Fatigue Management Policy Document for Marine Pilots

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Acknowledgments:

"I stand on the shoulders of giants" – Isaac Newton

This policy document is the culmination of research into shiftwork, sleep and fatigue that has occurred over many decades. We therefore would like to thank those people who strive to understand the complexities of shiftwork and its effects on individuals, families, communities and organisations.

We would also like to thank all of the people who contributed, directly or indirectly, to the development of this policy. In particular, all of the shiftworkers, their families and organisations who have contributed to this work via phone calls, faxes, letters and meetings. Our hope is that this policy can assist regulators, organisations and individuals manage shiftwork using more scientifically based approaches.

NOTE

Throughout this document we use the word "shiftwork" to describe irregular hours of work and irregular work schedules. The definition of **shiftwork** used by the Centre for sleep research is:

Any work performed outside the hours of 0600 to 1800 Monday to Friday.

CONTENTS

1. BACKGROUND TO THE POLICY

The Australian Marine Safety Authority (ASMA) is a Commonwealth Government Authority charged, amongst other things, with the responsibility for the regulation of coastal pilotage. AMSA's charter is to enhance efficiency and safety in the delivery of services for the Australian maritime industry.

With regard to its responsibilities in relation to safety, AMSA has recognised the hazards associated with fatigue, and has noted both Australian and international research describing the effects of fatigue on performance. Hence, ASMA have recognised the need to include policy concerning shiftwork and the hazards of fatigue.

Along with many other industries, organisational change in the maritime industry has shifted the regulation of hours of work from an industrial award framework to enterprise agreements and/or OH&S policy.

A number of the companies engaging in pilotage in Australia already use job allocation systems which contain a number of fatigue countermeasures. AMSA itself has introduced regulations requiring a 24-hour break between work assignments. However, these have not been brought together within a single OH&S framework.

There are numerous examples of shift systems negotiated in the new industrial relations' climate that are patently unsafe in the light of the scientific literature. In many cases, these hours-of-work have been negotiated without regard to their health and safety implications. Many organisations have taken the approach that 'flexible' hours-of-work can be 'bought' along with any other work practice reform. In the crudest sense, this reflects a simplistic re-working of the old principle of 'danger money'. That is, the notion that employees can be exposed to dangerous conditions provided they receive adequate compensation.

ASMA has recognised that this approach is not acceptable. This proposed policy has been prepared in recognition of the special characteristics and needs of marine pilots who operate outside of the traditional standard working week, and do not use rotating

rosters. This policy is designed to act as a framework to assist with the management of the risks associated with shiftwork and extended working hours.

This policy has been developed in response to research concerning the impact of shiftwork and extended working hours on employers, employees, families and the communities that support them. The risks that arise due to shiftwork and extended working hours have been well documented and are included in this policy document.

This policy has been prepared in recognition of the responsibilities of marine pilots and its employees under OH&S legislation. Within this legislative framework, a safe system of work must be provided to protect employees and other stakeholders. This is in contrast to the individual liability model, more commonly associated with some industries or workplaces.

1.1 Purpose

This policy provides practical guidance to marine pilots, their organisations and their families on how to eliminate or minimise risks arising from the hazards associated with shiftwork and extended working hours.

1.2 Scope

The scope of this policy is limited to hazards related to shiftwork and extended working hours and their effect on the health and safety of individuals and workplaces.

Other specific workplace hazards are not addressed by this policy and reference should be made to other legislation, standards, codes and guidance material in relation to those hazards.

1.3 Status of the Policy

This policy has been developed to be compatible and consistent with OH&S legislation. This policy does not have any specific legislative standing, but provides recommendations for duty holders to consider in meeting their obligations.

1.4 Legislative Framework

OH&S legislation sets out a general duty of care for employers to provide and maintain a safe and healthy workplace "so far as is practicable". In this context, 'practicable' means that the duty to provide and maintain a safe and healthy workplace is qualified by:

- the cost of removing or mitigating a hazard or risk.
- the state of knowledge about the hazard or risk.
- the state of knowledge about measures to control risks.
- the severity of the hazard or risk.

Consequently, this policy provides guidance on practicability in relationship to the hazards and risks associated with shiftwork and extended working hours.

Modern OH&S legislation is described as 'performance-based', highlighting the achievement of safety outcomes rather than defining in great detail the way in which the outcome is to be achieved. This policy is drafted within this framework to enable flexibility and innovation in managing workplace hazards pertaining to hours-of-work.

1.5 Employer and Employee Duties under OH&S Legislation

Employers' responsibilities under OH&S legislation are to:

- provide and maintain a safe system of work (e.g. work scheduling).
- provide adequate information, training, instruction and supervision to employees (e.g. emergency preparedness training).
- consult with employees and elected representatives on health and safety at work (e.g. introduction of new equipment).

- monitor and record the health of employees (e.g. sleep disorders).
- monitor conditions at work to ensure exposure thresholds are not breached (e.g. hours of continuous duty).
- provide adequate welfare facilities for employees (e.g. sleeping quarters).

Employers have an obligation not only to employees but also to contractors and their employees. Further, employers have a duty to others involved or affected by their business. For example, students in schools, customers in stores, visitors in factories and patients in hospitals are all owed a duty of care by employers in control of workplaces.

Under OH&S legislation, employers have the primary duty of care. However, there is also provision for an employee's duty of care. This refers to the duty of an employee to assist the employer in meeting health and safety obligations and to take reasonable care not to put themselves, or others, at risk. In other words, an employee has a duty to take reasonable care for their own health and safety, and for the health and safety of others that may be affected by their acts or omissions at the workplace.

