislation and Guideline Documents**

### **6.1 Existing Applicable Legislation**

- Though not specifically noted in Alberta OHS Legislation, fatigue is a hazard that should be included under the General Duty Clause - Part 2 of the Code.
- Existing regular and overtime hours of work are legislated through Canada Labour Code and Alberta Employment Standards.
- Some industries, such as commercial transportation, have hours of service limitations legislated through the 2005 Commercial Vehicle Drivers Hours of Service Regulations.

### **6.2 Canada**

- Canadian O&G best practices exist with Enform's Guiding Principles Agreement, Enform's Worker and Employer Guides to Safe Work - Fatigue Management, Enform's Employer Guide to Safe Work - Fatigue. There are currently no Canadian best practice documents for the mining industry.
- Best practice documents exist for other industries: Aviation, Rail Transportation. Other industries examining fatigue as a safety issue include nuclear, fisheries, healthcare.
- Requesting extended hours of service in commercial transportation requires the demonstration of a comprehensive FRMS.
- Some Extended Hours Permits in Alberta (ex. ARHCA - Alberta Road & Heavy Construction Association) require FRMS as part of the Hours of Work exemptions.

### **6.3 Internationally**

- American O&G best practices exist in API RP 755.
- Internationally OGP and IPIECA have held two international oil and gas conferences on fatigue and have produced multiple publications on oil and gas fatigue management best practices.
- North Sea oil and gas, through the Energy Institute, have best practices regarding fatigue management.
- In Australia, the mining industry is a leader in fatigue management best practices, including those published for the NSW Mining and extractives industry.

## **7.0 Scheduling Best Practices**

Work schedules must try to balance the needs of the organization with the needs of employees. Modern understandings of sleep science and circadian rhythms can assist with understanding scheduling best practices.

All key stakeholders should be consulted when determining new schedules.

Optimal schedules will satisfy business requirements through increased productivity, reductions in overtime, and reduced absenteeism. Employees will note reduced fatigue, improved morale and job satisfaction, and improved health and alertness.

Certain scheduling practices have been shown to reduce the likelihood of fatigue. The following are commonly understood scheduling best practices.

Scheduling recommendations source CCOHS.

**Direction of rotation of shifts.** It is recommended that shifts rotate forward from day to afternoon to night because circadian rhythms adjust better when moving ahead than back.

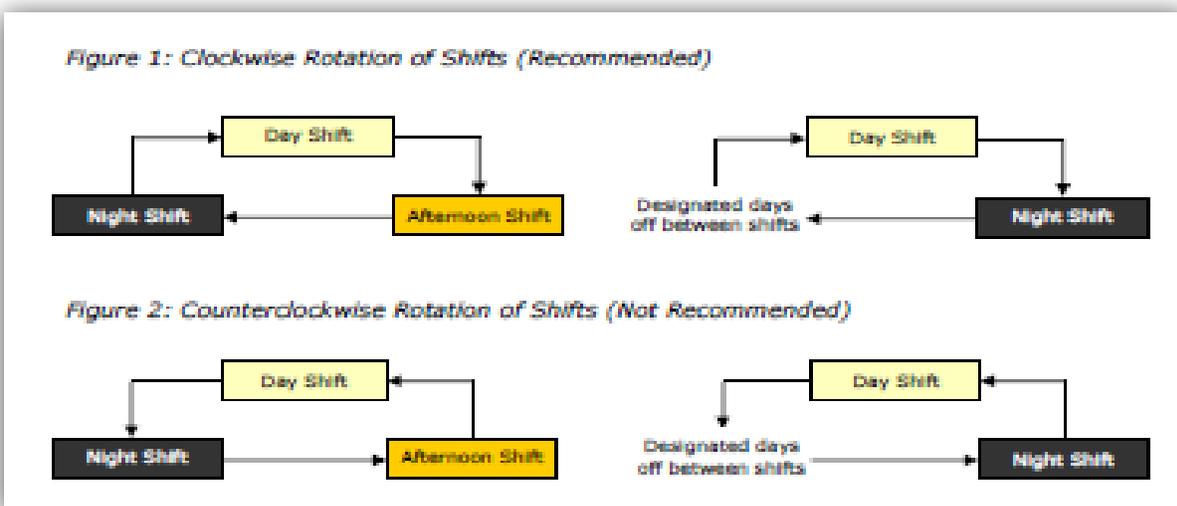


Figure 5: Enform Employer Guide to Fatigue Management 2007

**Start and Finish Times.** Early morning shifts are associated with shorter sleep and greater fatigue. It is advisable to avoid shift start times as early as 5 or 6 a.m. The social customs and desires of the specific work force should be considered as well as the availability of public transportation. The safety on the streets, in terms of crime and violence, is another consideration.

**Length of rest between shifts.** It is recommended that a rest period of at least 24 hours occur after each set of night shifts. The more consecutive nights worked, the more rest time should be allowed before the next rotation occurs.

**Length of the rotation period** (the number of days on any one shift before switching to the next shift). The optimum length of the rotation period has been disputed.

- The most common system has a rotation period of one week, with five to seven consecutive night shifts. However, since it generally takes at least seven days for adjustment of the circadian rhythms, it is argued that just as adjustment starts to occur, it is time to rotate to the next shift. Some schedule designers feel that a longer shift rotation should be arranged so that the worker spends from two weeks to one month on the same shift that would allow circadian rhythms to adjust. A problem occurs when the worker

reverts to a "normal" day/night schedule on days off, thus, possibly cancelling any adaptation. Also, longer periods of social isolation may result.

- Others suggest a rapid shift rotation where different shifts are worked every two to three days. This system may reduce disruption to body rhythms because the readjustment of circadian rhythms is minimized. It also provides time for some social interaction each week.
- In the end individual differences and preferences, play the most important role.

**Alternative forms of organizing work schedules.** For example, extended workdays of ten or twelve hours have been used. It has the advantage of fewer consecutive night shifts and longer blocks of time off. However, the additional fatigue from long work hours may also have adverse effects. The physical and mental load of the task should be considered when selecting the length of a work shift. Exposure to chemical or physical agents should also be considered when selecting a shift system as well as ergonomic hazards.

Additional shift scheduling information can be found in Appendix E.

## 8.0 Hours of Service Recommendations

*NOTE: It is key that the Industry Practice has recommended hours but careful consideration should be put into this. It may work to use the API recommendations, but research needs done to discover the rationale for these hours and if they make sense to adopt.*

### 8.1 Normal Operations - 8,10,12 Hours Shifts (Taken from API RP755 Summary)

#### Hours of Service (HoS)

<u>Operational Situation</u>	<u>12-Hour Shift</u>	<u>10-Hour Shift</u>	<u>8-Hour Shift</u>
Maximum Consecutive Shifts (Day or Night) In a Workset			
<b>a) Normal Operations</b>	<b>7 shifts</b>	<b>9 shifts</b>	<b>10 shifts</b>
<b>b) Outages</b>	<b>14 shifts</b>	<b>14 shifts</b>	<b>19 shifts</b>
<b>Minimum time off after a workset</b>			
<b>a) Normal Operations</b>	<b>36 hours</b>	<b>36 hours</b>	<b>36 hours</b>
▪ Workset of 4 or more night shifts	<b>48 hours</b>	<b>48 hours</b>	<b>48 hours</b>
▪ After 84 hours or more regardless of day or night	<b>48 hours</b>	<b>48 hours</b>	<b>48 hours</b>
<b>b) Outages</b>	<b>36 hours</b>	<b>36 hours</b>	<b>36 hours</b>

**8.2 Normal Operations - Outages and Extended Shifts** (Taken from API RP755 Summary)

**Hours of Service (con't)**

Extended shifts shall occur only to avoid unplanned open shifts or safety critical tasks

<u>Operational Situation</u>	<u>12-Hour Shift</u>	<u>10-Hour Shift</u>	<u>8-Hour Shift</u>
Unscheduled maximum shift	18 hours	16 hours	16 hours
Time off after shift			
10 – 16 hour shift	N/A	N/A	8 hours
12 – 16 hour shift	N/A	8 hours	N/A
14 – 16 hour shift	8 hours	8 hours	N/A
>16– 18 hour shift	10 hours	N/A	N/A
Maximum Daily Shift Length	18 hours	16 hours	16 hours
Maximum Number of Extended Shifts per Workset	1	- 1 for 14 hour shift or - 2 for 12 hour shifts - 3 or more 12 hour shifts, follow 12 hour normal operations guidelines above	extended shifts must be non-consecutive - 2 if greater than 12 hours in duration - If >2, follow 12 hour normal operations above

**9.0 Fatigue Toolkit**

**9.1 Evaluating Fitness for Work**

Evaluating a workers fitness for work with regards to fatigue involves a strong safety culture. Unlike drugs and alcohol, there is no definitive test for identifying fatigue. Fatigue assessment rely on assessments through various methods such as worker self identification or supervisor symptom observation. Workers must feel they will not be penalized for identifying fatigue. Supervisors must be empowered to recognize, assess, and control fatigue factors in the workplace. Workers must be given the responsibility and Supervisors the authority to determine fitness for duty with regards to fatigue. Multiple tools are available to assist in this evaluation.

**9.2 Types of Tools Available**

Fatigue management tools can be classified as either subjective or objective. Other tools include checklists developed to assist employees in remembering fatigue control options available.

**9.2.1 Subjective Tools**

Use self-reported fatigue information and quantify them to allow them to be used for directed decision making. These measures are usually inexpensive and easy to implement. They do, however, rely on worker self identification or supervisor observation. They require a strong safety culture and a comprehensive FRMP to be used effectively.

### 9.2.2 Objective Tools

Use biological or performance-based measures to indicate fatigue levels. Some objective measures have been created in recent years, although they are still relatively new and only being currently tested for efficacy in the field. The idea of objective tools is appealing, but it should be noted these controls are only effective when used in conjunction with a FRMP. These tools are, in essence, the PPE of fatigue management and should be used as the last line of defence when elimination, engineering and administrative controls are not able to control the hazard. There is also typically additional expense required for objective tools.

### 9.2.3 Control Checklists

Are designed to assist management, employees and other stakeholders remember fatigue controls that could be put into place to manage fatigue when it occurs. Checklists can be used by individuals or teams (crews) to review and implement applicable fatigue controls. The controls developed should be aligned with those detailed in the company FRMP.

It is not recommended that all of these tools be incorporated into a Fatigue Risk Management Plan. Plan developers and those in charge of implementation need to choose the tools that best fit available resources and the organization.

## 9.3 Subjective Tools

### 9.3.1 Fatigue Likelihood Assessments (FLA)

Fatigue Likelihood Assessments are a well recognized and validated method of assessing fatigue.

1. Fatigue Likelihood Assessments (FLA)
2. Decision Tree based on Fatigue Likelihood Assessment Score

Worker self-reporting of sleep obtained is done through the Individual Fatigue Likelihood Assessment. Agreed-to controls are based on the Fatigue Likelihood Score. The images depict both sides of an Individual Fatigue Likelihood Wallet Card.

INDIVIDUAL FATIGUE LIKELIHOOD ASSESSMENT					
<b>Step 1. Sleep in prior 24 hours</b>					
Sleep	≤ 2h	3h	4h	5h+	
Points	12	8	4	0	
<b>Step 2. Sleep in prior 48 hours</b>					
Sleep	≤ 8h	9h	10h	11h	12h+
Points	8	6	4	2	0
<b>Step 3. Hours awake since last sleep</b>					
Add one point per hour awake greater than sleep in Step 2					

*Figure 6. Calculating Fatigue Likelihood*

INDIVIDUAL FATIGUE LIKELIHOOD ASSESSMENT	
Step 4. Add all points together to determine your score	
<b>Score</b>	<b>Agreed Control Strategies</b>
1 to 4	Self Monitoring
5 to 11	Request Supervisor Monitoring
12+	Do NOT Commence Shift Until Fit For Work
Refer to FRMP policy for detailed explanation of controls	

*Figure 7. Sample Company Decision Tree Based on FLA  
 (Enform design based on Sleep Centre Research)*

IOSH Alberta Association  
**Industry Best Practice | Fatigue Management**

Workers assess likelihood of fatigue based on previous sleep obtained. FLA score is determined by calculating sleep obtained in the last 48 hours and by assessing how long it will be (at the end of their shift) since the worker last slept.

