GUIDELINE FOR THE COMPILATION OF A MANDATORY CODE OF PRACTICE FOR

RISK-BASED FATIGUE MANAGEMENT AT MINES



MINE HEALTH AND SAFETY INSPECTORATE

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DEPARTMENT OF MINERAL RESOURCES

MINE HEALTH AND SAFETY INSPECTORATE

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PART A: THE GUIDELINE

1. FOREWORD

1.1 **Fatigue** is more than simply feeling tired or drowsy. It is caused by prolonged periods of physical and/or mental exertion without enough time to rest and recover.

1.2 **Fatigue** is associated with multiple factors which among others include spending long periods of time awake and having an inadequate amount and/or quality of sleep over an extended period.

1.3 **Fatigue** can significantly affect an individual's capacity to function. Its side-effects include decreased performance and productivity, and increased potential for injuries to occur.

1.4 **Fatigue** management is a responsibility that must be shared between employer and employee – it involves factors that occur both in and outside of the workplace.

1.5 The aim of this Guideline is to provide a framework to assist the employer of every mine to prepare a risk-based Code of Practice (**COP**) on Fatigue Management.

2. LEGAL STATUS OF GUIDELINES AND CODES OF PRACTICE

In accordance with Section 9(2) of the **MHSA**, an employer must prepare and implement a **COP** on any matter affecting the health or safety of employees and other persons who may be directly affected by activities at the mines if the Chief Inspector of Mines requires it. These **COP**s must comply with any relevant guideline issued by the Chief Inspector of Mines (Section 9(3)). Failure by the employer to prepare or implement a **COP** in compliance with this guideline is a breach of the **MHSA**.

3. THE OBJECTIVES OF THE GUIDELINE

This guideline has been developed to assist employers in achieving the objectives of risk-based fatigue management at any working place, which are to assist mines to:

3.1 Develop strategies for controlling risks of **fatigue** effectively;

3.2 Develop site specific **fatigue** management plans and programmes; and

3.3 Look at factors to be considered when managing **fatigue**.

4. DEFINITIONS AND ACRONYMS (Arrange alphabetically)

"Bio-roster" means a biologically-compatible roster that takes into account the effects of circadian rhythms, sleep cycles and the additive effect of fatigue during the working week**.**

"Circadian rhythm" means the internal cycle of roughly 24 hours that regulates the physiological and behavioural activities of all living organisms – also referred to as "the body clock".

"COP" means Code of Practice;

"EAP" means Employee Assistance Programme;

"Fatigue" means reduced mental and physical functioning caused by sleep deprivation and/or being awake during normal sleep hours. This may result from extended work hours, insufficient opportunities for sleep, failure to use available sleep opportunities, or the effects of sleep disorders, medical conditions or pharmaceuticals which reduce sleep or increase sleepiness.

*"**FMC"*** means Fatigue Management Committee;

"FMP" means Fatigue Management Programme;

"MHSA" means Mine Health and Safety Act, 1996 (Act No. 29 of 1996), as amended;

"MHSC" means Mine Health and Safety Council;

"MQA" means Mining Qualifications Authority;

"Risk" means the likelihood that occupational injury or harm to persons will occur;

"*SAQA"* means South African Qualifications Authority;

"SETA" means a Sectoral Education and Training Authority established under the Skills Development Act No. 97 of 1998;

"Shift work" means an organisation of work where workers succeed each other at the same workplace while performing similar operations at different times of the day thus allowing longer hours of operation than feasible for a single worker;

"Supervisor" means any individual having authority, in the interest of the employer and is responsible for the day-to-day performance of a group of employees;

"Work schedule" means the hours to be worked for each day, shift, week, month or year, as scheduled by the employer.

5. SCOPE

This guideline:

5.1 Addresses areas of **fatigue** management as required at a mine;

5.2 Addresses areas of **fatigue** management from fatigue risk assessment to interventions that will be developed to mitigate the impact of **fatigue**; and

5.3 Covers all employees at a mine.

6. MEMBERS OF TASK COMMITTEE

This guideline was prepared by members of the **Fatigue Task Team**, which comprised of:

Ms. N. Masekoa	(State)
Dr. D. Mokoboto	(State)
Dr. L. Ndelu	(State)
Ms. M.A Hlapane	(State)
Ms. D Lekoba	(State)
Mr. P. Mira	(Labour)
Dr. C. Mbekeni	(Employers)
Dr. C Badenhorst	(Employers)
Ms. M Kunene	(MHSC Office)

PART B: AUTHOR`S GUIDE

The **COP** must, where possible, follow the sequence laid out in **Part C: "Format and content of the mandatory COP"**. The pages as well as the chapters and sections must be numbered to facilitate cross-reference. Wording must be unambiguous and concise.