Employees' responsibilities under OH&S legislation are to:

- participate in education and training in order to gain an understanding of the risks associated with shiftwork and extended working hours.
- utilise provided breaks within and between shifts to rest and recuperate.
- report all incidents and accidents arising from hazards related to shiftwork and extended working hours.
- recognise signs of sleep deprivation and/or fatigue and the impact on themselves and others.
- report to appropriate individuals (supervisors, team leader) the circumstances in which fatigue and lack of sleep are impacting on individual wellbeing and workplace safety.
- understand the implications of voluntarily seeking additional work hours that have the potential to increase risks to individual and organisational health and safety.

1.6 Shiftwork and Extended Working Hours

1.6.1 The body clock

Marine pilots are often required to work shifts or extended hours at times when they normally would be sleeping. Similarly, marine pilots are often required to attempt to sleep at times when they would normally be awake. Thus, shiftwork can be considered to be a biological disruptor.

The requirement to be awake at night and asleep during the day can disrupt natural body rhythms that repeat approximately every 24 hours (i.e. circadian rhythms). These rhythms are associated with many human functions including body temperature, alertness, performance, and sleep. Disrupted rhythms impact on the quantity and quality of sleep and on task performance (see Appendix A for review article), and create a perceived sense of personal imbalance.

1.6.2 Sleep and fatigue

Disruptions to normal sleep routines are often associated with night shift or extended working hours, where the major difficulty is getting adequate undisturbed sleep during the day. The cumulative result of these disruptions is insufficient recovery sleep, commonly known as sleep debt, leading to increased fatigue and impaired performance.

From an OH&S perspective, fatigue is most appropriately conceptualised as either work-related or non-work-related, and may be defined as an increasing difficulty to perform physical or mental activities. For marine pilots, maintaining intense concentration for extended periods, being exposed to temperature extremes, or working in a high-risk situation may cause work-related fatigue. Non-work-related fatigue may be caused by sleep disruption due to ill family members, stress associated with financial difficulties, or domestic responsibilities.

Levels of work-related fatigue may be considered to be similar across different individuals performing the same tasks. Therefore, work-related fatigue as defined in this policy, can be measured and managed at the organisational level (see section 4.3.1 for fatigue prediction methodology). However, non-work-related fatigue is

highly variable between individuals and is dependent on a person's environment as well as their physical and mental attributes. Therefore, non-work-related fatigue is best managed at the individual level. Nevertheless, under OH&S legislation, it is a requirement of all employers to provide access to information that allows their employees to make informed lifestyle choices. By providing relevant and accurate information, employees are more likely to minimise the impacts of non-work-related fatigue.

Effective management of work-related and non-work-related fatigue is likely to produce benefits to marine pilots and their families. Marine pilots may experience improvements in morale, safety, productivity and attrition rates. Individuals should expect improvements in health, wellbeing, motivation and quality of life.

1.6.3 Social and family disruption

Work scheduling that is based solely on organisational requirements may not acknowledge the personal, domestic and social needs of its employees. In many cases, shiftworkers find it difficult to maintain a satisfactory social and family life and may not allow sufficient time to recover from work in order to fulfil other needs.

The dislocation of family and social life may result in pressures on relationships, domestic workloads and community activities. As with sleep and fatigue, this has implications for task performance, health and safety, morale, absenteeism, productivity and attrition rates (see section 4.3.2 for psychosocial assessment methodology).

1.6.4 Long-term health effects

Long-term exposure to shiftwork or extended working hours may have deleterious effects on the health of individuals. Evidence from studies of shiftworkers indicate a higher incidence of:

- gastrointestinal disorders (e.g. peptic ulcers, heartburn, and nausea).
- cardiovascular disease (e.g. palpitations, high blood pressure).
- complaints associated with stress (e.g. anxiety, depression).

Generally, there is an assumption that prescription medication is used during the day and that sleep occurs at night. However, for shiftworkers this may not be the case. It is important to understand that the effects of medication are related to the time-of-day at which they are taken. Therefore, depending on the individual's roster, the intended effect of the prescribed medication may vary from the actual outcome.

2. HAZARD IDENTIFICATION, ASSESSMENT AND MANAGEMENT

OH&S regulations require employers to identify and manage actual and potential workplace hazards as far as is practicable. In order to be consistent with the philosophy and approach of OH&S legislation, a model based on hazard identification, risk assessment and risk control is utilised throughout this policy.

2.1 Hazard Identification

Marine pilots should ensure that all hazards associated with shiftwork and extended working hours are identified. Hazard identification should ideally be part of the day-to-day management of pilots' workplaces. In addition, regular formal audits of incidents and procedures should occur to document identified risks. Furthermore, a single individual should be made accountable for these processes and for legal compliance.

Information on hazards can generally be accessed from either internal or external sources, including:

Internal

- daily, weekly, monthly and annual working time records.
- incident and injury records.
- industry surveys.
- health surveillance records.

External

- reports or review of formalised complaints from specialists in work scheduling, shiftwork and fatigue (see Appendix B for contact list).
- research findings into the impact of extended working hours on work performance, health and safety.

Hazard identification requires consultative involvement between marine pilot managers and employees. This consultative process can be structured through the OH&S Committee or other workplace safety forums.

2.2 Typical Hazards Associated with Shiftwork and Extended Working Hours

The hazards associated with shiftwork are not necessarily a direct consequence of the allocation system at marine pilots. Rather, the hazards are associated with the way individuals and groups respond to the system. Specifically, these hazards include, but are not limited to: workload, the time of day at which work is performed, duration of work periods, length of breaks within and between work periods and the time of day that they occur, direction and speed of work rotations, and unpredictability of work schedules.

2.2.1 Type of work and workloads

Research indicates that particular types of tasks are performed better at particular times of the day than others. For example, tasks involving simple monitoring of activity improve over the day but are poorer at night.