It must be noted that this sleep scale does not accurately account for individual differences in sleep needs. It also does not account for accumulated sleep debt. This level does not assess other fatigue factors such as work tasks or environment. Fatigue controls could still be needed even if a Fatigue Likelihood score is 0.

Fatigue likelihood assessments are based on research regarding prior sleep-wake models. Fitness for work is determined by an algorithm that is composed of three simple calculations. These calculations are based on prior sleep in the last 24 hours, prior sleep in the last 48 hours, and length of time from awakening until end of shift. Significant research exists to validate this method for assessing fatigue.

Score	Possible Signs and Symptoms	Agreed Control Strategies
12+	Difficulty staying awake and possibly experiencing microsleeps. Uncoordinated physically and experiencing difficulty staying focused. Significant impairment evident.	Document and report risk to supervisor. Do not engage in ANY safety critical work or behaviors. Do not recommence until fit for work.
10	Clear evidence of behavior impairment. Difficulty sustaining attention on simple tasks. Uncoordinated physically.	Document and report risk to supervisor. Complete Samn Pernelli and Fatigue Symptoms Checklists. Engage in individual and team fatigue management strategies. Organize supervisory checks and work directly with a co-worker if possible. Nap if possible. Should not engage in safety critical work - task reassignment if necessary.
8	Clear loss of motivation and physically weak and listless. Significantly reduced situational awareness. Task performance impaired.	
6	Difficulty concentrating. Occasional lapses of attention. Poor judgement on complex tasks. Physically affected - sagging body posture, slow blinking, etc.	
4	Difficulty in maintaining extended concentration for complex tasks. Low energy levels and weakness apparent.	Document. Complete Samn Pernelli and Fatigue Symptoms Checklists. Take approved individual or team countermeasures. Self-monitor for symptoms, team monitor by co-workers, task rotation or other job alterations as required.
2	Slowed cognition. Occasional minor fatigue behaviors observed. Minor mood changes observable. Low energy levels or hyperactive.	Controls and fatigue management may be necessary. Assess and monitor for fatigue symptoms.
0	Able to perform tasks safely. Unlikely fatigue impairment, but monitor if required.	No controls unless otherwise indicated by other fatigue risk factors

*Figure 8: Extended Decision Tree Based on FLA Adapted (In-Scope Solutions)*

### 9.3.2 Other Subjective Measures

1. Samn-Perelli Fatigue Checklist
2. Visual Analogue Scales
3. The Karolinska Sleepiness Scale
4. Behavioral Monitoring Fatigue Checklist

Examples of additional Fatigue Assessment Tools including subjective measures are found in Appendix F.

## 9.4 Objective Measures

1. Eye Scan Devices
2. Vehicle Monitoring Devices
3. Psychomotor Vigilance Tasks (PVT)
4. Circadian Rhythms Biological Indicators
5. Actigraphs

The following information on eye scan devices and vehicle-monitoring devices is sourced directly from Catapillar Global Mining Finding technology solutions to combat operator fatigue. 2011

Two main types of technology exist: “fitness for duty” tests that check operator fatigue levels prior to their shifts, and systems that measure operator and machine behavior during operations. These technologies measure:

#### Machine behavior

- Lane deviation
- Steering wheel movement
- Pedal usage
- Machine movement

#### Operator physiological conditions

- Eye behavior (blink and pupil response properties)
- Heart rate
- EEG

#### Operator behavior

- Head nodding
- Mental and physical reaction times

Fitness-for-duty tests have been in use for some time to check operators for drug and alcohol usage. New technologies are being employed to test for fatigue, including:

- Pupilometry—measures eye reflexes, pupil constriction and the speed of eye movement. Degradation of reaction times can indicate impairment.
- Psychomotor Vigilance Tests—evaluate reaction times and hand/eye coordination. Using a computer mouse, trackball or joystick, operators must follow a target and maintain their position.

These units are not cost-prohibitive. They range from US\$5,000 to US\$10,000 per unit and they are rock solid for drugs and alcohol. They are still being evaluated on how well they work for fatigue, or more precisely, impaired alertness.

Systems that monitor operator activity in the cab as well as vehicle activity also show promise. These systems monitor the operators around the clock, sometimes sending information to dispatchers as well as accumulating long-term data about the behavior of an operator or his or her machine.

On-board technologies include:

- In-dash cameras or eyeglasses with sensors that monitor eye movement and blink speeds—both indicators of fatigue.

Information on the following Fatigue Assessment Tools including the following objective measures can be found in Appendix F.

1. Psychomotor Vigilance Tasks (PVT)
2. Circadian Rhythms Biological Indicators
3. Actigraphs

### 9.5 Control Checklists

1. Individual Control Example List
2. Team Control Example List

The following are examples of individual and team control measures that can be used depending on the level of fatigue. These checklists should be modified to include control measures the organization has agreed to. The checklists are useful to have in a fatigue toolbox because they remind individuals of the types of controls that can be implemented.

Diagram 1.7 Individual Control Examples	Diagram 1.7 Team Control Examples
<b>Individual Control (Examples)</b>	<b>Team Control (Examples)</b>
Controlled use of Caffeine	Communicate fatigue status at morning safety meeting
Adequate hydration	Communicate high Fatigue Likelihood Score to supervisor and coworkers
A light or low fat protein snack	Document high Fatigue Likelihood Score
Adjust working temperature	Increase cross checking among coworkers
Adjust lighting	Increase supervision
Take a break	Task reallocation or rotation
Change tasks	Delay safety sensitive work if possible
Remove safety sensitive tasks from work	Take a collective break
Take a 15 - 40 minute nap	Work together with a co-worker where possible
Increase social interaction	Engage in conversations and social interactions
Defer to a second opinion	Fatigue leave - all crew stand down
Increase supervision	
Stand Down - do not proceed until fit for work	

*Figure 9: Individual and Team Control Examples (Adapted by In-Scope Solutions from information sourced from Fatigue Risk Management System Resource Pack Published by the Queensland Government, 2009)*

## **10.0 Industry Practices**

Industry best practices specific to the oil and gas or mining industries will need to be developed. These could be created through a consultant process that examines what has been created for oil and gas and mining in other places, what has been created in other industries, and methods found to be affected by operators in Canada.

Examples of strategies and best practices that have been developed for the Oil and Gas Industry in are shown in Appendix G.

## **11.0 Incident Investigations**

Understanding fatigue as a causal factor in an incident is key to creating controls and conditions that reduce the likelihood of the incident reoccurring. Current incident investigation tools do not typically include investigation techniques required to recognize fatigue as a causal factor. Incident investigation practices across the industries should work to either eliminate or recognize fatigue as a causal factor in all incidents investigated.

Specific questions can be easily adapted and implemented into existing organizational incident investigation processes. These questions are designed to either eliminate or recognized fatigue as a contributing causal factor.

### **11.1 Fatigue Incident Investigation Information**

1. Date, time and place of the accident (not the time of the report)
2. Work Schedule History (Schedule, Rotation, Shift Length, Breaks)

Describe the actual work schedule (regular hours plus overtime) for the **four days** prior to the accident (fill out by date and shift until all four days prior to the accidents are covered).

- How long from the last scheduled break?
  - How long in duration was the last scheduled break?
  - Shift Work
    - How many hours into the shift did the incident occur? (ex. 3 hours in)
    - How far into the work schedule was the individual involved?
    - List Day #/Shift #: (ex. Day 12/28)
    - What shift was the individual working (day or night)?
3. Work Task and Work Environment
    - What task was being performed at the time of the incident?
    - What was the work environment like?
    - How mentally or physically stimulating was the task and work environment prior to the accident?
    - Rate Physical Factors, Mental Factors, Environmental Factors on a Scale of 1-5 (with 1 being low and 5 being very fatiguing)

4. Individual Worker Factors:
  - Previous Sleep Assessment: Number of hours of actual sleep in previous 24, 48 and 72 hours (i.e. 3 days) prior to the accident.
  - Overall quality of sleep 24, 48 and 72 hours (i.e. 3 days) prior to the accident.
  - Did any health problems affect the individual's sleep during the month leading up to the accident?
5. Incident Information
  - Any signs/symptoms of fatigue during the persons waking hours prior to the accident (either self reported or observed by others)
  - What, if any, fatigue assessment had occurred prior to and during the work shift? (ex. Fatigue Likelihood Assessment score, self-reporting of fatigue, supervisor noting of symptoms, Samn-Perelli Scale, etc.)
  - Observations/witness accounts indicating lack of attention to work environment
  - Observations/witness accounts indicating impairment of worker abilities (mental/physical/emotional)
6. Other Relevant Information
  - Any other information regarding the incident or worker relating to fatigue that could be relevant to the investigation.

Developed by an O & G Industry Committee Probabilistic concept based on Bayesian Networks -  
Modified by In-Scope Solutions

## **12.0 Tracking Metrics**

### **12.1 Organizational Metrics**

To properly assess and review the organizations FRMP, metrics should be kept on any fatigue related incidents (near miss or loss). Organizations should track these incidents and use them to improve fatigue controls.

### **12.2 Industry metrics**

One of the key impediments to managing fatigue in the oil and gas and mining industries is a lack of industry metrics. To further increased safety across the industries, it is recommended a centralized database be created to track fatigue related incidents. Organizations could be encouraged to share information with this centralized database. This data could be used to improve existing industry best practices for fatigue management.

**13.0 Understanding Fatigue Background Information**

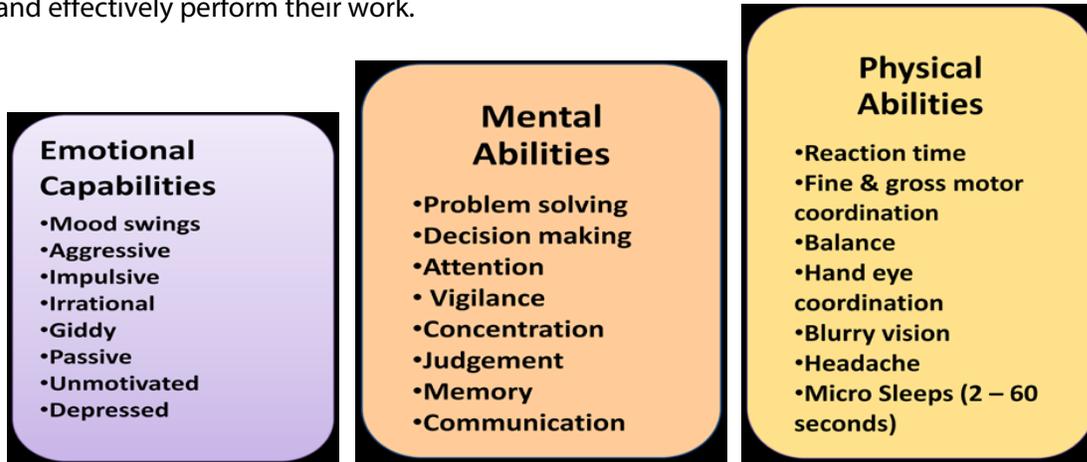
**13.1 How is Fatigue a Safety Issue**

A fatigued individual can be impaired and may not be able to perform tasks safely or efficiently. For example, fatigue can affect your:

- **Alertness** - to notice or react to changes in your work environment
- **Emotional Stability** - to remain emotionally calm or communicate clearly
- **Mental Ability** - difficulty concentrating, thinking clearly, making decisions
- **Physical Ability** - slower reaction times and lower overall coordination

**13.2 Fatigue Impacts on Performance**

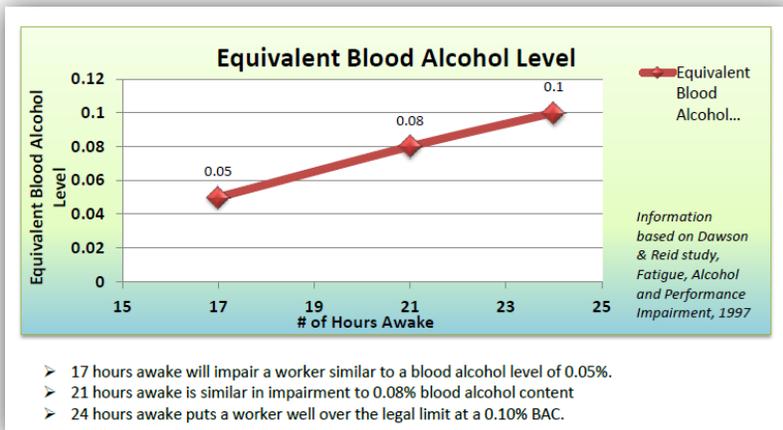
Short-term effects of fatigue create significant safety hazards in terms of a worker's ability to safely and effectively perform their work.