IT SHOULD BE INDICATED IN THE COP AND ON EACH ANNEX TO THE COP WHETHER:

(a) The annex forms part of the guideline and must be complied with or incorporated in the **COP** or whether aspects thereof must be complied with or incorporated in the **COP**, or

(b) The annex is merely attached as information for consideration in the preparation of the **COP** (i.e. compliance is discretionary).

When annexes are used the numbering should be preceded by the letter allocated to that particular annex and the numbering should start at one again. (e.g. 1, 2, 3, A1, A2, A3,).

Whenever possible illustrations, tables, graphs and the like, should be used to avoid long descriptions and/or explanations.

When reference has been made in the text to publications or reports, references to these sources must be included in the text as footnotes or side notes as well as in a separate bibliography.

PART C: FORMAT AND CONTENT OF THE MANDATORY CODE OF PRACTICE.

1. TITLE PAGE

The title page must include the following:

1.1 Name of mine;

1.2 The heading: "**Mandatory Code of Practice for Risk-based Fatigue Management**;

1.3 A statement to the effect that the **COP** was drawn up in accordance with this guideline **DMR 16/3/2/4-B2** issued by the Chief Inspector of Mines;

1.4 The mine's reference number for the **COP**;

1.5 Effective date of the **COP**; and

1.6 Revision dates.

2. TABLE OF CONTENTS

The **COP** must have a comprehensive table of contents.

3. STATUS OF MANDATORY CODE OF PRACTICE

This section must contain statements to the effect that:

3.1 The mandatory **COP** was drawn up in accordance with Guideline **DMR 16/3/2/4-B2** issued by the Chief Inspector of Mines.

3.2 This is a mandatory **COP** in terms of Sections 9(2) and (3) of the **MHSA**.

3.3 The **COP** may be used in an incident/accident investigation/inquiry to ascertain compliance and also to establish whether the **COP** is effective and fit for purpose.

3.4 The **COP** supersedes all previous relevant **COPs**.

3.5 All managerial instructions or recommended procedures (voluntary **COPs**) and standards on the relevant topics must comply with the **COP** and must be reviewed to assure compliance.

4. MEMBERS OF DRAFTING COMMITTEE

4.1 In terms of Section 9(4) of the **MHSA** the employer must consult with the health and safety committee on the preparation, implementation or revision of any **COP**.

4.2 It is recommended that the employer should, after consultation with the employees in terms of the **MHSA**, appoint a committee responsible for the drafting of the **COP**.

4.3 The members of the drafting committee assisting the employer in drafting the **COP** should be listed giving their full names, designations, affiliations and experience. This committee should include competent persons sufficient in number to effectively draft the **COP**.

5. GENERAL INFORMATION

The general information relating to the mine must be stated in this paragraph.

The following minimum information must be provided:

5.1 A brief description of the mine and its location;

5.2 The commodities produced;

5.3 The mining methods/mineral excavation processes taking care to identify the potential situation and/or sources that could give rise to fatigue;

5.4 The unique features of the mine that have a bearing on the **COP** must be set out and cross referenced to the risk assessment conducted; and

5.5 Other relevant **COPs**.

6. TERMS, DEFINITIONS AND ACCRONYMS

Any word, phrase or term of which the meaning is not absolutely clear or which will have a specific meaning assigned to it in the **COP**, must be clearly defined. Existing and/or known definitions should be used as far as possible. The drafting committee should avoid jargon and abbreviations that are not in common use or that have not been defined. The definitions section should also include acronyms and technical terms used.

7. RISK MANAGEMENT

7.1 Section 11 of the **MHSA** requires the employer to identify hazards, assess the health and safety risks to which employees may be exposed while they are at work, record the significant hazards identified and **risk** assessed. The **COP** must address how the significant **risks** identified in the **risk** assessment process must be dealt with, having regard to the requirements of Sections 11(2) and (3) that, as far as reasonably practicable, attempts should first be made to eliminate the **risk**, thereafter to control the **risk** at source, thereafter to minimise the **risk** and thereafter, insofar as the **risk** remains, to provide personal protective equipment and to institute a program to monitor the **risk**.

7.2 To assist the employer with the hazard identification and **risk** assessment all possible relevant information such as accident, locality of mine, ergonomic studies, research reports, manufacturers' specifications, approvals, design criteria and performance figures for all relevant equipment should be obtained and/or considered.

7.3 In addition to the periodic review required by Section 11(4) of the **MHSA**, the **COP** should be reviewed and updated after every serious incident/accident involving the conveyor belt installation, or if significant changes are introduced to procedures, mining and ventilation layouts, mining methods, plant or equipment and material.