Performance reduction with particular types of tasks can be modified by factors such as the activity duration and the intrinsic nature of the work. This means that performance may be maintained over longer periods for stimulating tasks but simpler, routine administrative tasks may not be completed at a satisfactory level.

2.2.2 Night shift or extended working hours prior to night shift

The combined effects of sleep deprivation and disruption to the body's internal timing system can combine together after an individual works a night shift or where prolonged hours stretch into a night shift.

Circadian rhythms can cause performance levels to vary across the 24-hour day, such that many aspects of human performance are at their lowest level at night. However,

performance at all times of day can be made worse if sleep deprivation occurs. Sleep deprivation is most likely to accumulate between night shifts, as daytime sleep is of lower quality and quantity than night sleep. Therefore, working a night shift, or a series of night shifts, represents an additional hazard for employees working extended hours.

2.2.3 Shift duration

Working long hours in any one period may have a number of effects, including:

- further disruption to the circadian system.
- lack of sleep and accumulation of fatigue.
- declining safety, performance, communication and productivity.

2.2.4 Lack of rest within and between work periods

Within a period of work, short breaks should be taken where practicable. These breaks should allow for mental and physical time away from the work environment. Potentially this may lead to improved vigilance, performance, safety and efficiency.

Lack of suitable recovery periods between shifts may be viewed as a major potential hazard. This is particularly the case between night shifts. On night shift, the body is forced to stay awake when it is programmed to sleep. In addition, the equivalent amount of time in bed during the day has less recovery value than a night sleep. Therefore, the value of a break with a set duration between shifts is completely dependent on the time of day at which the break commences. Hence, minimum break durations should acknowledge the time of day impact.

2.2.5 Inappropriate speed and direction of shift rotations

The human body has difficulty adjusting to changing work routines. These disruptions often impact sleep quality and quantity, fatigue accumulation and personal interactions. There is some scientific evidence suggesting that the body can adapt more easily to going to sleep later (forward rotation) rather than earlier (backward rotation). However, this is somewhat dependent on individual preferences and circumstances and the evidence in this field is equivocal.

The speed of rotation describes the number of days an individual spends on a particular shift before a change to another shift or to a time-off period occurs. A slowly rotating schedule, working for example 3 to 4 weeks on the same shift, allows greater time for body rhythms to adjust and adapt. However, as the quality of sleep is lower when working night shift, such long cycles may create an accumulating sleep debt and fatigue problem. This can be exacerbated if workers return to a day routine on their days off.

A fast rotation, changing shifts every two or three days for example, may enable the employees to minimise circadian movement, as the body does not have time to adjust to differing shift times. Such rapid rotations minimise the accumulation of a large sleep debt as long periods of night shifts are avoided.

2.2.6 Irregular and unpredictable work schedules

Whatever the individual experience of different speed and direction of shift rotations, it is generally more favourable to have a regular and predictable work scheduling arrangement. Unpredictable work schedules may also compromise the quality of rest time if there is the continual possibility of recall to duty. However such regular work arrangements are not applicable to the business of marine pilots.

Consequently, on-call arrangements both on-site and off-site need to be structured in accordance with the issues considered under hazards already outlined. Where on-call arrangements are used, on-site facilities should maximise the opportunity for undisturbed rest and sleep. Where recall to duty is involved, particular attention should be given to the individual's current and recent work pattern in order to minimise hazards created by disruption of body rhythms and the potential for reduced work performance.

2.3 Risk Assessment

Marine pilots should undertake a risk assessment to determine the risks associated with hazards identified.

A risk is the potential of injury or illness arising from exposure to a hazard. Risk assessment is a process to determine the likelihood of potential injury or illness for those exposed to the hazard. The risk assessment should consider any controls or methods already being used to control risk and assess the effectiveness of such current methods.

Risk assessment methods should be identified that are appropriate for the hazards concerned and may include:

- use of specialist expertise in scheduling and shiftwork.
- use of techniques that enable calculation of potential sleep deprivation and fatigue risk factors.
- consultation with employees on 'best fit' schedules and on individual orientations to different work schedules.
- use of available research on shiftwork and extended working hours.

A risk assessment checklist and guide is set out below. This should facilitate the assessment process and, with the recommended standards, should form the basis of any work scheduling. Where these standards are not practicable, marine pilots should institute actions to minimise the impact of any individual hazard or the cumulative effect of related hazards. However, if the standards are not practicable, it is still the responsibility of marine pilots to conform to legal requirements.

The hazards associated with shiftwork and extended working hours are complex and interrelated. In addition, individuals can have differences in their circadian timing systems as well as their personal circumstances. Therefore, there are a range of factors that can further impact on performance at different times of the day. Consequently, the risk assessment process needs to consider not only risks arising from work schedules and environments but other potential impacts as well. The latter are best determined via current research literature and consultation with employees.

The following checklist includes a number of defined operating standards and thresholds at which action should be triggered. Where these minimum standards are not being met, a higher risk exposure is possible; in these cases consideration needs

to be given to ways in which hazards can be eliminated or individual elements can be counter-balanced by other compensating aspects.

The checklist is in the form of questions to which a 'yes' response would indicate that further risk controls should be considered. Using this checklist, marine pilot managers and employees should assess the risks associated with identified hazards.

The hazards and their associated risks are interrelated and, in many cases, cumulative. The traditional risk assessment model of frequency, severity and probability of occurrence is difficult to apply with these hazards but the following guidelines drawn from the checklist illustrate a risk continuum from low to medium to high.

The guide that follows the checklist is not intended to be overly constraining but rather a tool in the assessment of risks. Other factors, such as lifecycle (e.g. age) and the intensity and nature of work, should also be considered. These factors should be defined and assessed at the workplace and individual levels.