*Figure 10. Impacts on Performance (In-Scope Solutions)*

**13.3 Fatigue Impairment = Alcohol Impairment**

It is well documented through several research studies that fatigued workers are impaired in ways very similar to alcohol-intoxicated workers.



*Figure 11. Equivalent Blood Alcohol Level*

### 13.4 Health Effects of Fatigue

Numerous studies and statistics have been conducted on fatigue and its health effects. The following chart summarizes some of the main health concerns identified.

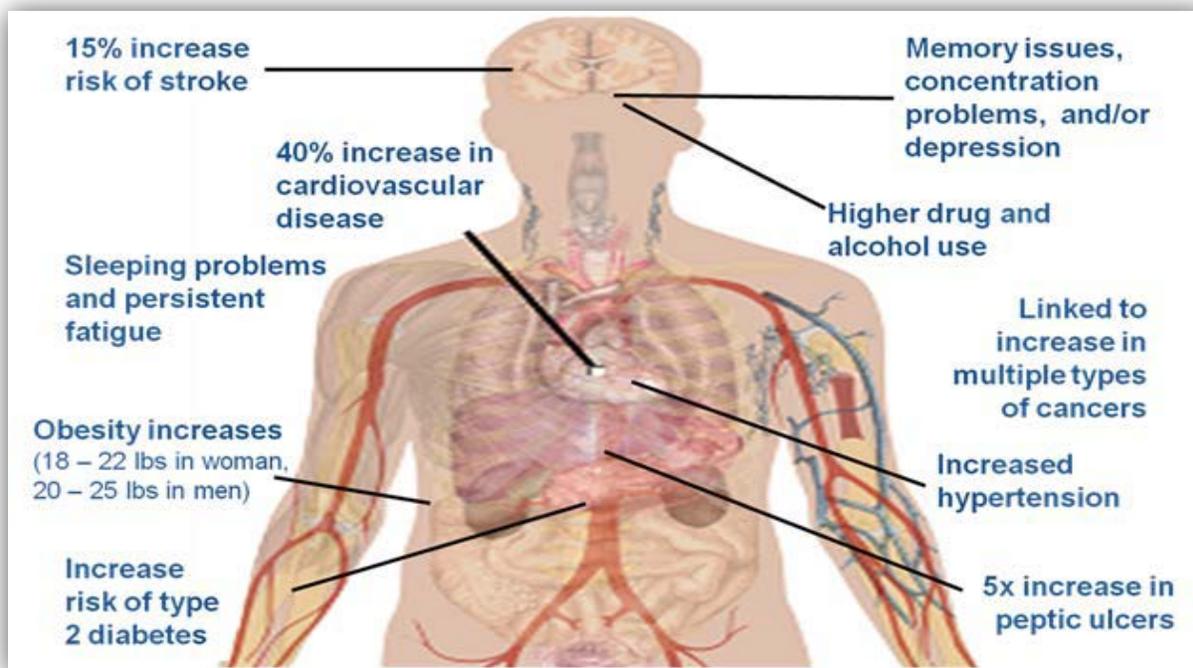


Figure 12. Effects of Sleep Deprivation by In-Scope Solutions (Body photo source - wikimedia.org)

#### 13.4.1 Acceptance of Fatigue

- It is familiar
- There is a culture of acceptance and an attitude of "toughing it out"
- Our work culture rewards fighting fatigue - incentives for longer hours and overtime
- It is not recognized as impairing our abilities or creating safety hazards
- Not widely publicized
- Lack of education, knowledge and awareness
- Many industries are not tracking metrics or collecting data
- Hard to demonstrate accidents/incidents caused by fatigue

### 13.5 Scientific Understandings

#### 13.5.1 Sleep Science

Sleep cycles study our brain waves as we sleep. They note we go through five distinct state of sleep and each of these stages help to restore us in certain ways. Specific factors such as the timing of our sleep and how often sleep is interrupted will influence our sleep cycles and influence the ability our sleep has to fully restore us. In other words, both **quantity and quality of sleep are important** and when we do not get these it affects our alertness, cognitive and physical abilities and our emotional state.

### 13.5.2 Sleep Debt

Although it is not really possible to store extra sleep, it is possible to accumulate a sleep debt. Studies have shown that missing a few hours of sleep for several consecutive nights can leave one as sleep deprived as missing an entire night's sleep.

## 13.6 Sleep and Shift Work

Various strategies can be used to assist workers in reducing fatigue while working shift work.

### 13.6.1 Anchor Sleep

Refers to sleep that occurs through at least half of the time normally reserved for sleep, thus anchoring circadian rhythms to a particular schedule and causing minimal disruption. For instance, if one sleeps from 8:00AM to 4:00PM after a night shift and from 4:00AM to 12:00PM on days off, the overlapping interval from 8:00AM to 12:00PM is anchor sleep and may help minimize circadian disruption. It is a strategy that can be used to manage fatigue issues for shift workers.

### 13.6.2 Napping

For years naps have been discounted and those taking them have previously been thought of as 'lazy' or 'asleep at the switch'. But lately new scientific evidence has given respect to the common nap and they are being recognized as a valid method to control fatigue. The benefits of napping to mental acuity, physical reaction time, and overall health have been documented. Multiple studies have demonstrated that naps improve alertness, creativity, mood, and productivity in the later hours of the day. Naps have also been shown to reduce the likelihood of fatigue related incidents during night shifts.

### 13.6.3 NASA Nap

Research on pilots has shown that a 26-minute 'NASA' nap (in-flight what the plane is manned by a co-pilot) enhances performance by 34% and overall alertness by 54%. A 60-minute nap can improve alertness for up to 10 hours (although 1 hour naps require much longer recovery times due to increased sleep inertia). One Harvard study demonstrated that a 45-minute nap could improve learning and memory.

## 13.7 Circadian Rhythms

Circadian rhythms are the daily rhythms of our bodies that are based on light. These daily rhythms affect many of our body's basic systems and have a large influence on our alertness, our energy levels and our physical well being which changes our:

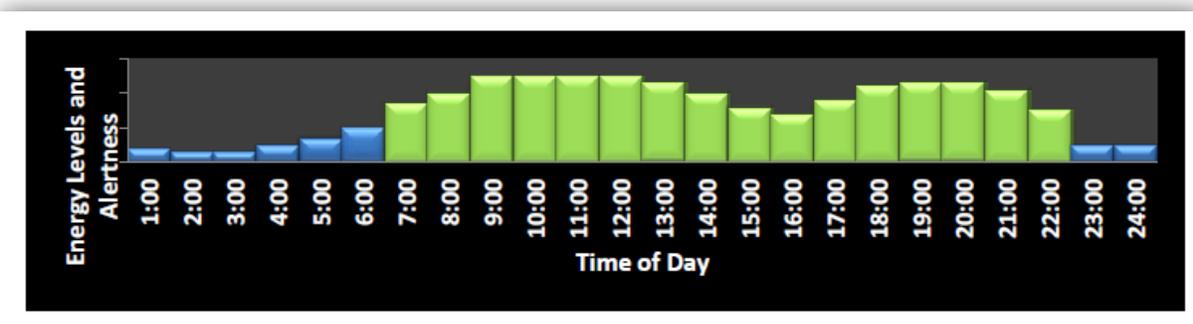
Circadian Rhythms Affect:	This Changes Our:
Body Temperature	Alertness
Blood Pressure	Behaviour
Heart Rate	Reaction Times
Blood Sugars	Physical Coordination
Digestive Enzymes	Mental Abilities
Hormone Production	Emotional Stability

*Figure 13. Body Systems and Behavioral Influences Due to Circadian Rhythms (In-Scope Solutions)*

Circadian rhythms cycle throughout a 24-hour period with sleep need being the highest from 2AM - 5AM with a second sleepy period occurring from 1PM to 4PM.

Understanding natural alert times and naturally sleepy times can be very important when determining fatigue risks to health and safety.

For example, a night supervisor should be aware that individuals are at their least alert from 2 to 5AM, and they should be the most alert for signs of fatigue in their workers during those times. A dayshift supervisor should be aware that a secondary dip in alertness occurs typically between 1 to 4 PM in the afternoon. These circadian low times are not a good time to schedule safety-sensitive tasks.



*Figure 14. Graph of Energy Levels and Alertness (In-Scope Solutions)*

These pre-programmed biological rhythms are difficult to adjust even for those who regularly work nights. The majority of people find working at night more difficult because it interrupts their basic biological sleep/wake patterns and other biological rhythms.

For example, when someone is working at night, their heart rate is lower, their blood pressure is lower, and their bodies are producing hormones that are slowing the neurological transfer of information in their brains. If they try to eat, their bodies are less able to digest the food and less able to regulate their blood sugars. A number of their biological systems are working against them, and this alters their ability to be alert and function at an optimal level.

Functioning outside of our circadian rhythms has a number of effects on our bodies. These short- and long-term effects can influence our abilities to be alert and work safely as well as affect our long-term health.

## **13.8 Causes and Contributing Factors of Fatigue**

### **13.8.1 Sleep**

- The primary cause of fatigue is insufficient rest and sleep.
- Sleep is a key requirement for physical and mental restoration.
- Rest is required for recovery from activities.
- Quality and quantity of sleep is key to its restorative properties (sleep science).
- Physical and Mental issues can impede proper sleep (sleep disorders, stress)
- Being active outside of regular daytime hours increases fatigue (circadian rhythms)

### 13.8.2 Sleep Disorders

Sleep apnea is another common form of sleep disorder. It occurs when the brain stops sending a signal to the muscles to take a breath, or when the signal is sent, but the airways are obstructed and prevent adequate flow of air. Individuals with sleep apnea temporarily stop breathing multiple times throughout the night, and this causes the individual to awaken feeling unrested and fatigued. Individuals who are overweight or snore are more likely to have sleep apnea.

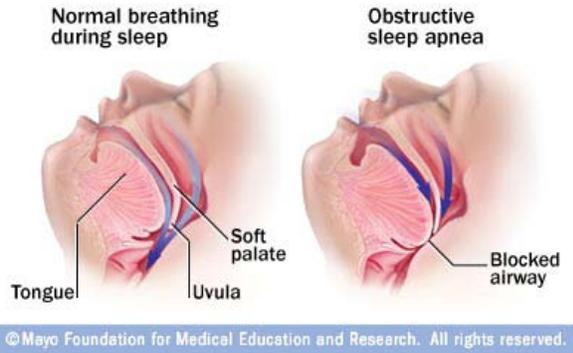


Figure 15. Sleep Apnea

**Other conditions:** There are numerous sleep disorders and medical conditions that can affect an individual's ability to obtain adequate sleep. **If you suspect you are suffering from any condition that is affecting your ability to obtain sleep, seek medical assistance.** There are a variety of treatments for sleep disorders, but medical assistance is often needed to return to proper sleep patterns.

### 13.8.3 Work Factors

Key work factors influence fatigue levels as well.



Figure 16. Work Factors Influencing Energy Levels and Alertness (In-Scope Solutions)

The table below briefly outlines the factors that can cause fatigue

<b>Individual Factors such as:</b>	<b>Work Scheduling Factors such as:</b>
<ul style="list-style-type: none"> <li>• Lack of sleep (just once or over time)</li> <li>• Individual variations, chronotypes, age</li> <li>• Overall health including sleep disorders</li> <li>• Personal factors such as family and social obligations</li> <li>• Stress</li> <li>• Use of medications, alcohol, or drugs</li> <li>• Poor sleep hygiene</li> </ul>	<ul style="list-style-type: none"> <li>• Long hours of physical or mental activity</li> <li>• Inadequate breaks</li> <li>• Not enough rest between work days</li> <li>• Shift work (permanent or rotating)</li> <li>• Extended or compressed work weeks and day-off patterns</li> <li>• Being on call</li> <li>• Time of day</li> </ul>
<b>Work Tasks:</b>	<b>Work Environment:</b>
<ul style="list-style-type: none"> <li>• Are physically or mentally difficult</li> <li>• Are monotonous or boring</li> <li>• Require you to work alone</li> <li>• Require constant vigilance</li> <li>• Are boring and require constant vigilance (e.g. driving long distances)</li> </ul>	<ul style="list-style-type: none"> <li>• Is noisy</li> <li>• Is dusty</li> <li>• Has poor air quality</li> <li>• Has excessive or continuous vibration</li> <li>• Is chaotic</li> <li>• Has dark or poor quality lighting</li> <li>• Has uncomfortable temperatures such as too much heat or too much cold</li> <li>• Is very comfortable such as being warm and dark</li> </ul>
<b>Other Factors such as:</b>	
<ul style="list-style-type: none"> <li>• Jet lag – traveling through time zones</li> <li>• Circumpolar effects</li> <li>• Disruption in Circadian Rhythm</li> </ul>	

Figure 17. Factors Causing Fatigue

## 14.0 Approaches to Fatigue Management

### 14.1 Hours of Service

Once fatigue was understood to be a key safety issue, industries and organizations began developing fatigue management approaches. The original approach used was often an Hours of Service approach in which fatigue is managed mostly by limiting the number of hours a worker could work. Although this approach has demonstrated only limited success, it has been used in a variety of industries including commercial ground transportation.