In addition to the periodic review required by Section 11(4) of the **MHSA**, the **COP** should be reviewed and updated after every altered circumstance or if significant changes are introduced to procedures, mining and ventilation layouts, mining methods, plant or equipment and material

8. ASPECTS TO BE ADDRESSED IN THE CODE OF PRACTICE

The **COP** must set out how significant risks identified and assessed in terms of the **risk** assessment process referred to in paragraph 7.1, will be addressed. The **COP** must cover at least the aspects set out below, unless there is no significant **risk** associated with that in relation to emergency at the mine**.**

8.1 Factors to be considered when addressing fatigue at mines

The **COP** should set a process for determining general considerations for **fatigue** management.

8.1.1 Causes of **fatigue**

Human fatigue is multifactorial and from a health and safety perspective, fatigue is most appropriately conceptualised as either work related or non-work related.

8.1.1.1 Work-related causes

Common workplace issues that can cause **fatigue** include:

- Work time arrangements;
- High physical workloads;
- Temperature extremes;
- Excessive noise;
- Work stress; and
- Poor ergonomic design of workstations and equipment.

8.1.1.2 Non-work-related causes

Non-work-related causes that are variable on an individual level include the following:

a) Undiagnosed medical conditions – many diseases and disorders can trigger **fatigue**, including:

- Sleep disorders, such as sleep apnoea or restless leg syndrome;
- Chronic **fatigue** syndrome;

- Tuberculosis;
- Chronic pain;
- Heart problems; and
- HIV.

b) Living conditions (housing and nutrition).
c) Alcohol and substance abuse.
d) Lack of exercise.
e) Certain medications.

It is the responsibility of employees to inform the employers of any health condition or medication they are on.

8.1.1.3 Total worker **fatigue**

The **fatigue** experienced by an individual is usually an accumulation of several of the above factors and can be expressed in the following equation:

$F_T = F_{SS} + F_{EW} + F_{PF}$

Where;

F_T	=	total **fatigue**
F_{SS}	=	**fatigue** caused by the shift system/work time arrangements
F_{EW}	=	**fatigue** caused by poor ergonomics, environmental and work factors
F_{PF}	=	**fatigue** caused by personal factors such as insufficient/poor sleep, health, nutrition and personal lifestyle.

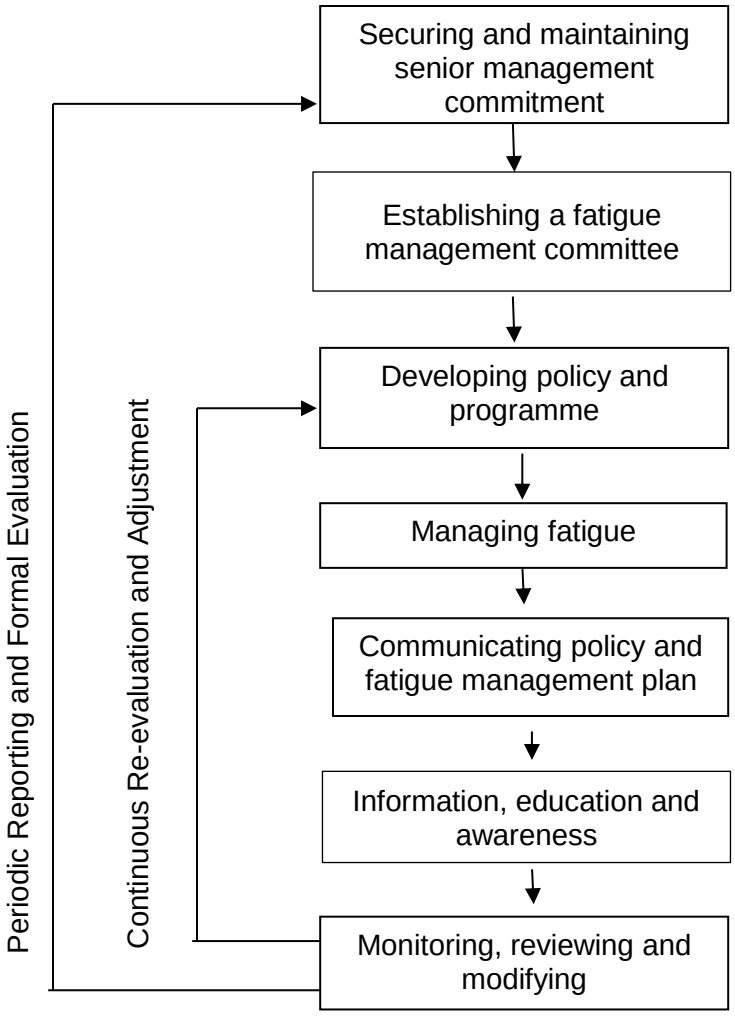
8.2. Development of a fatigue management plan

In general, the goal of a **fatigue** management plan is to maintain and, where possible, enhance safety, performance and productivity in operational settings, and manage the **risk** of **fatigue** in the workplace.