Risk Assessment Checklist

(please circle a response to each question)

Are employees regularly scheduled to work more than 10-hour shifts?.....Yes □ No □

Do employees work more than 12 consecutive hours in any one period
(including overtime and callouts) at least twice a week?.....Yes □ No □

Is the minimum period of rest between scheduled work less than
8 hours? .....Yes □ No □

Is the minimum rest period after more than 12 consecutive hours'
work less than 12 hours? .....Yes □ No □

Are the total hours worked:

- In a 7-day period more than 70 hours
  (including overtime and recalls)?.....Yes □ No □

- In a 14-day period more than 140 hours?.....Yes □ No □

- In a 28-day period more than 280 hours?.....Yes □ No □

Is the minimum non-work time:

- In a 7-day period less than 88 hours? Yes □ No □
- In a 14-day period less than 176 hours? Yes □ No □
- In a 28-day period less than 352 hours? Yes □ No □

Is there less than one 24-hour break free of work in a 7-day period? ..... Yes □ No □

Are there less than three 24-hour breaks free from work in a 14-day period? ..... Yes □ No □

Are there less than seven 24-hour breaks free from work in a 28-day period? ..... Yes □ No □

Are employees working standby/on-call more than once every 7 days? ..... Yes □ No □

Is an employee scheduled for more than three night shifts in a 7-day period? ..... Yes □ No □

Is an employee working standby/on-call duty comprising more than 24 hours of the minimum 88 hours free from work in a 7-day period? ..... Yes □ No

Is an employee scheduled to work night shifts whilst educational and training requirements have to be met? ..... Yes □ No □

Risk Assessment Guide (based on a 7-day period)

Low Risk 40 to 50 hours worked	**Medium Risk** Between 50 to 70 hours	**High Risk** More than 70 hours
No more than 10 consecutive hours worked in any one shift	Up to 14 consecutive hours in any one shift	14 or more consecutive hours worked at least twice
Short breaks taken during shift	Short breaks taken during shift	No short breaks taken during shift
Little or no overtime	More than 10 hours overtime	More than 20 hours overtime
On call less than 3 days in 7 days	On call duty 3 days or more in 7 day period	On call continuously for more than a 7-day period
No night shift or extended hours into night shift	At least 2 night shifts or extended hours into night	At least 3 night shifts or extended hours into night
Minimum 12 hour breaks between shifts and 2 days free of work	Minimum 12 hour breaks between shifts and1 day free of work	Less than minimum 12 hour break on shifts and no full day free of work
Forward shift rotation and predictable cycle	Forward shift rotation but changed cycle	No stable direction or speed of rotation
No changes to work arrangements without notice	Changes to work arrangements through overtime and recalls	Work arrangements changed so much because of overtime and worked recalls to be unpredictable
Maximum opportunity for sleep to be taken at night	About two-thirds of sleep able to be taken at night	Less than half of sleep able to be taken at night
No requirement for on-site rest facilities	Rest facilities on-site suitable for undisturbed sleep	Lack of rest facilities on-site suitable for undisturbed sleep

- Each Low Risk Element to be scored at 1
- Each Medium Risk Element to scored at 2
- Each High Risk Element to be scored at 3

The checklist is based on a 7-day cycle. However, as the known hazards associated with shiftwork and extended working hours are cumulative, this model should be applied to 14- and 28-day periods.

For example, an employee who works more than 70 hours a week for 4 weeks would score 24 points in the final week. Conversely, if the 70-hour week were a one-off event then the score at the end of the 4-week period would be between 6-9 points.

Another example is when at least two night shifts are worked in a week but breaks are taken within shifts, the minimum break between shifts is maintained and the shift cycle is predictable. In this case a potential high risk is balanced by other measures and the overall profile may be kept at the lower risk end of the scale.

The purpose of scoring is to provide a simple way of acknowledging potential risks to marine pilot companies, marine pilots, their families, and the community. The profile can be used to establish a preferred profile that meets organisational and individual needs as well as legal requirements to provide and maintain a safe workplace.

3. RISK CONTROL

Improving hours-of-work and workplace practices can achieve workplace risk management. It is not sufficient to manage only hours-of-work, because not all risks associated with shiftwork are directly linked to hours-of-work. To minimise all potential shiftwork hazards, both hours-of-work and other workplace issues need to be addressed simultaneously.

Before attempts are made to rectify any work allocation hazards, marine pilots must have effective and open communication lines or processes in place. These formal lines of communication must be two-way. That is, communications must be able to move freely both up and down within the organisational structure and reach their expected target(s) without hindrance or interference. The communication relationships are some of the most critical links in developing and maintaining occupational health and safety best practices. In addition, access to organisational information may enable all stakeholders to make informed decisions related to any potential workplace change(s).

Under OH&S legislation, an employer's duty is to control known hazards by either eliminating or minimising them.

As hours-of-work are an organisational matter, the controls must be applied at a lower level in what is often called the 'hierarchy of control'. At the top of the hierarchy are controls that do not rely on human action (e.g. design, engineering), extending down to those that are dependent on individual and organisational measures (e.g. training, skills and behaviour). The effectiveness of controls depends on shared ownership of the protocols and practices that minimise hazards.

Risk controls for shiftwork and extended working hours cannot be set out as a series of stand-alone solutions that will be effective in all cases. A series of strategies should be used, including:

- design principles for schedules.
- information, supervision, consultation and training.
- facilities and services.

- monitoring and review.