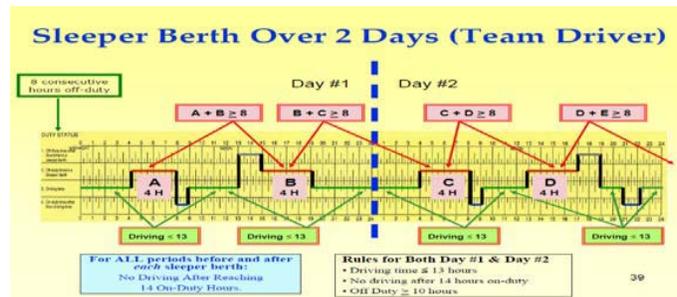
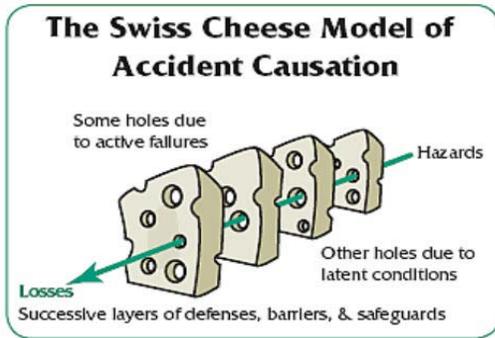


Figure 18. Sleeper Berth Over 2 Days HOS Calculations (Enform)

The key issue with using the hours of work approach is that no matter how complex the system for calculating hours, it only provides a single level of fatigue control. Workers can be in compliance with the hours of work, but still have other factors that cause fatigue. For example a worker with a sleep disorder, a new baby, driving at night or second job, can be in complete compliance with hours of work, but still be highly fatigued and still be a significant safety hazard.

## 14.2 Comprehensive Fatigue Risk Management Approach

There has been a lot of occupational research showing that a comprehensive multilevel structured approach, integrated into a safety management system, is much more effective in controlling fatigue in the workplace. This model recognizes that there are number of stages in which a hazard can be controlled before it turns into an actual incident.



*Figure 19. The Swiss Cheese Model of Accident Causation (Adapted from James Reasons Managing the Risks of Organizational Accidents 1997)*

**15.0 Term Definitions**

Term	Definition
Alertness	The opposite state of sleepiness, the state of cognitive and physiological arousal, and responsiveness to environmental/situation conditions.
Anchor Sleep	Anchor sleep refers to sleep that occurs through at least half of the time normally reserved for sleep, thus anchoring circadian rhythms to a particular schedule and causing minimal disruption. For instance, if one sleeps from 8:00 AM to 4:00 PM after a night shift and from 4:00 AM to 12:00 PM on days off, the overlapping interval from 8:00 AM to 12:00 PM is anchor sleep and may help minimize circadian disruption.
Automatic Behavior Syndrome (ABS)	ABS is sometimes known as 'sleeping with your eyes open'. It is a state in which an individual's eyes are open but their EEG indicates brain waves characteristic of deep sleep. The individual is capable of performing basic tasks but is often unaware of what they are doing and is not alert to their environment.
Circadian Lows	Times when a person is biologically programmed for rest, rather than wakefulness. Circadian rhythms dip from 1 to 3 in the afternoon, and create a trough or extreme low, from 2 until 5 in the morning.
Circadian Rhythm	A neural pacemaker in the brain that monitors the day/night cycle (via a special light input pathway from the eyes) and determines our preference for sleeping at night. Shift work is problematic because it requires a shift in the sleep/wake pattern that is resisted by the circadian body clock which remains 'locked on' to the day/night cycle.
Fatigue	<b>Fatigue is a state of impairment.</b> It is a physiological state of reduced mental or physical performance capability resulting from sleep loss or extended wakefulness, circadian phase, or workload (mental and/or physical activity) that can impair a worker's alertness and ability to safely perform their duties.

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Fatigue Competency	Individuals aware of fatigue issues and able to understand how to use effective strategies to manage the risks. This can be increased through competency-based training programs designed to ensure that individuals are competent to understand and manage fatigue risks.
Fatigue Countermeasures	Organizational, individual and team based fatigue management strategies to reduce the effects of fatigue.
Fatigue Likelihood Assessment	A quantitative measure of the amount of sleep an individual is able to obtain. It is used to determine the likelihood an individual will experience fatigue symptoms or reduced levels of alertness.
Fatigue Risk	The potential for harm from an individual being impaired by fatigue. Risk of an incident is increased in likelihood and severity by fatigue.
Fatigue Risk Management	The management of fatigue in a manner appropriate to the level of risk exposure and the nature of the operation. Fatigue risks are managed in order to minimize the adverse effects of fatigue on the safety of operations.
Fatigue Risk Management Plan or Strategy (FRMP, FRMS)	A FRMP is an integrated set of management practices, beliefs and procedures for monitoring and managing the risks posed to health and safety by fatigue. It is based in safety management theory.
Fatigue Symptoms Checklist	A list of fatigue symptoms that can be used to assist in identifying when an individual might be experience fatigue.
Fit for Work	OGP defines "fitness for work "as the process of assuring that an individual can complete a task safely and without unacceptable risk to themselves, their employing company, or a third-party. Fit for work assesses an individual's physical and mental conditions and often evaluates fatigue, drug and/or alcohol impairment.

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Five Level Fatigue Trajectory	A model utilizing multiple layers of defense to manage the occurrence of fatigue-related incidents. It is the major practical or day-to-day aspect of a comprehensive FRMS and includes tools and controls for monitoring and managing fatigue-related risk. At each level there are opportunities to put in place control strategies to manage the fatigue related risk. For an incident to occur, each level must have failed in some part to allow the error to pass through.
Microsleeps	A short period of time (seconds) when the brain disengages from the environment (it stops processing visual information and sounds) and slips uncontrollably into light non-REM sleep. Microsleeps are a sign of extreme physiological sleepiness.
Modified Work Schedules	Alterations to typical eight hour workday schedules. Examples include a compressed work week and flexible hours of work.
Nap	A brief period of sleep, usually defined as less than half of a full night time sleep period. Naps as short as 5 minutes have been shown to provide (temporary) relief from the cumulative effects of sleep loss. Naps of 15 - 20 minutes or 1.5 - 2 hours are considered most effective.
Napping Strategies	Effective use of naps to assist in coping with fatigue during difficult work circumstances such as shift work, altering day/night schedules, emergency work, etc. Specific strategies can be effectively used depending on the situation.
Performance	The observable/behavioral manifestation of alertness and sleepiness, and the combination of one's efforts and the results of those efforts.
Prior Sleep	The amount of sleep obtained prior to a specific time (ex. the start or end of a shift).
Prior Wake	The amount of time spent awake prior to a specific period (usually assessed at the end of a shift).
Rotational Shiftwork	The term "rotational shiftwork" covers a wide variety of work schedules and implies that shifts rotate or change according to a set schedule. These

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	shifts can be either continuous, running 24 hours per day, 7 days per week, or semi-continuous, running 2 or 3 shifts per day with or without weekends. Workers take turns working on all shifts that are part of a particular system. (CCOHS)
Shift	The hours between the start and finish of established daily work schedules.
Shift Worker	A person who works rotating shifts, irregular shifts, evening/night shifts, afternoon shifts, morning shifts or split shifts. Another term for this work is 'non-traditional work hours.'
Short Change Shift	A day to night shift change that involves less than 24 hours between shifts. For example a worker would work an 8 hour day shift, have 8 hours off and start their night shift rotation that evening.
Sleep Apnea	Sleep apnea is a serious sleep disorder that occurs when a person's breathing is interrupted during sleep. People with untreated sleep apnea stop breathing repeatedly during their sleep, sometimes hundreds of times. When untreated, this sleep disorder can result in serious health and safety concerns. Studies say between 14 - 25% of adults are affected with some form of this sleep disorder.
Sleep Debt	Sleep loss accumulated when sleep is insufficient for multiple nights (or 24-hr days) in a row. As cumulative sleep debt builds up, performance impairment and objective sleepiness increase progressively, and people tend to become less reliable at assessing their own level of impairment.
Sleep Disorders	A range of problems that make it impossible to obtain restorative sleep, even when enough time is spent trying to sleep. More than 80 different sleep disorders that can cause varying amounts of sleep disruption have been identified. Examples include obstructive sleep apnea, the insomnias, narcolepsy, shift worker sleep disorder, and restless leg syndrome (periodic limb movements during sleep). Sleep apnea is a prevalent disorder that can often go undetected and cause considerable fatigue impairment and fatigue risk.
Sleep Science	The area of knowledge relating to research understandings of sleep. They include understanding sleep cycles, sleep's restorative qualities, quality and quantity influences on sleep, effects of sleep deprivation, strategies for managing sleep deprivation or debt (napping), and sleep disorders.
Split Shift	Synonymous with swing shift and rollover shift. A shift pattern in which a long period of days is followed by a long period of nights (or vice versa). A typical offsite split shift is a 14-day tour starting with day shifts of 12 hours for the first half of the tour then changing to night shifts for the second half.

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Subjective Fatigue	Self-reported levels of feelings of fatigue, assessed on a seven-point scale ranging from 'fully alert, wide awake', to 'completely exhausted, unable to function'.
Work Rotations/Cycles	The working period scheduled between any significant break away from work.

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**Appendix A: Roles and Responsibilities**

The following is an example of how roles and responsibilities could be determined (developed by In-Scope Solutions based on a FRMP developed for a Canadian mining operation).

Responsibility	Risk Factor	Initial Strategy	Assessed Through	Documentation Process	Control Actions Required
Management	Sleep opportunities for workers	Ensuring Adequate Sleep Opportunity through work scheduling	Rostering, scheduling, hours/types of shifts	Review of initial schedules, rosters, hours, etc and a new review conducted for any major changes	High risk factors in rostering, scheduling and shift lengths are recognized and mitigated through the many layers contained in this comprehensive FRMP
Management	Worker tasks creating fatigue factors.	Ensuring work task and environment is not creating fatigue risks	Review of work tasks and breaks scheduled for specific work tasks	Specific tasks (ex. mud drill, haul truck driver) require scheduled breaks that are taken and documented each shift.	Worker task risk factors are recognized and mitigated through the many layers contained in a comprehensive FRMP
Management	Proper nutrition, hydration or exercise for workers.	Ensuring camp conditions are adequate and reduce fatigue risks	Review of current camp conditions with regards to fatigue factors. Ensuring sleep hygiene is considered as new camp is built.	Appendix within FRMP and part of cyclical review.	Specific efforts are made to ensure proper nutrition through camp menus, hydration through access to fluids and exercise through the onsite gym and various recreational opportunities (ex. Hockey rink). Sleep hygiene factors are understood and all efforts are made to incorporate them at the camp. This includes, but is not limited to blinds in the rooms, quiet areas, controlled temperatures in the rooms, etc.