The recommended process of developing and maintaining a successful **fatigue** management plan consists of the following interrelated elements:

a) Securing and maintaining senior management commitment;
b) Establishing a **fatigue** management committee;
c) Developing policy and programme;
d) Managing **fatigue**;
e) Communicating policy and **fatigue** management plan;
f) Information, education and communication; and
g) Monitoring, reviewing and modifying.

Figure 1:
The **fatigue** management plan development process as a flow chart diagram



8.2.1 Management commitment and Stakeholder Buy-In

In order for a Fatigue Management Programme (**FMP**) to be effective, senior management must provide visible support, endorsement and allocate sufficient resources to establish, sustain, monitor and optimise the **FMP**.

8.2.1.1 Assign responsibility for the development of the **FMP**

Management should form a specific committee or assign responsibility to an existing high level Health and Safety Committee to establish and oversee the implementation the **FMP**. This should be a truly representative cross section of the mine's stakeholders; managers and union representatives (preferably health and safety representatives). Responsibilities, authority and accountability for managing **fatigue** within the **FMP** need to be defined. These roles and responsibilities include:

- Creating a statement of safety, performance, business goals and benefits the mine expects to achieve as a result of implementing the **FMP**;
- Identifying and listing of the internal and external resources, support and expertise the mine will require to implement, monitor and improve the **FMP;**
- Developing procedures for handling cases of employee **fatigue**;
- Initialising protocols and objectives to evaluate the FMP. This can include comparative pre- and post Key Performance Indicator (KPI) analysis and auditing of compliance; and
- Planning, implementing and executing all facets of the **FMP**.

8.2.2 Establish a **fatigue** management committee

Given the complexities involved in the design, implementation, monitoring and review of a **FMP** and the various different disciplines and department's involved~~,~~ close co-ordination and effective management are essential. The mine should establish a Fatigue Management Committee (**FMC**) at the mine to discuss and address the identified circumstances leading to **fatigue** and the control measures necessary. Action plans should be monitored at committee meetings.

The **FMC** should elect its own chairperson and scribe.

8.2.3 *Develop a policy (to be integrated into health policy)*

The **FMC** should develop the policy which should include:

a) Statement of goals and objectives;
b) Clear roles, responsibilities and accountabilities for managing **fatigue** in the workplace;
c) Documentation of the support and expertise available to the programme;

d) Policies regarding employee alertness and fatigue, including possible disciplinary action for failure to maintain satisfactory levels of alertness on the job; and
e) Plan for reporting and reviewing organisational progress toward **FMP** goals.

8.2.4 *Fatigue Risk Management*

In order for the mines to manage the risks of **fatigue** effectively and efficiently the following steps should be followed:

Step 1: Hazard identification;
Step 2: Risk assessment;
Step 3: Risk control;
Step 4: Monitoring and evaluation; and
Step 5: Documenting **FMP**.
(Refer to Annexure A – C)

8.2.4.1 *STEP 1: Hazard identification*

a) *Identify factors that contribute to **fatigue***

The first step when managing **fatigue** is to identify, and develop a list of all the factors that have the potential to contribute to **fatigue** within the workplace. Factors to consider are work time arrangements, type of work performed, work environment and non-work-related factors.

There are many ways of identifying workplace factors that contribute to **fatigue**. They include:

i. Inspecting workplace rosters;
ii. Consulting with workers (ask them if they regularly feel **fatigued** and about any problems they have encountered, any near misses or unreported injuries);
iii. Consulting with workplace health and safety representatives and committees;
iv. Conducting a health and safety audit; and
v. Analysing injury and incident reports (pay particular attention to injuries and incidents that occur in periods of high **fatigue**, i.e. the latter half of shifts and night work, particularly between 2:00 and 6:00).

b) *Identify the hazards of **fatigue***

i. Shift systems and rostering (See Annexure A);
ii. Ergonomics, environmental and work factors (See Annexure B);
iii. Personal factors (See Annexure C);
iv. **Fatigue risk** worksheets (see annexure D); and
v. Review accident or incident reports (See Annexure E).

8.2.4.2 *STEP 2: **Risk** assessment*

a) Assess the **risks** of **fatigue**

Managing **fatigue** involves assessing the **risks** associated with the workplace factors that contribute to **fatigue**. For each of the **risks**:

- Determine the likelihood of an incident occurring at the workplace, bearing in mind the existing control measures;
- Determine the consequences of an incident occurring at the workplace, bearing in mind the existing control measures; and
- Combine the estimates of the likelihood and consequences to rate the risk.