3.1 Design Principles for Schedules

Scheduling the work of employees to eliminate or minimise the potential health and safety risks to all stakeholders is required. The following performance-based principles should underline the design of work schedules:

- minimise the occasions on which employees are required to work more than 10 hours in a period.
- ensure that minimum breaks between shifts enable employees to have a minimum of 6 hours continuous sleep before resuming work.
- ensure that any period of extended working hours is compensated with a longer break before resuming a shift.
- ensure employees have regular times (a minimum of 36 consecutive hours) free of work in a 14-day period.
- minimise consecutive night shifts in order to limit reductions in performance levels caused by circadian disruption, fatigue and reduced alertness.
- account for 'covering' contingencies caused by sickness or absences.
- optimise the opportunity to take breaks within shifts.

Other hazard reduction strategies that may be used in managing workloads include:

- where practicable, complex tasks should be scheduled during the day and routine and administrative tasks should be minimised or redesigned to ensure employees can focus on core duties during their night work.
- the allocation of employees during peak times and demands is fundamental in minimising the exposure to risks associated with extended working hours. Numbers and types of employees should be allocated to work on the basis of predictable demands for services by daily, weekly, seasonal and annual trends.
- employees should be replaced or substituted where extended working hours have created a risk to employee health and safety.
- non-urgent work should be deferred to allow appropriate rest and recuperation for employees.

3.2 Information, Management and Non-Management Approaches

3.2.1 Information

Employees should be provided with information on shiftwork and extended working hours, including:

- the hazards associated with shiftwork and extended working hours.
- potential health and safety impacts of shiftwork and extended working hours.
- duties under OH&S legislation of both employer and employee responsibilities.
- how to identify potential and/or existing problems associated with lack of sleep and fatigue.
- individual coping strategies to best minimise the adverse impacts of shiftwork and extended working hours.
- services made available to help employees' better cope with shiftwork and extended working hours.
- ensuring and encouraging the reporting of near-misses, incidents and/or accidents.
- ensuring employees access to an appropriate form for the collection of such data.

3.2.2 Organisational approaches

At the broadest level, marine pilots must update all policies to reflect current legislative requirements and scientifically based approaches to shiftwork management. Promotion of good shiftwork and workplace practices needs to be adopted by senior management to demonstrate their commitment to optimising safety. This is best achieved by the provision of adequate and appropriate resources. Furthermore, it is pertinent that senior management resource and respond to relevant issues within the negotiated time frame. These appropriate and timely actions will clearly demonstrate the importance of minimising workplace hazards.

Appropriate and efficient management of shiftworkers is crucial in meeting the demands of OH&S legislation as well as ensuring high levels of workplace productivity, efficiency and profitability. Furthermore, shiftwork management can

impact on the physical and psychological wellbeing of individuals both in and out of the workplace.

The management of non-work fatigue related hazards should be assigned to one supervisor within a marine pilot organisation working with a suitable Employee Assistance provider. This will anchor the process of workplace safety such that all stakeholders can rapidly access and coordinate particular issues of concern. This individual must ensure continuous and consistent monitoring and subsequent management of identified challenges.

3.2.3 Management approaches

The responsibilities of marine pilot management in relation to this policy are to:

- ensure the implementation and monitoring of relevant OH&S legislation and codes of practice in addition to this policy.
- regularly monitor workplace safety, workloads, work allocations to ensure that no employees are placed at risk and to review work patterns immediately when they are shown to be potentially deleterious to employee health, safety or welfare.
- consult effectively with relevant employees and the OH&S representative about the introduction of shiftwork. Ensure that all stakeholders have a genuine opportunity to contribute to the outcome of the work allocation.
- provide information, instruction and training to employees about any risks to health, safety or welfare involved with shiftwork.
- provide adequate levels of supervision of employees during all shifts to ensure that employee health, safety and welfare is not compromised.
- provide necessary support services for employees required to work non-traditional hours. This ensures the maintenance of their health, safety and welfare. Examples of support services are the provision of nutritious foods, adequate emergency and first aid services, etc.
- Permit OH&S representatives to:
    - investigate any problems related to shiftwork.
    - inspect the workplace for any hazards related to shiftwork.

- implement methods to monitor the safety, health and welfare of shiftwork employees.
- monitor shiftwork arrangements and review procedures and policies in relation to hours-of-work.
- provide assistance and give advice to managers and the OH&S representative in relation to health, safety and welfare issues related to shiftwork.

3.2.4 Supervision

Individuals responsible for change are generally supervisors and the management of the marine pilot companies. Supervision by these individuals ensures that tasks are performed safely and work instructions and procedures are adhered to. In addition, these agents play a vital two-way role as liaison between management and employees. Ideally, supervision should be commensurate with the complexity of tasks to be undertaken and enable prompt action to be taken to maintain health and safety standards.

Employees and management should be particularly aware of all of the risks associated with shiftwork and extended working hours. Another role is to reflect on daily observations and discussions with reference to expected outcomes. Such reflection provides direction for future developments and feedback for all employees. In addition, supervisors should be able act appropriately to fulfil their responsibilities under OH&S legislation to eliminate or minimise known or potential hazards. Therefore, formal and informal feedback from other employees should be welcomed as it potentially assists in solving current challenges.

3.2.5 Non-management employees

Management commitment to organisational safety needs to be presented to non-management employees. Furthermore, all employees must be made aware that management is open to suggestions that reduce potential hazards, maximise safety and optimise productivity. This will promote employee-management relations and may provide a forum for the development of appropriate solutions.

In addition, these employees must be made aware of legislative and organisational developments for the minimisation of hazardous workplace practices. Current legislative requirements of the organisation and employees should be divulged by an appointed OH&S representative, where appropriate.

3.2.6 OH&S representatives:

The functions of elected OH&S representatives in relation to this policy are to:

- inspect their workplace and examine shiftwork to identify any potential health, safety or welfare problems.
- attend meetings with managers, employees and other stakeholders to discuss and debate hours-of-work in relation to health, safety and welfare concerns.
- consult with relevant managers in relation to shiftwork issues.
- direct that work cease when there is an immediate threat to the health and safety of workers.
- serve default notices if they believe that shiftwork will jeopardise the health, safety or welfare of employees.