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**Appendix A: Roles and Responsibilities**

Management	Fatigue effects due to the influence of alcohol or drugs	Company has a strictly enforced zero tolerance for alcohol or drugs at the work site.	Standard Company procedures.	Part of regular SMS system	All incoming bags are checked for drugs. All workers are tested prior to employment commencing.
Management (Supervisors)	Workers being fit for work in relation to fatigue factors	Ensuring workers obtained adequate rest	Review of Fatigue Level Risk Assessments	Scores about 5 are recorded.	Follow agreed control strategies listed in FRMP
Management (Supervisors)	Ensuring workers are not affected adversely by fatigue factors	Observations for fatigue symptoms	Fatigue Symptoms Checklist	Document	Discuss concerns with worker. Follow agreed control strategies listed in Level 3
Management	Fatigue related error occurring - indicates system error in controls within FRMP	Follow up on all Fatigue Related Errors.	Based on worker self-reporting	No-loss incident reporting form	Take seriously and stop worker immediately! Discuss with worker. Alter work duties to not include any safety sensitive tasks or do not allow worker to continue until fit for work. Post incident follow up to discover where Levels 1 - 3 were ineffective.
Management	Fatigue related incident occurring	Investigate all Incidents	Based on incident	Incident Reporting Form, Incident Investigation Report including company's Fatigue Incident Investigation Information	If fatigue is in any way a causal factor, a thorough review to discover where controls in the FRMP were ineffective and improvements are required. A review of the FRMP may be required.
<b>Responsibility</b>	<b>Risk Factor</b>	<b>Initial Strategy</b>	<b>Assessed Through</b>	<b>Documentation Process</b>	<b>Control Actions Required</b>
Worker	Workers being fit for work in relation to fatigue factors	Obtaining adequate sleep during off hours and accurately reporting sleep obtained	Individual Fatigue Likelihood Assessment	On FLA	Follow agreed control strategies listed in FRMP.
Worker	Ability to mitigate fatigue risk factors at work	Self-reporting and monitoring of any fatigue symptoms or risk factors	Samn Perelli Scale	On FLA	Follow agreed control strategies listed in FRMP

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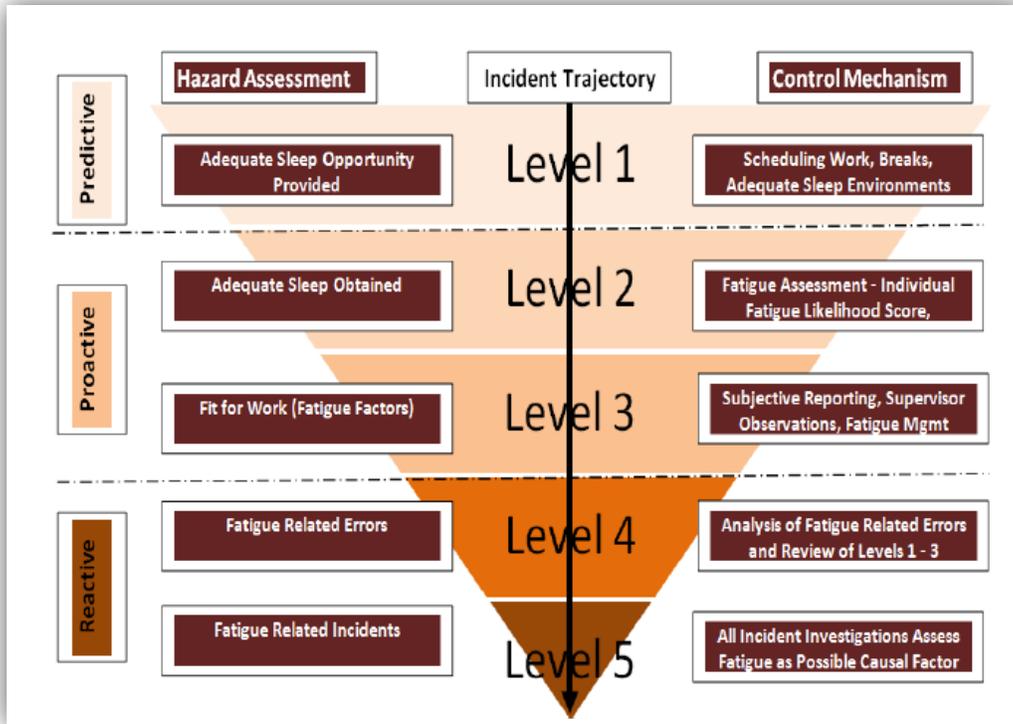
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**Appendix A: Roles and Responsibilities**

Worker	Ensuring coworkers are not affected adversely by fatigue factors	Observations for fatigue symptoms in co-workers	Fatigue Symptoms Checklist	Report concerns to co-worker and supervisor	Follow agreed control strategies listed in FRMP
Worker	Fatigue related error occurring - indicates system error in controls within FRMP	Report fatigue related errors	Self-assessed based on fatigue levels and actions.	No-loss incident reporting form	Stop Work! Discuss with supervisor. Alter work duties to not include any safety sensitive tasks or do not continue until fit for work.
Worker	Fatigue related incident occurring	Report all Incidents	Based on incident	Incident Reporting Form	All work is stopped after an incident. Work does not commence until a supervisor deems it safe to continue.

**Appendix B: Five Level Fatigue Risk Management Plan**

The multi-level FRMP is based on a five-level fatigue risk trajectory and focuses on multiple levels of countermeasures, designed to be used in combination to minimize the risks associated with fatigue. The plan recognizes that the hazard of fatigue exists within certain tasks within the organization. It creates multiple levels of controls along the pathway to prevent the hazard from becoming a loss.



*Image Source: In-Scope Solutions (Based on the concepts of a 5 level Fatigue Risk Management Strategy adapted from research conducted at The Centre for Sleep Research, University of Southern Australia)*

The five-level fatigue risk management model was first introduced by the Center for Sleep Research at the University of Southern Australia. It is based on the James Reason's model for introducing multiple levels of control to better mitigate risks. It introduces five levels of controls to mitigate fatigue risks as they pass along the trajectory of hazard to loss.

Using a multi-leveled and comprehensive risk management approach allows companies to identify high-risk situations, and then put countermeasures in place that can minimize the likelihood of an incident occurring.

This type of system relies on hazard identification, assessment and control measures within a comprehensive safety management system. The FRMP is designed to provide multiple opportunities to introduce countermeasures intended to minimize the possibility of a fatigue-related error occurring.

**Overview of the Plan**

Each level introduces a new type of control that designates responsibility for implementation. Each control is designed to address specific fatigue hazards.

The image to the right demonstrates the five-level fatigue risk trajectory. There is a hazard and five levels of controls designed to address the hazard and minimize loss. Consistent improvement of the controls is an integral part of the plan.

**Level 1 Controls – Corporate Responsibility:** Management ensures provision of adequate sleep opportunity through scheduling of work and appropriate work environments. Camp accommodations may also be included at this level.

**Level 2 Controls – Individual Responsibility:** Workers verify they are fit for duty through Fatigue Likelihood Assessment and self-reporting. If fatigue is indicated, agreed-upon controls are implemented.

**Level 3 Controls – Preconditions (Behavioral Observations and Monitoring):** Management and workers work as a team to ensure behavioral indicators of fatigue are identified and managed.

**Level 4 Controls – Continuous Improvement:** All stakeholders ensure the likelihood of fatigue errors becoming incidents are minimized – fatigue-proofing the system. This is done through hours of work audits and reviews, timely reviews of controls and fatigue error incident reporting (loss and no loss).

**Level 5 Controls – Continuous Improvement:** Management ensures fatigue-related incidents are prevented from re-occurring unnecessarily. This is done through fatigue-specific incident investigation and systematic review of the plan.

**Requirements**

**Levels 1-3** require education and training for workers and supervisors to understand the need for sleep, the causes and effects of fatigue, the signs of fatigue, and the safety and health hazards fatigue can create.

**Levels 2-5** require a culture that understands and accepts fatigue as a safety hazard, not a worker weakness. Workers understand the importance for self-reporting fatigue and fatigue risks, and supervisors must treat reported fatigue as a safety hazard, not a worker deficiency.

**Levels 4-5** requires a strong commitment from management to follow up on fatigue reports and examine any places in the system that are not properly mitigating fatigue-related risks. To be effective, the plan must be reviewed on a regular basis to ensure controls are working well.

*The following is an example of how these levels could be accommodated:*

Controls	Type	Main Focus
Level 1	Organizational	<i>Predictive:</i> Ensuring adequate sleep opportunity is provided
Level 2	Individual/Workers	<i>Proactive:</i> Workers self-reporting (Fatigue Likelihood Scores)
Level 3	Team	<i>Proactive:</i> Monitoring for fatigue signs
Level 4	All	<i>Reactive:</i> Fatigue proofing the system
Level 5	Organizational	<i>Reactive:</i> Incident investigation and system review

**Appendix C: Example of a Fatigue Risk Matrix**

**Table 4.2b: Defining Fatigue Risk Severity**

Fatigue Risk Severity		
Meaning		
Catastrophic	<ul style="list-style-type: none"> <li>• Multiple deaths</li> <li>• Equipment destroyed</li> </ul>	A
Hazardous	<ul style="list-style-type: none"> <li>• A large reduction in safety margins, physical distress or a workload such that crewmembers cannot be relied upon to perform their tasks accurately or completely</li> <li>• Serious injury</li> <li>• Major equipment damage</li> </ul>	B
Major	<ul style="list-style-type: none"> <li>• A significant reduction in safety margins, a reduction in the ability of crewmembers to cope with adverse operating conditions as a result of increase in workload, or as a result of conditions impairing their efficiency</li> <li>• Serious incident</li> <li>• Injury to persons</li> </ul>	C
Minor	<ul style="list-style-type: none"> <li>• Nuisance</li> <li>• Operating limitations</li> <li>• Use of emergency procedures</li> <li>• Minor incident</li> </ul>	D
Negligible	<ul style="list-style-type: none"> <li>• No significant consequences</li> </ul>	E

**Table 4.2C: Fatigue Risk Assessment Matrix**

Fatigue Risk						
Risk Probability		Risk Severity				
		Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent	5	5A	5B	5C	5D	5E
Occasional	4	4A	4B	4C	4D	4E
Remote	3	3A	3B	3C	3D	3E
Improbable	2	2A	2B	2C	2D	2E
Extremely Improbable	1	1A	1B	1C	1D	1E

*Image source: Fatigue Risk Management Systems - Implementation Guide for Operators. IFALPA IATA ICAO 2011.*

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## Appendix D: Fatigue Risks and Control Options