Site-specific information and evidence of **fatigue**-related incidents could be used to assist in the risk assessment process. In this context review:

- Incident reports;
- Self-reports and complaints from employees;
- Reports from supervisors about any evidence of **fatigue**;
- Aggregate data from any **EAP** (ensure that confidentiality is maintained when using such data); and
- Environmental and medical monitoring and other advice from those with technical expertise in the relevant disciplines.

From this information, determine the risk factors that need to be controlled and prioritise actions.

8.2.4.3 STEP 3: ***Risk** Control*

Implement **risk** control measures

Control mechanisms should be put in place to manage the factors (identified through the risk assessment process) contributing to **fatigue** and to reduce the risks from employee **fatigue**.

The controls should address the sources of **fatigue** in the workplace and take into account the factors identified in the personal environment.

Control measures should be introduced using the hierarchy of controls. According to the hierarchy of controls, the ideal solution when managing **fatigue** is to completely eliminate factors that contribute to **fatigue**.

This may involve, for example, the elimination of night shifts and extended working hours. If possible, there are a number of control options that may be used alone, or in combination, to minimise and control exposure to **fatigue**:

These could include:

a) Review and amendment of policies and procedures that are identified as having an effect on employee **fatigue**.
b) Adjustment of shift rosters to the most optimal, using the **Bio-roster** concept. The shift roster should take into account the need for the person to spend time with his/her family and participate in family and community affairs. The shift systems devised shall have the support of employees.
c) Elimination of unnecessary routine from the **work schedule**.
d) Control of the working environment to reduce factors that promote **fatigue** and drowsiness (e.g. physical workload, noise, vibration, temperature, lighting, etc.).
e) Lighting of rest areas to promote wakefulness and assist with adjustment of the **circadian rhythm**.
f) Suitable systems to monitor the performance of workers in safety-critical positions (e.g. drivers and operators) during the course of the shift and, where appropriate, suitable technology to monitor performance during the shift.
g) Regular medical examination and certification of fitness of employees and contractors in safety critical positions. Follow-up at suitable intervals on employees with chronic illnesses that may contribute to **fatigue** through the medical surveillance programme. Provision of education and information on how to best manage the condition to these employees by a suitable medical practitioner.
h) Availability of a suitable and easily accessible source of drinking water to all employees.
i) Designing meals that are provided on night shifts to reduce drowsiness and adverse health effects associated with eating at this time of day.
j) Substitute: introduce safer practices in place of those currently in use, e.g. increasing the length of breaks in a shift:
k) Engineer: introduce engineering controls, e.g. improve ventilation and illumination levels to improve alertness.
l) Administrative controls: introduce procedures and training programmes to support effective control of **fatigue**.
m) Personal protective equipment: carefully manage the use of protective gear as a control measure because it may not provide sufficient reductions in exposures, e.g. hearing protection devices may not provide sufficient attenuation over a 12-hour shift as opposed to an eight-hour shift.

FATIGUE RISK MANAGEMENT TOOL

Hazard Identification	**Risk Assessment** (Low - Moderate - Higher Risk: Tick applicable box)			**Risk Control**
MENTAL AND PHYSICAL DEMAND OF WORK	***Low***	***Moderate***	***Higher Risk***	***Interventions***
These include:				
Monotonous work				
Sustained physical or mental effort				
Complex physical or mental tasks				
WORK SCHEDULING AND PLANNING	***Low***	***Moderate***	***Higher Risk***	***Interventions***
Length of shift				
Sequential right shifts				
Breaks during work				
Breaks between work periods				
EXCESSIVE COMMUTING TIMES	***Low***	***Moderate***	***Higher Risk***	***Interventions***
WORK ENVIRONMENTAL CONDITIONS	***Low***	***Moderate***	***Higher Risk***	***Interventions***
Exposure to hazardous substances				
Exposure to extreme temperatures				
Exposure to vibration				
Exposure to noise				
INDIVIDUAL AND NON-WORK FACTORS	***Low***	***Moderate***	***Higher Risk***	***Interventions***
Sleep (amount and quality)				
Chronic conditions				
Alcohol and substance abuse				
Fitness levels (BMI)				
Nutrition				

For ease of reference it is recommended that the **fatigue risk** management charts be used to list the identified hazards, the qualitative **risk** assessment and the interventions that have been put in place to mitigate the **risk** of **fatigue**.

8.2.4.4 *STEP 4: Evaluation*

Monitoring and Evaluation

The **fatigue** management plan should be reviewed at regular intervals to ensure that all relevant hazards are included and to assess the effectiveness of the controls. Some of the specific factors to consider as part of the monitoring and evaluation include:

a) Have the control measures been implemented as planned?
b) Are there any new operational processes that have been introduced?
c) Review available fitness, health, **EAP** and absenteeism data.
d) Review incident data.