3.2.7 Consultation

Under OH&S and equal opportunity legislation, employers have an obligation to consult with employees in relation to hours-of-work. This process of consultation will assist in the development and maintenance of a safe workplace by ensuring schedules and workloads that are reasonable and practicable.

Consequently, the development of effective controls through workplace scheduling and task allocation is achieved through consultation with those working the shifts.

Employees should ideally be involved in the development and design of work schedules, taking into consideration the design principles set out above. In addition, employees should be involved in all future discussions regarding changes or adjustments to their shift system.

3.3 Training

Marine pilot management should ensure that employees are provided with appropriate training to minimise the risks associated with shiftwork and extended working hours.

An induction program for employees should include reference to the following:

- duties of employers and employees.
- circadian rhythms and their relationship to work scheduling.
- shiftwork schedules and design principles.
- hazards associated with shiftwork and extended working hours.
- the impact of shiftwork and extended working hours on health and safety.
- individual strategies for managing shiftwork and extended working hours.

Providing appropriate education and training is an essential part of shiftwork management. It enables employees and employers to:

- ensure informed decisions regarding the development and design of work schedules.
- perform critical self-assessment in terms of fitness-for-work.
- understand and recognise situations of sleep disruption, sleep deprivation and fatigue and act accordingly.

3.4 Facilities and Services

An essential management strategy is to provide suitable facilities in which employees can have rest breaks or short naps during shifts.

Marine pilot management should provide:

- rest areas in which employees can take short breaks from work.
- suitable facilities for employees who are on-call, on standby or working extended hours to enable a minimum of 6 hours undisturbed sleep between shifts or to have short naps within long shifts.

- access to suitable catering facilities providing nutritional food and beverages consistent with diet guidelines that maximise the ability to work shifts and extended hours.
- access to counselling services to assist in any issues arising from the disruption to individual, family or social patterns caused by shifts or extended working hours.
- access to advice on diet and physical fitness.

3.5 Monitoring and Review

Due to the nature of work scheduling and unanticipated workloads of marine pilots, the system of risk management needs constant monitoring, evaluation and review.

The process of monitoring should be done on a single turn basis, over 7-, 14- and 28-day periods to establish potential risk exposures and to actively manage known risks in the upcoming period.

Where it is not practicable to keep working hours within normal parameters (less than 50 hours per week) then close monitoring of the related risk factors is required.

Actual hours worked should be reviewed at least quarterly and annually to identify opportunities to reduce or eliminate risks. This review should involve employees and managers.

The review process should include an examination of any incidents related to employee welfare that may have been associated with hazards arising from shiftwork or extended working hours. Secondly, the review should draw on longer-term incident reporting to determine trends that may require preventative action.

3.6 Actions Checklist

The following is an example checklist for short, medium and long-term organisational and employee actions. This is not an exhaustive list; these items should be modified or added to, where appropriate.

Short-term actions based on quarterly reviews:

- if not already aware of the benefits of best practice shiftwork and fatigue policies, marine pilot managers should be informed of potential benefits such as: productivity, efficiency, safety, profit and other factors.
- management should demonstrate their commitment to shiftwork and fatigue issues by undertaking to provide consistent support and resources to respond quickly and openly to issues and concerns related to hours-of-work.
- a methodical strategy to address the shiftwork training and education of marine pilot managers and employees (and their families) should be developed.
- the requirements under relevant legislation regarding identification and management of workplace hazards should be clarified.
- the organisational accident and incident reporting form should reflect current best practice format (see Appendix C). In addition to standard information, essential elements should include operator sleep history, work history, self-rated fatigue at time of event and individual sleepiness scales.
- current organisational accident and incident databases should be assessed to determine relationships between events and factors, such as time of day, time of week, position in shift cycle, prevalence of overtime and time into shift.
- a literature review outlining the benefits of napping should be obtained (see Appendix D). In addition, further information should be obtained with regards to the benefits and management of napping.

Medium-term actions based on annual review:

- the overtime policy may need to be revised and aligned with current best practice guidelines.
- education and training methods should be developed by culturally sensitive and competent individuals. Training and education materials outlined in the short-term action list should now be completed and ready for implementation.
- the amount of time employees have available for sleep between night shifts should be more accurately assessed. In particular, the main reasons why employees can not or do not sleep properly during the day should be determined and, where possible, addressed.
- the actual amounts of time that employees manage to sleep between night shifts should be determined using validated sleep diary methodologies (see section 4.3 for further details). This will allow the suitability of the current work schedule, and other potential arrangements, to be determined using fatigue modelling technologies.

Long-term actions based on twice-yearly reviews

- ongoing evaluation to determine whether information on shiftwork and fatigue issues is being communicated quickly and accurately through all levels of marine pilots.
- evaluation of the psychosocial impact of any workplace changes on individuals, families and communities.
- review of workplace practices, scheduling and communication systems.
- the content of an employee's night shift diet should be assessed with respect to current nutrition, alertness and performance literature.

4. ORGANISATIONAL COMMUNICATION SYSTEMS

- Formal: Verbal hierarchical network, written (memo, suggestion box), organisational (overtime, accident/incident, fatigue prediction, psychosocial impacts, education and training, auditing, policy and procedure development and change process implementation).

- Informal: Verbal (lunchroom discussions, debriefing sessions)

4.1 Incident Reporting and Investigation

The reporting of incidents and/or accidents that involve near misses, personal injury or damage to equipment is required under OH&S legislation. Comprehensive and accurate reporting enables corrective action to be taken and allows better prevention planning to take place.

Depending on the nature of the incident, regulatory agencies require the reporting of incidents involving death, injury and dangerous occurrences.