Hazard Identification		Risk Assessment			Risk Control
		Lower Risk	Moderate Risk	Higher Risk	
<b>MENTAL &amp; PHYSICAL DEMANDS OF WORK</b>					
<p>These include, for example:</p> <ol style="list-style-type: none"> <li>1. Repetitive or monotonous work</li> <li>2. Sustained physical or mental effort</li> <li>3. Sustained and/or complex physical or mental tasks</li> </ol>		<p>1. Varying tasks demand</p> <p>2. Minimal physically demanding work</p> <p>3. Minimal periods of high concentration and/or mentally demanding work</p>	<p>Highly repetitive work and/or high concentration work, with high demands over an extended period of time</p> <p>It is physically demanding work that results in muscle fatigue</p> <p>Long periods of high concentration and/or mentally demanding work</p>	<p>Options</p> <ul style="list-style-type: none"> <li>&gt; Re-design jobs to eliminate boring, repetitive tasks</li> <li>&gt; Improve communication</li> <li>&gt; Provide training to allow multi-skilling and effective job rotation</li> <li>&gt; Use alarms and monitors, particularly for solo work (eg driving vehicles)</li> <li>&gt; Use plant, machinery and equipment to eliminate or reduce the excessive physical demands of the job</li> <li>&gt; Reduce the amount of time employees/workers need to spend performing sustained physically and mentally demanding work</li> <li>&gt; Ensure there are adequate employees/workers and other resources to do the job without placing excessive demands on staff</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Roster enough employees/workers during peak times and demands</li> <li>&gt; Ensure adequate breaks during shifts to allow recovery</li> <li>&gt; Allow supervisors and employees/workers to reschedule tasks if fatigue becomes a problem</li> <li>&gt; Ensure work demands gradually increase towards the middle of the shift and decrease towards the end</li> <li>&gt; Eliminate sources of risks that might exacerbate fatigue (eg lack of job control, manual handling, extremes of temperature)</li> <li>&gt; Improve communication processes</li> <li>&gt; Improve the duration and timing of work</li> <li>&gt; Ensure safe and efficient shift hand-over</li> </ul>
<b>WORK SCHEDULING &amp; PLANNING - NIGHT WORK</b>					
<ol style="list-style-type: none"> <li>1. Shift end (for those working eight hours or more between 10:00pm and 6:00am)</li> <li>2. Length of shift</li> <li>3. Sequential night shifts</li> <li>4. Period of non-work following a sequence of night shifts</li> <li>5. Breaks during work - frequency</li> <li>6. Breaks between work periods - recovery time</li> <li>7. Seasonal work arrangements - hours worked</li> </ol>		<p>1. After 10:00 pm</p> <p>2. 8 Hours</p> <p>3. 8 or more 8 hour shifts, 5 or more 10 hour shifts, 4 or more 12 hour shifts</p> <p>4. 48 Hours</p> <p>5. Adequate and regular breaks</p> <p>6. Adequate time for sleep, travel, meals, etc</p> <p>7. Regular hours over 12 months</p>	<p>After 10:00 pm</p> <p>Before 6:00 am</p> <p>10 Hours</p> <p>12 Hours</p> <p>Less than 48 hours</p> <p>Infrequent or no breaks</p> <p>Inadequate time for sleep, travel, meals, etc</p> <p>Long hours during peak season</p>	<p>Options</p> <p><b>Night shifts, including the number of consecutive night shifts</b></p> <ul style="list-style-type: none"> <li>&gt; Eliminate or limit night work where possible</li> <li>&gt; Eliminate the use of nightshifts for particular jobs or activities</li> <li>&gt; Schedule complex tasks for daytime</li> <li>&gt; Schedule work for hours when the risks may be lower - for example, complex and safety-critical tasks are best undertaken during normal day shifts when employees/workers are less likely to be fatigued, rather than during low body clock periods (ie don't schedule tasks between 2am and 6am and, to a lesser degree, between 2pm and 4pm)</li> <li>&gt; Avoid scheduling higher risk tasks on the first night of a task cycle, if unavoidable, when planning the task consider additional controls such as job rotation or additional rest breaks</li> <li>&gt; Minimize or redesign routine administrative tasks to ensure employees/workers can focus on core duties during their night work</li> <li>&gt; Allow for naps during night shifts</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Limit the number of consecutive night shifts worked - no more than four night shifts in a row</li> <li>&gt; Allow regular night employees/workers periods of normal nights' sleep to catch up on their sleep deficit</li> <li>&gt; Ensure that rosters allow for at least two full nights' sleep after the last night shift</li> <li>&gt; Arrange shifts so that day sleep is adequate</li> <li>&gt; Use a forward-rotation shift system (ie morning to afternoon, afternoon to night)</li> <li>&gt; Improve the order, speed, direction and length of rotation of the shift cycle</li> <li>&gt; Except for emergencies, give at least 24 hours notice before night work. Consider providing a longer period of notice so that employees/workers have time to adjust their activities</li> </ul>
<b>WORK SCHEDULING &amp; PLANNING - SHIFT WORK</b>					
<ol style="list-style-type: none"> <li>1. Length of shift</li> <li>2. Time of shift</li> <li>3. Speed and direction of shift</li> <li>4. Split shifts/variable shifts</li> </ol>		<p>1. 10 Hours</p> <p>2. Day shifts</p> <p>3. Forward rotation (morning/afternoon/night)</p> <p>4. Backward rotation (evening/morning/afternoon)</p> <p>5. Slower rotation (weeks/24 weeks)</p> <p>6. 13 hour period</p>	<p>11 Hours</p> <p>Afternoon shifts</p> <p>Night shifts</p> <p>Backward rotation (evening/morning/afternoon)</p> <p>13 hour period</p>	<p>Options</p> <p>Hours of work in a single shift. This includes travel time, especially for remote sites</p> <ul style="list-style-type: none"> <li>&gt; Reduce working hours</li> <li>&gt; Increase resourcing</li> <li>&gt; Eliminate the use of extended hours for particular jobs or activities</li> <li>&gt; Control the length of shifts</li> <li>&gt; Limit the use of overtime, especially unscheduled overtime</li> <li>&gt; Monitor hours of work</li> <li>&gt; Provide alternative transport at end of overtime/long shift</li> </ul>	
<b>WORK SCHEDULING &amp; PLANNING - HOURS</b>					
<ol style="list-style-type: none"> <li>1. Average weekly hours</li> <li>2. Total hours over a three-month period</li> <li>3. Daily work hours</li> <li>4. Daily work hours and work-related travel</li> <li>5. Scheduling of work</li> </ol>		<p>1. 35-40 Hours (working weeks)</p> <p>2. 48 Hours (working weeks)</p> <p>3. 56 Hours (working weeks)</p> <p>4. 624 working hours</p> <p>5. 9 working hours</p> <p>6. 12 working hours</p> <p>7. 18 working hours</p> <p>8. 13 working hours</p> <p>9. Regular and predictable hours</p>	<p>48 Hours (working weeks)</p> <p>56 Hours (working weeks)</p> <p>624 working hours</p> <p>12 working hours</p> <p>13 working hours</p> <p>18 working hours</p> <p>13 working hours</p> <p>Irregular and unpredictable hours, where employees/workers are often on call across shift cycle</p>	<p>Options</p> <p>Hours of work across a shift cycle</p> <ul style="list-style-type: none"> <li>&gt; Develop a working-hours policy on daily work hours, maximum average weekly hours, total hours over a three-month period and work-related travel</li> <li>&gt; Reduce working hours</li> <li>&gt; Reduce the number of consecutive day shifts that can be worked</li> <li>&gt; Eliminate or reduce the need to work long shifts for more than four consecutive days</li> <li>&gt; Allocate shift employees/workers consecutive days off, including some weekends, depending upon their fatigue risk level</li> <li>&gt; Avoid working arrangements that provide incentives to work excessive hours</li> <li>&gt; Control overtime, shift swapping and on-call duties</li> <li>&gt; Offer alternatives to employees/workers who may have difficulties adjusting to working hours</li> <li>&gt; On call duties <ul style="list-style-type: none"> <li>&gt; Limit use of standby and on-call duties</li> <li>&gt; Ensure that exchange of shifts does not result in excessive hours</li> <li>&gt; Ensure that responding to emergencies does not result in excessive hours</li> </ul> </li> <li>&gt; Breaks between work shifts <ul style="list-style-type: none"> <li>&gt; Increase the length of breaks between shifts</li> <li>&gt; Allow for recovery between work periods</li> <li>&gt; Defer non-urgent work to allow appropriate rest and recuperation for employees/workers</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>&gt; Provide rest days (opportunity for two consecutive night sleeps)</li> <li>&gt; Improve the timing of shifts</li> <li>&gt; Allow for family and social commitments between shifts and shift cycles</li> <li>&gt; Make sure that there is enough time in a break for six hours uninterrupted sleep</li> <li>&gt; Breaks within work shifts</li> <li>&gt; Provide more and/or longer breaks to allow for recovery within work periods</li> <li>&gt; Provide adequate resources to cover breaks</li> <li>&gt; Ensure adequate number and location of cabs and toilet facilities</li> <li>&gt; Reduce the use of split shifts</li> <li>&gt; Where split shifts are used, arrange timing so sleep of employees/workers is not disrupted due to the times they are required to work</li> <li>&gt; Don't start or finish between 10pm and 6am</li> <li>&gt; Ensure time for adequate communication at shift handovers</li> <li>&gt; Match shift times to the availability of public transport</li> <li>&gt; Changes to rosters</li> <li>&gt; Set shift rosters ahead of time and avoid sudden changes of shifts to allow employees/workers to plan leisure time</li> <li>&gt; Reduce irregular and unpredictable work schedules</li> </ul>
<b>EXCESSIVE COMMUTING TIMES NECESSARY</b>					
		<p>Minimal commuting time</p> <p>Long commuting time</p>		<p>Options</p> <ul style="list-style-type: none"> <li>&gt; Start work at long distance commute sites on the day after arrival and start travel home on the day after the shift cycle is finished</li> <li>&gt; Assist with travel arrangements, eg provide transport</li> <li>&gt; Reduce active working time to account for long commuting time or distance</li> </ul>	
<b>WORK ENVIRONMENT CONDITIONS</b>					
<ol style="list-style-type: none"> <li>1. Exposure to hazardous substances and atmospheric contaminants</li> <li>2. Exposure to noise</li> <li>3. Exposure to extreme temperatures</li> <li>4. Exposure to vibration</li> <li>5. Effect of exposure during extended shifts</li> </ol>		<p>1. For hazardous substances, low risk calculated using national exposure</p> <p>2. Low risk calculated according to formulae in AS/NZS 1269.1</p> <p>3. Minimal exposure</p> <p>4. Minimal exposure</p> <p>5. Minimal exposure</p>	<p>For hazardous substances, high risk calculated using national exposure</p> <p>High risk calculated according to formulae in AS/NZS 1269.1</p> <p>Long period exposure</p> <p>Long period exposure</p> <p>High exposure</p>	<p>Options</p> <p>Hours of work across a shift cycle</p> <p>Stress</p> <ul style="list-style-type: none"> <li>&gt; Improve job control and the other risk factors associated with stress</li> <li>&gt; Ensure opportunities to clarify stress-related issues</li> </ul> <p>Physical conditions</p> <ul style="list-style-type: none"> <li>&gt; Avoid working during periods of extreme temperature</li> <li>&gt; Control exposure to hazardous substances and environments</li> <li>&gt; Provide effective protective clothing and equipment, allowing for different shifts.</li> <li>&gt; Use heating and cooling to control ambient temperatures to support alertness</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Provide adequate facilities for rest, sleep, meal breaks, and/or accommodation (if appropriate) and other essential requirements, such as bathroom facilities</li> <li>&gt; Install adjustable, vibration-free seats in appropriate machinery and vehicles</li> <li>&gt; Ensure the workplace and surroundings are well lit, safe and secure</li> <li>&gt; Employees/workers who perform repetitive manual tasks should have regular rest breaks</li> <li>&gt; Ensure exposures are carefully monitored and exposure levels adjusted. For example, exposure during a 10-hour shift may not equate to 1.25 times the exposure experienced during an eight-hour shift</li> </ul>
<b>INDIVIDUAL &amp; NON-WORK FACTORS</b>					
<ol style="list-style-type: none"> <li>1. Sleep (amount and quality)</li> <li>2. Health</li> <li>3. Fitness for work</li> <li>4. Lifestyle factors</li> </ol>		<p>1. Night sleep</p> <p>2. 8 hours night sleep (in 24 hours)</p> <p>3. Poor alert</p> <p>4. Recent illness/injury</p> <p>5. Sleep disorders</p> <p>6. Influence of alcohol, drugs or amount of sleep</p> <p>7. Activities/responsibilities that limit amount of sleep, or extend job or long commute</p>	<p>Duty sleep</p> <p>8 hours night sleep (in 24 hours)</p> <p>Poor alert</p> <p>Recent illness/injury</p> <p>Sleep disorders</p> <p>Influence of alcohol, drugs or amount of sleep</p> <p>Activities/responsibilities that limit amount of sleep, or extend job or long commute</p>	<p>Options</p> <ul style="list-style-type: none"> <li>&gt; Maintain vigilance in identifying non-work related factors</li> <li>&gt; Subsidize modifications to private homes to improve sleeping conditions (eg air conditioning)</li> <li>&gt; Provide information and education about how non-work related factors can increase the risks of fatigue</li> <li>&gt; Provide a mechanism to encourage employees/workers to report non-work factors that might affect fatigue management</li> </ul>	

INDUSTRY & INVESTMENT NSW website: [www.dps.nsw.gov.au/minerals/safety/world-leading-ohs](http://www.dps.nsw.gov.au/minerals/safety/world-leading-ohs)  
 This chart is based on appendix 2 of the joint worksafe vic/nsw workcover report *fatigue prevention in the workplace*, 2008. [http://www.worksafe.vic.gov.au/wps/wcm/resources/files/eb87f08b727473/vwa\\_fatigue\\_handbook.pdf](http://www.worksafe.vic.gov.au/wps/wcm/resources/files/eb87f08b727473/vwa_fatigue_handbook.pdf)

## Appendix E: Additional Shift Scheduling Information

(source CCOHS - <http://www.ccohs.ca/oshanswers/ergonomics/shiftwrk.html>)

### Additional Scheduling Considerations

- Provide time off at "socially advantageous" times like weekends whenever possible.
- Start a special shift system if production demands result in extended periods of overtime work
- Inform shift workers of their work schedules well ahead of time so they and their families and friends can plan activities. Allow as much flexibility as possible for shift changes. Keep schedules as simple and predictable as possible.