8.2.4.5 *STEP 5: Documentation*

Documenting **fatigue** management plan

The fourth step in the **fatigue** management process is to develop and document a plan detailing how control measures will be implemented. The **fatigue** management plan should be integrated as part of an overall occupational health and safety programme. The plan should be:

a) Specific to the mine site.
b) Developed through consultation.
c) Publicly available, e.g. on display.
d) Communicated regularly and appropriately, e.g. in inductions and safety talks.
e) Regularly reviewed to take account of changes in site needs and knowledge about the risks.

It should include:

a) A statement of the principles for managing **fatigue**.
b) Roles and responsibilities of all levels of the organisation.
c) The **risk** assessments that have been undertaken.
d) The **risk** controls that are and will be in place, along with an implementation plan.
e) The support systems that already exist and that will be set up along with an implementation plan, e.g. **EAP**, training programmes and monitoring systems.

8.2.5 *Communicating the policy and **fatigue** management plan*

Careful, but vigorous, communication is critical when 'rolling out' the **fatigue** management plan. Once the policy and the **FMP** framework have been adopted, they must be communicated to the entire workforce of the organisation. The communication framework should also provide and encourage opportunities for family members to be included in the information exchange.

Overall, the **FMP** will benefit from open lines of communication between all stakeholders, including employees, line supervisors, middle managers and senior management.

Providing information to families of employees can stimulate or reinforce the employees' willingness to focus attention on the important issue of **fatigue**.

8.2.6 *Information, education and awareness*

An appropriate information, education and awareness programme should be put in place to create awareness and educate all employees and their families on the impact of **fatigue** in the workplace, their role in managing the risks, and the controls in the workplace.

The programme should provide information and education on:

- The factors that cause **fatigue**.
- The signs and symptoms of **fatigue**.
- The risks of **fatigue** in the daily execution of their duties and the factors that cause **fatigue**.
- The action they can take when feeling the effects of **fatigue** during their shift.
- The impact of **shift work**, the importance of quality sleep and good nutrition to combat the effects of **shift work**.
- How to maintain an environment that will allow good quality sleep.

8.2.7 *Monitoring, reviewing and modifying*

The **FMP** should be subject to periodic assessments (minimum at least every two years) to ensure that it remains appropriate and effective, and can address existing and emerging or changed **fatigue** risks. Targets should be set for key parameters of the **FMP**. The review should cover the testing and auditing of all aspects of the **FMP**, in order to determine if controls are meeting business and safety goals.

The review should strike an appropriate balance between 'leading indicators' and outcome measures. The following are examples of the former:

a) The number of individuals diagnosed and treated with sleeping disorders.
b) The number of individuals who self-report **fatigue** when at work.

Obviously, attention should also be paid to outcomes and these will involve the usual measures such as:

a) Incident / accident rates.
b) Near misses and safety-critical events.
c) Equipment damage.
d) Feedback from employees.
e) Absenteeism.
f) Staff turnover.

PART D: IMPLEMENTATION

1. IMPLEMENTATION PLAN

1.1 The employer must prepare an implementation plan for its **COP** that makes provision for issues such as organizational structures, responsibilities of functionaries and programs and schedules for this **COP** that will enable proper implementation of the **COP**. (A summary of/and a reference to, a comprehensive implementation plan may be included).

1.2 Information may be graphically represented to facilitate easy interpretation of the data and to highlight trends for the purpose of **risk** assessment.

2. COMPLIANCE WITH THE CODE OF PRACTICE

The employer must institute measures for monitoring and ensuring compliance with the **COP**.

3. ACCESS TO THE CODE OF PRACTICE AND RELATED DOCUMENTS

3.1 The employer must ensure that a complete **COP** and related documents are kept readily available at the mine for examination by any affected person.

3.2 A registered trade union with members at the mine or where there is no union, a health and safety representative on the mine, or if there is no health and safety representative, an employee representing the employees on the mine, must be provided with a copy on written request to the manager. A register must be kept of such persons or institutions with copies to facilitate updating of such copies.

3.3 The employer must ensure that all employees are fully conversant with those sections of the **COP** relevant to their respective areas of responsibility.

ANNEXURE A:
Shift systems and rostering (F_{SS})

Work time arrangements and work systems that might have a negative impact on an individual's ability to adjust to **shift work** include but are not limited to:

a) a shift roster with an irregular or unpredictable pattern.
b) more than four consecutive 12-hour night shifts.
c) more than five consecutive 8-hour night shifts.
d) **work schedules**/rosters that do not allow opportunity for continuous sleep of seven to eight hours in each 24-hour period.
e) excessive regular overtime and on-call work.
f) early morning shift start times (before 6:00).
g) backward rotating rosters (day to night to afternoon).
h) shifts lacking appropriate shift breaks.
i) less than 36 hours off after a period of night shift work.
j) 12-hour shifts that involve critical monitoring tasks, heavy physical work, potential exposure to harmful agents/substances.