Marine pilot companies should establish policies and procedures that:

- define the kinds of incidents and accidents that require reporting.
- encourage, and not discipline, employees to accurately report incidents and accidents.
- provide the resources to ensure that all incidents and accidents are recorded and analysed.
- ensure incidents are investigated and that any required corrective action be taken.
- ensure all appropriate information is available for the review process outlined in section 2.2.

4.2 Record Keeping

OH&S regulations require risk assessment records to be kept and made available to the regulatory authority on request.

Organisations are requested to keep risk assessment records that:

- apply to all work scheduling, or
- document how alternative management strategies were established.

4.3 Evaluation Tools

There are numerous methodologies that can be utilised to assess the impact to changes to work allocation.

4.3.1 Fatigue modelling

Work-related fatigue and consequent changes in alertness, reaction time, hand-eye coordination, communication and decision-making have been identified as major risks for shiftworkers. The association between hours-of-work and occupational health and safety outcomes is widely accepted; however, few policymakers or organisations currently attempt to manage or audit work-related fatigue in any systematic or practical manner.

This reluctance is due, at least in part, to the difficulties in making generalisations about fatigue from the findings of laboratory-based studies. Such studies do not usually account for the competition that exists between the biological necessity for rest and recovery and other needs such as quality family life or social time. Also, very few specific shift systems have been modelled in the laboratory and it is difficult to generalise the findings from one shift system to another that is completely different.

In addition, for many organisations, financial and/or service imperatives are often viewed as the overriding determinant of the shift schedule. Employees in many of the industries in which fatigue carries the greatest potential risk and cost typically work

irregular or unpredictable hours. For this group it is difficult to generalise and almost impossible to compare findings.

Outlined below are the details of an applied modelling approach that enables organisations to quantify, compare and predict work-related fatigue and could, therefore, provide a valuable tool to improve fatigue management.

For the purposes of this model, fatigue will be defined as a dynamic balance between two competing forces. There are the forces that produce fatigue and the forces that reverse the its effects, that is lead to recovery.

Essentially, the model allocates fatigue or recovery value to work and break periods based on three factors: duration and timing of work periods and recency of shifts. In simple terms, we are interested in the length of each work or break period, the time of day at which the work or break occurred and how far back in the past that work or break took place.

The information on which this model is based has been produced as a result of significant experimental studies into the effects of shift length, the time of day that shifts occur, and the importance of the recency of past work periods. This experimentation has been undertaken over previous decades at various facilities throughout the world. In addition to this information, the workings of the model have been 'fine-tuned' to specifically model individuals from the Australian work climate by utilising information provided by The Australian Workload Study. This study allowed the capture of information regarding how shiftwork and extended working hours affect an individual's work, sleep, health, social and family life and psychological wellbeing in Australian industrial conditions.

Potential benefits of a modelling approach

The information needed to model work-related fatigue, that is hours-of-work, is usually available from time sheets, pilots duty forms, or pay records. From a work history of hours worked over a certain period, the work-related fatigue rate at the end

of the period, or indeed at any time during the work period, can be determined. This is assuming that at least one week of work times is available.

Furthermore, hours that have not yet been worked can be entered into the model and predictions of future work-related fatigue levels can be made. Using this format, shifts that show high fatigue levels can be identified without the shift actually being worked. This model allows comparisons between different work schedules and therefore can provide guidelines for fatigue management by comparing fatigue levels of different employees, working shifts of different lengths at different times of the day.

The model does not make decisions about which work schedules are most appropriate in specific workplaces. What the model does, however, is provide information that can be useful when decisions about fatigue management need to be made. Tracking fatigue scores in relation to OH&S data, absenteeism levels, employee illness days etc. would allow a clearer illustration of the relationship between hours-of-work and its related costs.

Defining the scores produced

To differentiate between schedules, four levels of work-related fatigue scores are defined. Standard fatigue scores are those ranging up to the maximum fatigue scores produced for a Monday to Friday 0900-1700hr standard work week (i.e. a score of 40). Moderate fatigue scores are those which are up to 200% of the maximum scores produced by the standard work week i.e. a score of 80. High fatigue scores are those which are between 200 and 250% of the maximum scores produced by the standard workweek i.e. a score between 80 and 100. Very high fatigue scores are those which are between 250 and 300% of the maximum scores produced by the standard work week i.e. a score between 100 and 120.

High fatigue scores are equivalent to the predicted level of work-related fatigue experienced after 23-24 hours of continuous sleep deprivation following a week working Monday to Friday 0900-1700h with Saturday and Sunday off. Performance impairment at such a level of sleep deprivation has been compared with the

impairment due to a blood alcohol concentration over 0.05% in a recent study (Dawson & Reid, 1997). Such a level of alcohol-related impairment would not be acceptable at work; therefore, the equivalent impairment due to fatigue is considered to be at a high level. Since fatigue levels undermine performance in a way similar to alcohol intoxication, high fatigue scores should be considered a significant risk.

4.3.2 Social evaluation modelling

OH&S risks associated with shiftwork have been accepted and documented for several decades (Baker, 1980; Harrington, 1978; Moore-Ede et al., 1985). More recently, shiftwork has been identified as a workplace hazard. However, unlike other hazardous workplace practices, the risks associated with shiftwork do not remain solely within the workplace but can be found to extend to incorporate the social and community arenas (Spelton et al., 1993). Not surprisingly, the impact and 'costs' of shiftwork in these non-workplace environments is significant (Rogers et al., 1997). Current literature acknowledges that shiftwork disrupts the lives, social relationships and contact shiftworkers have with their family and friends.