**Facilities:** The provision of certain facilities can help the shift worker cope better.

- Give attention to the work environment. For example, good lighting and ventilation are important on all shifts. Do not widely separate workstations so that workers at night can remain in contact with one another.
- Provide rest facilities where possible. Whenever a person must remain at work after a night shift to attend a meeting or a training session, providing rest facilities is advisable. When a night worker is "on call" and must remain in the building, it is advantageous for this person to be well rested rather than tired and bored.
- Provide healthy cafeteria services so a balanced diet can be maintained. The nutritional needs differ between day shifts and other shifts because of circadian rhythms. Provide educational and awareness materials on the benefits of eating a balanced meal.
- Consider offering facilities for social activities with the needs of the shift worker in mind. Recreational opportunities are often minimal for workers on "non-day/night" shifts.
- Consider access to quality day-care for shift workers' children. Some strain on all family members would be alleviated.

**Education:** Educate employees on the potential health and safety effects of rotational shift work and what can be done to stop these effects. In particular, education in stress recognition and reduction techniques is helpful.

### Guidelines for Scheduling Sustained Emergency Response Plans

#### Recommendations for 24-Hour Emergency Coverage

Source: *American Journal of Public Health, 2007*

- Avoid the impulse to have key individuals available on a 24-hour basis during the early phases of response.
- Create separate rotation rosters for executive decision makers and shift-watch personnel.
- Delegate authority to the greatest extent possible to conserve executive resources.
- If the size of personnel pool allows, use clockwise rotation: 3 day shifts, 3 evening shifts, 3 night shifts, and 3 recuperative days off
- 8-hour shifts are preferable to 12-hour shifts
- If the size of personnel pool is too limited to allow the rotation pattern above, individuals should remain on dedicated shifts, up to a maximum of 10 consecutive shifts followed by 3 recuperative days; the number of recuperative days can be lowered for fewer consecutive shifts.

## **Work Schedule Guidelines**

Adapted from: Fatigue Management for the Australian Aviation Industry, May 2011

### **Circadian Cycle**

- When possible, avoid or reduce schedules that are not tied to the 24-hour circadian cycle.
- If unable to avoid night shift scheduling, recognize and control fatigue risks.
- When possible, program short naps just prior to or during night shifts.
- Schedule high risk and safety-sensitive tasks by circadian cycles
- Do not begin morning shifts before 0700 hours to avoid beginning work during the circadian trough and to maximize REM sleep.

### **Work Schedules**

- When possible, schedule the main rest period for the same time each 24-hour period.
- Attempt to allow at least a week on each shift before a rotation; however, individuals who appear "night shift intolerant" are best given only one or two consecutive night shifts.
- Longer rotation periods are best for optimum performance. Avoid daily or continuously rotating schedules (there is conflicting evidence on this point).
- During periods of critical work demands, attempt to provide a ten-hour rest/non-work period each 24-hour period (this generally allows for a six- to eight-hour period for sleeping – depending on commute times and other obligations).
- Forward or clockwise shift rotation (morning - afternoon - night) is favoured as it allows longer rest intervals and parallels the body's natural tendency to extend past a 24-hour cycle.
- Limit consecutive 12-hour workdays to maximum 7 and limit night shifts to maximum 4. Note that there is a progressive decline in performance over several consecutive night shifts.<sup>2</sup>
- Allow a minimum 48 hours off work when switching from nights to days.

### **Shift**

- Encourage workers to take regular breaks during shifts, especially night shifts, and allow flexibility and worker choice as to when breaks are taken.
- Shifts longer than 8 hours increase the risk of an incident by 12-28%. Shifts longer than 12 hours create a significantly higher fatigue risk if napping cannot occur during shift.
- Shift length should be determined by the physical and mental characteristics of likely duties. Hours should be reduced for highly complex and demanding tasks.

Scheduling should try to accommodate work demands with worker needs. Any time work demands create shifts outside of natural circadian rhythms, fatigue risks increase.

## Appendix F: Fatigue Assessment Tools

### Subjective Measures

The following is examples of other subjective measures of fatigue.

- 1) Samn-Perelli Fatigue Checklist
- 2) Visual Analogue Scales
- 3) The Karolinska Sleepiness Scale
- 4) Behavioral Monitoring Fatigue Checklist

### Samn-Perelli Fatigue Checklist

The Samn-Perelli Fatigue Checklist can be used throughout a shift and could be triggered by the following:

- Start of shift (routine assessment)
- Start of night shift
- Following a nap
- If shift is to be extended
- For a call-in overnight shift
- If Level 2 assessment places the person in yellow or red zones
- Co-worker or supervisor notes symptoms
- Individual experiences symptoms
- Error committed or noticed
- Incident

Samn-Perelli is a subjective scale. It seeks to quantify subjective feelings of fatigue to enable them to be consistently controlled. It has the advantage of being quick and easy to administer, but it is relatively easy to provide inaccurate information and it may lack validity in that it will not always reliably reflect objective performance measures.

Here is the checklist and sample controls based on the score (image designed by In-Scope based on research taken from)

### Samn-Perelli Fatigue Checklist

Samn-Perelli Fatigue Checklist	
1	Fully alert
2	Very lively
3	Okay
4	A little tired
5	Moderately tired
6	Extremely tired
7	Completely exhausted

Samn-Perelli Fatigue Checklist Controls Based on Score	
1 to 2	Proceed with work, monitor if symptoms appear
3 to 5	Direct supervisor monitoring required, alter work duties if needed
6 to 7	Stop work, have worker rest before beginning shift

Samn-Perelli Scale can also be linked to specific controls based on an organizational decision tree. The following is one example of this:

Specific scores on the checklist can be used as thresholds to trigger a set of fatigue risk controls, as per the example following:

**Example 3.1: Fatigue checklist**

Samn-Perelli fatigue checklist	Risk level	Controls
1-3	Low	No specific controls necessary. Except in the presence of higher level indicators of fatigue (ie. symptoms, errors or incidents).
4-5	Moderate	Initiate moderate fatigue risk mitigation actions <ul style="list-style-type: none"> <li>• Level 2 and 3 assessment</li> <li>• Individual controls.</li> </ul>
6	High	Initiate high fatigue risk mitigation actions <ul style="list-style-type: none"> <li>• Document with unit director and/or EDMS</li> <li>• Level 2 and 3 assessment</li> <li>• Individual controls</li> <li>• Team-based controls</li> <li>• Support napping and safe-home policies.</li> </ul>
7	Very high	<b>Intolerable risk. No individual rostered beyond this threshold. Any proposed exceptions to be escalated to the district management for approval.</b>

Source: Fatigue Risk Management Resource Pack, Queensland Health, Australia (2009).

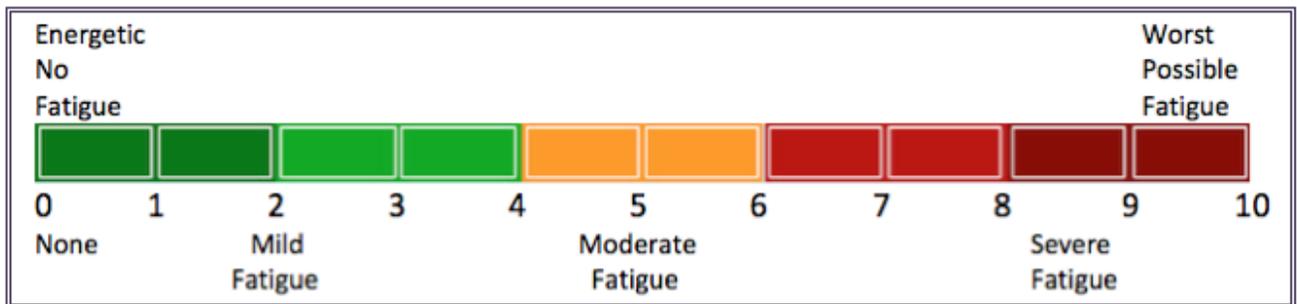
### Visual Analog Scales

Sometimes called linear analogue scales, these scales involve a short (typically 10 cm) line with various labels applied. The worker marks his/her fatigue in relation to the scale.

Visual analog scales are frequently used when managing fatigue with regards to health issues and diseases such as cancer.

The advantage of these scales is their simplicity, but key disadvantages are the lack of definition of various points along the line and the inability to compare results to objective measures.

#### Sample 1



#### Sample 2



### Karolinska Sleepiness Scale (KSS)

The Karolinska Sleepiness Scale was developed by the Karolinska Institute. It is similar to the Samn-Perelli in that it is designed to quantify subjective feelings of fatigue.

#### KSS

- 1 = Extremely alert
- 2 = Very alert
- 3 = Alert
- 4 = Rather alert
- 5 = Neither alert nor sleepy
- 6 = Some signs of sleepiness
- 7 = Sleepy, but no effort to keep awake
- 8 = Sleepy, some effort to keep awake
- 9 = Very sleepy, great effort to keep awake
- 10 = Extremely sleepy, falls asleep all the time

The advantage of this scale is that there is some research linking it to EEG readings and performance impairment. The scale is also fairly simple to use. The disadvantages are again the fact that it is subjective, it is fairly easy to alter and may lack validity. It may not always reliably reflect objective performance measures.

**Behavioural Monitoring**

Behavioral monitoring involves identifying fatigue symptoms to assist with monitoring for fatigue impairment. Supervisors can use this list to assist in monitoring for signs of fatigue in workers during shifts. Workers should also be taught to monitor themselves and each other for signs of fatigue.

Anyone exhibiting signs should be approached and questioned regarding Fatigue Likelihood Scores and feelings of fatigue. A mitigation strategy should be worked out with the individual.

\*Remember, those who are fatigued often underestimate the level of their fatigue and are less able to make effective decisions. Err on the side of caution when implementing controls.

Common Symptoms of Fatigue Checklist					
Physical	Observed	Mental	Observed	Emotional	Observed
Yawning		Difficulty concentrating		Quiet	
Slow blinking		Lapses in attention		Withdrawn	
Rubbing eyes or face		Memory lapses		Lethargic	
Aching muscles or headache		Difficulty communicating		Lacking motivation	
Uncoordinated movements		Lack of situational awareness		Bored or disinterested	
Sagging body posture		Making mistakes		Irritable	
Slower movements		Reduced ability to process information		Impulsive	
Weak and low energy		Confusion		Easily frustrated	

This tool is useful in identifying situations where fatigue could be an issue. This may occur when the worker’s fatigue likelihood assessment score was high or when the individual did not previously identify high fatigue. This tool is very useful in building awareness of fatigue and its symptoms

## **Objective Measures**

### **Psychomotor Vigilance Tests - PVTs**

Psychomotor Vigilance Tasks involve a task that requires sustained attention. It measures the subject's responses to a visual stimulus. The test runs for 3 to 10 minutes and is typically recorded on an electronic device of some sort. The device then uses the number of missed responses to calculate the individual's likely fatigue levels.

A typical PVT involves subjects pushing a button as soon as a light appears on the screen. Fatigue assessment is based not on the reaction time but on how many times the individual fails to push the button. The measure is sustained attention and the output is a numerical measurement of sleepiness calculated by counting the number of lapses in attention by the test subject.

"The Psychomotor Vigilance Self Test on the International Space Station (Reaction Self Test) provides the crewmembers with feedback on neurobehavioral changes in vigilant attention, state stability, and impulsivity. It aids crewmembers to objectively identify when their performance capability is degraded by various fatigue-related conditions."<sup>1</sup> PVT has also been used successfully in the aviation industry.

The advantages of these tests are the relatively short duration needed to administer them, the minimal amount of training required to teach individuals to use the test, and the fact that the devices can be portable and carried out in multiple environments. The biggest advantage of these types of tests are the fact that they are objective, very difficult to alter input data, and that the results have been validated against objective performance measures in a number of studies. The disadvantages are the equipment that is required and that workers must have 3 to 10 minutes to complete the assessment without interruption.

### **Circadian Rhythms Biological Indicators**

Although there are a number of biological indicators that will signify circadian rhythms and fatigue, methods of analysis are not yet consistent to make them practical in occupational settings to determine fatigue levels.

Biological indicators that have been studied are melatonin levels, melatonin offset, core body temperature, and the plasma level of cortisol. These can be measured through internal temperature readings, blood, urine, or saliva, but there is not currently enough research to validate these measures in terms of fatigue levels and objective performance impairment.