To assess the **fatigue** risks caused by shift systems and work time arrangements at a mine site, the relevant **risk** factors should be examined in detail in detail (Table 1.1).

Table 1.1:
Risk assessment of shift systems and work time arrangements

Risk factor	Consideration
Shift schedule design factors	
Night shifts, including the number of consecutive night shifts	• Are too many consecutive night shifts worked? • Is more than eight hours' work required over-night shift? • Are tasks requiring sustained physical or mental effort undertaken on night shift? • Are complex physical or mental tasks undertaken on night shift? • Do night shift workers have difficulty getting undisturbed sleep during the day?
Long hours of work in a single shift. This includes travel time, especially to remote sites	• Does one shift involve more than 12 hours in a day (including call-outs)?
Long hours of work across a shift cycle	• Do hours of active work (total time spent at work including overtime) exceed 50 hours in any seven days?
Long hours because of on-call duties	• Are there irregular and unplanned schedules as a result of call-outs? • Is the working day or working week extended beyond 12 hours in a single day or hours in any seven days as a result of call-outs?

Risk factor	Consideration
Short breaks between work shifts	• Is there enough time between work shifts to allow for adequate sleep: – Enough time in a break for five hours' uninterrupted sleep in 24 hours (only for one night)? – Enough time in breaks for 12 hours of sleep in 48 hours (i.e. in two days)? – Enough time in breaks for 50 hours' sleep in 7 days? – Is the break between shifts less than 10 hours?
Short breaks within work shifts	• Are breaks within shifts long enough and frequent enough to allow workers to rest, refresh and nourish themselves?
Shift start/finish times	• Do any shifts start or finish between midnight and 6:00? • Are there split shifts? • Are complex, difficult or strenuous tasks required at the start or end of such shifts?
Changes to rosters	• Do workers get sufficient notice of roster changes? • Is **fatigue** management taken into account in roster changes?

ANNEXURE B:
Ergonomics, environmental and work factors (F_{EW})

Exposure to environmental stressors, physical strain and work stress play an important role in the development of **fatigue**. To assess the **fatigue** risks caused by these factors, they should be examined in detail (Table 1.2).

Table 1.2:
Risk assessment of environmental and work factors

Risk factor	Consideration
Task-related factors	
Repetitive or monotonous work	• Do jobs involve repetitive or monotonous work, e.g. haul truck driving?
Sustained physical or mental effort	• Is the work physically demanding? • Is there time pressure due to a heavy workload? • Is work fast paced? • Is work intensive? • Can workers vary work pace or work tasks as desired? • Do workers have a say over work tasks or how to carry them out?
Complex physical or mental tasks	• Are high vigilance and/or concentration required? • Are there different demands that can be difficult to combine? • Are complex, difficult or strenuous tasks required at the end of shifts or shift cycles?
Adverse working conditions	• Are there adverse working conditions, e.g.: • Exposure to noise? • Exposure to heat? • Exposure to hazardous substances? • Whole body vibration? • Awkward body posture? • Restricted ceiling heights? • Travel distances to workplace facilities.

ANNEXURE C:
Personal factors (F_{PF})

There are human factors and employee choices that might have a negative impact on an individual's ability to remain alert and adjust to **shift work**. In order to assess the **fatigue** risks caused by personal factors the following should be examined in detail (Table 1.3).

Table 1.3:
Risk assessment of personal factors

Risk factor	Consideration
Personal factors	
Excessive commuting times necessary	• Is significant travel to and from work necessary each day so that time for adequate sleep is reduced? • Are long-distance commutes necessary at the beginning of a work cycle?
Socio-economic issues	• Do jobs involve high demand, but low control? • Are there poor social relations at work, e.g. bullying? • Is there a low level of social support from peers and **supervisors** at work? • Second job for pay. • Family commitments.
Health conditions and medication	• To what extent is there evidence of problems as a result of: a) Pregnancy; b) Chronic Diseases; c) Medication; d) Other medical issues; e) Sleeping disorders; and f) Psychological issues.
Alcohol and substance abuse	• Alcohol and/or drug misuse/abuse
Living conditions	• Housing • Nutrition • Poor sleeping conditions • Unfavourable sleeping environment

ANNEXURE D:
Fatigue risk worksheets for FSS/FEW

1. Worksheet A: Example of **fatigue** hazard identification checklist

Are any of these statements true in the workplace?	**Yes**	**No**
Many employees work shifts that include nightshifts		
Working overtime/long shifts is common		
Back-to-back shift working is common		
Breaks during shifts are short and do not provide a good rest		
Some people have to drive a long way to work, work long hours, then drive home		
Some shifts start very early (before 7:00)		
Shifts rotate 'backwards' (nights, evenings, day shifts)		
Shifts rotate forwards on a slow pattern		
Safety critical work is often done at:		
— a 'circadian low point'		
— two to four hours into a shift		
— at the end of a shift		
— following mealtimes		
— just before or just after a break (crew member may be tired just before the break, not fully alert after the break)		
Work is mainly very boring and uneventful		
Work is done:		
— in a hot environment		
— where the lighting is low		
— where it's fairly comfortable		
Shift workers don't have any say in the design of shift patterns		
Shift workers' family and friends don't provide much support for their unusual working hours		
There is no realistic support from employers on how to handle problems caused by shift working (e.g. 'education', briefings, counselling)		
Fitness for duty is not checked – especially the amount of sleep someone has had before starting a shift		
Some employees 'moonlight' during scheduled rest periods between shifts		
There is an ageing workforce working nights or long hours		
People rely on tea, coffee or other stimulants to stay alert		
The shift system has been designed entirely by the workforce		
Some people need to take unofficial 'naps' to keep working		

Scoring:
Add the number of ticks in the 'Yes' column. This gives a broad indication only of whether there is an alertness or **fatigue** problem.

- Three or fewer ticks – there is probably no need for action.

- Four to 10 ticks – it would be wise to investigate further and consider solutions.
- More than10 ticks – there is definitely a problem; there should be further investigation and immediate action.

2. Worksheet B: Example of Checklist to interview shift workers to assess the **fatigue risk**

	Yes	**No**
Do you regularly lose one or two hours' sleep when working shifts?		
Is the quality of sleep you get generally poor – e.g. frequently interrupted (by noise or bright light)?		
Do you sometimes have to work on safety-critical tasks at a 'low point' in the day, e.g. early hours of the morning; mid to late afternoon or after a meal?		
Do you regularly work long shifts – e.g. over 12 hours?		
Do you have enough breaks during the shift?		
Are the breaks long enough?		
Are rest periods between shifts long enough to recover from the previous shift (at least 12 hours)?		
Can you rest properly (or even nap) during breaks?		
Do you feel generally drowsy a lot of the time?		
When changing from night shifts to day shifts, do you feel 'rough' for the first few days?		
Are you noticeably absent-minded or forgetful at work or do you find it hard to concentrate?		
Do you sometimes feel that you just can't move; or don't want to?		
Do you suffer from a lot of heartburn, indigestion or a generally upset stomach?		
Do you find it difficult to get a good undisturbed sleep between shifts?		
At work, do you:		
Often find it hard to concentrate, make clear decisions or take in and act on information?		
Have more than occasional lapses of attention or memory?		
Find your reaction times are slow (for example, responding to an alarm or a threat that builds up in your workplace)?		
Make lots of errors?		
Occasionally fall asleep at work – momentarily or for several minutes?		
Find that you are often irritable?		
Do you have the opportunity and facilities to rest properly (or even nap) during breaks?		

Scoring:
Some of the above are normal and unavoidable effects of **shift work**. This doesn't mean that answering 'Yes' to any of the above is acceptable. If anyone is showing severe or long-term symptoms of **fatigue**, action should be taken

ANNEXURE E:
Review of accident or incident reports

There is evidence that **fatigue** is under-reported in incident investigations. The following will be helpful in identifying whether **fatigue** was an issue:

Consider the time of day the incident occurred. Was it:

- At a 'circadian low point'? (13:00 – 16:00; midnight and 06:00)?
- Close to the end of a shift?
- Within a period of two to four hours from the start of a shift?

Consider the point within the shift cycle when the incident occurred. Was it:

- At changes of shift, for example during the first day shift following a cycle of night shifts?
- At the end of a period of night shifts?

Consider the sleeping patterns of those involved in the incident, in particular, those who seem to have 'caused' the incident. Were they:

- Sufficiently rested during the off-shift period before coming on shift?
- Suffering from disrupted sleep?
- Doing a second job during an extended period of rest days between shifts?

Consider the work environment. Was it:

- Dark?
- Hot?
- Quiet?
- Generally conducive to sleep?

Consider the type of work being carried out. Was it:

- Routine (boring)?
- Work requiring sustained attention or extended concentration?
- Work requiring significant physical effort?
- Safety-critical work that could have been scheduled at another time?

Consider those involved in the incident. Were they:

- Taking any medicines that could have caused drowsiness or lack of attention?
- Taking stimulants (such as caffeine) to maintain their alertness?
- Assessed for fitness for duty before starting work or monitored during the shift for signs of **fatigue**?
- Tired on arrival after a long journey to work?