Obtaining these measures is also not usually practical in an occupational setting. There may, in the future, be an objective biological marker test for fatigue, but this is not currently a valid option.

## **Actigraphs**

Actigraphs are small devices, typically worn on the wrist or waist that measure an individual's rest/activity cycles in a non-invasive way. The data is later uploaded to a computer and analyzed.

The advantage of using an actigraph to monitor sleep/wake patterns is that it is objective and difficult to alter the input data. The disadvantage is that it is a significant initial investment, and requires technology support and time to upload and analyze the data.

Actigraphs are not frequently used as part of a fatigue management plan, but they have been used in studies within the rail system to assist engineers in improving individual sleep habits, in monitoring and reporting fatigue levels, or determining best schedules.

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**Appendix G: Sample Industry Best Practices**

The following Sample Best Practices are sourced from *Improving Alertness Through Effective Fatigue Management, Energy Institute 2006*.

IMPROVING ALERTNESS THROUGH EFFECTIVE FATIGUE MANAGEMENT

Factor	Problem	Suggested Solution	Comments
<b>Scheduling</b>			
Length of work period	Shifts are too long. Several long shifts are worked on consecutive days.	Reduce hours as necessary/possible. Where not possible, continue to monitor for adverse effects and schedule safety critical work for safest period of shifts.	Some organizations cannot avoid working 12-hour shifts. Long shifts are popular with many people as they result in compressed week/longer periods off. The WTR limits working to 48 hours on average per week averaged over 17 weeks (there are exceptions e.g. averaged over 26 or 52 weeks for offshore installation. In some workplaces, the workforce can opt out and work longer hours.
Rest breaks within shifts	Rest breaks are too short or do not allow the opportunity for resting.	Arrangements are usually determined by collective agreement. Workforce breaks should be monitored.	Adequate rest and meal breaks should be taken away from the work station and in an appropriate place conducive to proper rest/relaxation. Consider allowing "napping" during long or particularly fatiguing shifts. A quiet comfortable rest area will be required and napping supported by co-workers and management. Beware of period immediately following napping - the operator will need time to recover - deploy on non-safety critical tasks for that period.
Shift patterns	Operators work a backward-rotating shift or shifts are forward rotating but on a slow rotation.	Change shift patterns to rapid forward rotating shifts; avoid backward rotation and slow rotations, also avoid swing shifts if possible, avoid permanent night shifts if possible.	Breaks between shifts should allow the opportunity for an eight-hour sleep period. Where the workforce sleeps at work (e.g. offshore, truck drivers) provide suitable sleeping accommodations (quiet, dark, comfortable), encourage those sharing accommodations to be considerate to others. Typically, shared cabins will be arranged to accommodate one night and one-day worker offshore. Only one person occupies the cabin at a time.
Shift breaks/holidays	Operators failing to recover from shift by "moonlighting" or otherwise taking inadequate rest.	Adopt policies for ensuring adequate rest is taken; include 'sleep contracts' or other contractual obligations with appropriate sanctions.	Workforce returning after a between-shift break, sickness absence or a holiday need time to return to full efficiency and alertness. Consider scheduling duties to avoid safety critical work or increase supervision during this period.

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<b>Factor</b>	<b>Problem</b>	<b>Suggested Solution</b>	<b>Comments</b>
Standby support/call out	Staffing levels and shift rostering is inadequate for providing cover in unusual circumstances.	Develop contingency plans to postpone safety critical tasks, review staffing arrangements, ensure that 'standby' personnel are on-call and fit for duty to step in as required.	Resources that make up the IP Staffing arrangements toolbox can be used to assess whether staffing arrangements are adequate; this includes a specific element on alertness and fatigue. It may be possible to roster an additional shift into the working arrangements to cover for training needs, sickness absence, peak demands, etc. and also to allow time out for training. This arrangement can also improve company communications as time is then available for discussion, briefings, etc.
Scheduling of safety critical tasks (circadian)	Safety critical tasks are performed at circadian (or other) 'low points' during the shift.	Either reschedule the tasks or provide support to the task performer (supervision or a co-worker to assist/check). Identify workers who are more suited to night working (owls) day working (larks) and assign duties if possible based on type. Otherwise, be aware that a 'lark' may be working as an 'owl' and provide support/supervision and education.	Accident rates are generally higher within two to four hours of the start of a shift. Research has failed to establish a conclusive reason for this, but it should be noted that this is also a less suitable time for scheduling safety critical tasks. Alertness is low around the hours of 2 p.m. and 4 a.m.
<b>Job Environment</b>			
Working conditions	The working environment encourages sleep rather than alertness (warm, dark, comfortable, silent)	Control lighting, noise levels, temperature and comfort of the workplace. Educate workforce to stretch, walk around and alert others to the fact that they are feeling drowsy.	Ensure that staff has the opportunity for a break that takes them out of such a working environment if they feel drowsy. Caffeine is a short-term solution but more effective if accompanied by a nap. Bright lights will reduce the level of the sleep hormone melatonin in the body; bright light in the workplace (controlled to a level that will not cause glare/discomfort) or in break areas (if napping not used) may be effective in reducing sleepiness in the short term.
Work content	Work is unstimulating and uneventful	Rotate work to ensure that staff has a mix of interesting stimulating work interspersed with more routine tasks. Consider worker preferences and aptitudes for different types of work.	Consider multi-skilling of staff, flexible working and self-directed team initiatives to stimulate interest in and control over work content.

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Factor	Problem	Suggested Solution	Comments
<b>Staff Support</b>			
Consultation with and involvement of staff	Staff not involved in decisions that directly affect them can feel left out and fail to support solutions offered.	Consult and actively involve staff on fatigue and alertness matters; for example, collaborate on shift schedule and working arrangement design (work content) and on incident investigations and their follow up. <i>HSE Simple assessment tool for reviewing workforce involvement.</i> Appoint person to act as champion (train them - as part of general health and safety training)	Staff consultation is good for determining solutions that are practical and acceptable, for example, to eliminate the causes of certain fatigue-related incidents. It should be noted that shift schedules preferable from a social or economic viewpoint might not necessarily be the safest. Negotiation on such matters should be based on the best evidence available on the relative risks involved in different staff arrangements compared to the benefits for staff and employers. An external consultant may be required to advise.
Involvement of family, friends and others	Shift worker is not supported by family - shift worker requirements for a home environment conducive to their needs is not understood.	Involve family (and friends) in supporting shift workers. Provide educational leaflets and advice to family concerning sleeping arrangements and habits and also maintaining a social life outside of work. Expert advice or counseling may be required and may be coupled with general training and education on shift work.	Spouses/partners and other family members can help by maintaining a quiet home to ensure that the shift worker there is able to sleep when required. This will involve them eliminating noise they make and also any noise made by neighbors or visitors to the house (friends, meter readers, delivery staff, etc.). Family members should also help ensure that the shift worker adopts good sleeping habits and also good habits relating to diet, exercise and socializing, all of which can be affected by working evenings or nights.
Social interaction	Working shifts can disrupt social contact with friends and family - breaks may coincide with normal weekends only occasionally.	Shift arrangements should be as flexible as possible to allow time off and socializing; rapidly rotating shifts tend to allow more frequent time off to coincide with weekends. Allow shift workers to contact family and be contactable when working shifts or if working away from home.	There is little research on the issue of the social effects of shift work but much anecdotal evidence of problems with family and friends as a result of working shifts.
<b>Management Procedures</b>			
Monitoring following changes	Not knowing if the remedies are working	Monitor impact of changes	Need to decide on a 'measurement'. Self-reports from staff are useful but rely on staff being truthful about their state of fatigue.

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Factor	Problem	Suggested Solution	Comments
Fitness for duty testing	Staff report for duty without having sufficient rest beforehand or with medical/social problems that may affect alertness	Where staff is involved in hazardous work, conduct routine assessment of their fitness for duty. Educate workforce on the key issues including travel arrangements to and from work (early start if commuting long distance; driving to and from work). Consider sleep contracts with workforce members. Establish contingency plans to deal with unexpected short-term problems (e.g. cover for family sickness, etc.).	Methods for assessing fitness for duty include self-reporting and 'sign-on' discussion with supervisors. More formal methods may require the operator to sign a declaration of fitness including statements confirming that they are fit, well, rested, in a good state of mind and not taking any substances that may adversely affect alertness (e.g. alcohol, hay fever preparations, decongestions, travel sickness preparations, etc.). More intrusive medical surveillance measures may include blood or urine sampling although this would not be a routine practice.
Incident analysis	Fatigue as a contributor to or cause of incidents is overlooked or not investigated.	Raise awareness of fatigue as a possible factor in incident investigations. See incident analysis guidance (section 3.3).	Ensure that accident/incident investigation systems include some line of questioning relating to fatigue. Monitor time on job/sleep before accident or incident.
Risk assessment	Current risk assessments may not feature alertness as an issue.	See risk assessment guidance (section 3.2)	The guidance in this publication should support the risk assessment process by providing an overview and some detail concerning the factors that affect alertness.
Information input	Under-reporting of incidents	Establish a confidential reporting scheme to identify fatigue and alertness issues in the workplace.	Fatigue is an under-reported problem due to the stigma attached to being seen to be working while fatigued. Confidential reporting would be a means of gathering more information on the extent of the problem.
Sickness absence monitoring	Employee(s) take time off to recover from fatigue.	Patterns of sickness following long shifts or extended night work may indicate a fatigue problem.	Further monitoring, discussion and counseling of employees may be necessary.
<b>Education/Information</b>			
Developments in fatigue research	Low awareness of developments in alertness, fatigue and sleep issues	Maintain awareness of developments in these issues by, for example: - Subscribing to websites specializing in this field. - Establishing contact with academic institutions specializing in studies of alertness, fatigue or sleep. Sharing information across industry organizations.	New information is constantly being developed on fatigue, alertness and sleep; industry is generally seeking new solutions and approaches and legal requirements change or become more refined. Company health and safety departments or safety representatives might take on responsibility for this among other duties.
Knowledge of fatigue causes	Management and workforce are not familiar with fatigue issues.	Educate/advise/counsel all staff to ensure that they are aware of the primary causes and effects of fatigue.	HSE <i>Managing shift work</i> and this publication include references to many information sources on the subject.

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Factor	Problem	Suggested Solution	Comments
Additional Factors			
Exercise	Employees may be generally unfit and feel lethargic.	Educate in healthy lifestyle. Provide facilities for exercise.	Fitter personnel are better able to cope with the strains of shift working and tend to sleep more soundly.
Age differences	Older workforce is less able to cope with shift work. Younger drivers are more likely to have an accident.	Monitor older members of workforce, use self-reporting methods.	The circadian rhythms of people in their late 40's early 50's change and they tend to become more 'lark' than 'owl', this makes them less able to tolerate night working.
Diet/ stimulants/ depressants	Employees have a poor diet which may be either:  - Conducive to sleep when at work. - Disruptive to sleep when at home.	Provide guidance on:  - Suitable diets e.g. avoiding heavy lunches which can encourage sleepiness shortly after. - Effects of drugs to promote sleep or alertness. - Side effects of drugs used for other purposes that can affect alertness.	Caffeine may be used as a short-term solution; it can be used very effectively if coupled with a nap. It is recommended that the coffee be drunk before the nap (that is, before the caffeine takes effect). Certain medicines can cause drowsiness - raise awareness of the effects of prescription and non-prescription preparations, ensure that members of the workforce who are taking any medicines - prescribed or otherwise - consult the company occupational health department, medic or a pharmacist for advice; consult up to date list of possible sleep-inducing medicines (See <i>DIT Over-the-counter medicines and the potential for sleepiness</i> ); raise awareness of combinations of factors, for example, older people are more affected by alcohol. Some workers have obtained supplies of melatonin to encourage sleep but this is not a licensed medicinal product in the UK and there are a number of unknown side effects. Even in the US where it can be obtained, it is not well controlled and dosages can vary widely.

A sleep contract is a means of managing fatigue within a company's safety management system. Employers and employees formally document how they will: 1) identify and report fatigue risk; 2) respond to reports of fatigue problems, and 3) record, review and address reports of fatigue risk. Sleep contracts make it clear that employees and management are jointly responsible for fatigue risk management and state the responsibilities and accountabilities of each party. See *IP Research Report Viability of using sleep contracts as a control measure in fatigue management*.