Hence, by quantifying the social disruptions associated with differing shiftwork systems it is possible to assess which sequence of shifts, number of consecutive shifts or rotation of shifts results in the greatest social consequences. That is, by recognising the social ramifications of specific work arrangements we can modify them to minimise social disruption. An applied modelling approach that enables organisations to quantify, compare and predict work-related psycho-social implications provides a methodology to improve shiftwork management and hence the lives of shiftworkers, their families and communities.

The psycho-social model is based on a survey designed to determine the social 'value' of time for both shiftworkers and non-shiftworkers. The survey provides the weighting for specific hours and days of the week. Consequently, the model scores the hours across the week depending on the time of the day and day of the week. This provides the relative 'social value of time' for any pattern of work compared to the more standard working week of 0900-1700h Monday to Friday. By recording the start time and duration of a work period it is possible to estimate the duration and

quality of sleep (based on previous research) and to calculate the work-related social 'cost' for any point in time within a work schedule.

The psychosocial model quantifies the 'psycho-social cost' for participants**.** In addition, it allows us to compare the psychosocial impact of different shiftwork systems in different situations. The model in essence acts as a 'token economy' for which there is a loss or gain in 'social value' depending on the days and hours worked.

The model is useful in that it allows comparisons to be made between any work arrangement independent of the number of hours worked, the length of the shift or the timing of the shift. Comparisons can be made between work allocations prior to their implementation to determine the social impact and the possible ramifications for the individuals and organisation concerned.

4.3.3 Actigraphy and sleep diaries

Sleep measures can be estimated from activity records obtained using ambulatory wrist actigraphy monitors (Gaehwiler Electronics, Hombrechtikon, Switzerland) worn on the wrist of the non-dominant hand for a given duration.

Rest/activity behavioural data, an indicator of sleep quality, can be recorded by an ambulatory wrist actigraphy monitor. Actigraphy provides a continuous record of the rest/activity cycle on an epoch by epoch basis (an epoch lasts 30 seconds). The amount of activity within an epoch is defined as the proportion of the epoch spent moving on a scale from 0 to 255. The rest/activity data is transformed into periods of arousal and non-arousal using an algorithm; this determines whether continuous non-zero epochs of activity are above or below a preset threshold based on the amount and duration of activity within a specific activity bout. This algorithm has been validated with polysomnographic measures of activity and shows correlations between 0.85 and 0.9. In this model the amount of 'energy' is derived from the product of the Root Mean Square (RMS) activity level and the duration of the arousal or non-arousal period. Hence higher levels of 'energy' in an arousal period reflect an increase in the

degree of wakefulness and conversely lower levels of 'energy' in a non-arousal period reflect a deeper level of sleep (Wallace et al., 1992; Dawson et al., 1995).

Essentially, when an individual is asleep there is little or no movement while when the individual is awake movement is generally recorded. Thus there is an assumption that if there is no movement the person is asleep while movement means that they are awake.

Sleep diary

The timing, duration and quality of sleep can be captured using a diary technique, generally over 14 consecutive days. In addition, the diary allows individuals to subjectively record their level of sleepiness using the Stanford Sleepiness Scale. This diary technique can compare the impact of different work arrangements on sleep and alertness. From this information it may be possible to infer changes in performance and safety.

4.3.4 Performance testing

Neurobiologically-based fatigue has been increasingly identified as a risk factor in occupational health and safety. Cognitively fatigued employees exhibit slow reaction time, impairment in complex reasoning skills and changes in cognitive psychomotor performance in a similar manner to individuals intoxicated by alcohol (Dawson & Reid, 1997). Evidence suggests this fatigue may be caused by conflict between irregular work hours and the endogenous biological processes that regulate everyday functioning (Dinges, 1995). Such processes are thought to be regulated by two mechanisms: the circadian pacemaker and homeostatic processes of sleep.

The first of these mechanisms, the circadian pacemaker, is located in the suprachiasmatic nuclei of the hypothalamus. It is the circadian pacemaker that causes certain physiological processes to oscillate with a period of 24 hours (Meijer & Reitveld, 1989). The second regulatory mechanism, the homeostatic drive for sleep is regulated by neural systems in the brainstem and basal forebrain. This regulates the amount of sleep required for a person to maintain alertness (Akerstedt, 1995; Gillberg, 1995). A combination of these two biological mechanisms constitute the

major determinants of many periodic neurobehavioural processes (Akerstedt, 1995). Such neurobehavioural rhythms are seen in many processes including: performance, subjective alertness, sleep propensity, body temperature, melatonin, and the sleep/wake cycle (Mitler & Miller, 196; Monk et al., 1997).

Shiftwork (sleeping during the day and working at night) prevents optimum co-ordination of neurobehavioural rhythms (Akerstedt, 1995). Conflict between hours-of-work and neurobehavioural rhythms of performance and alertness are of particular interest, as evidence strongly suggests that decrements in performance and alertness increase the likelihood of accidents in the workplace (Lauber & Kayton, 1988; Mitler et al., 1994; Mitler & Miller, 1996). Although it is known that shiftwork is associated with reductions in performance and alertness, little is known about the particular aspects of irregular hours-of-work and sleep disruption that cause these reductions.

Performance and alertness have neurophysiological rhythms that are circadian in nature (Monk et al., 1997). Research shows circadian rhythms of simple repetitive performance tasks and self-assessed alertness peak in the late afternoon and decline in the early morning, between 0300 and 0700h (Akerstedt et al., 1982; Monk et al., 1983, 1997). As a consequence, night shift requires an individual to work at the lowest point of the circadian rhythm of performance and alertness. Furthermore, the combined effects of reduced recuperation time and time of day of shift commencement lead to an increased risk of fatigue and accidents in the workplace (Akerstedt, 1995).

Many studies indicate that night workers have disrupted day sleep (Akerstedt, 1991; Akerstedt et al., 1991; Kecklund et al., 1994). This disruption is thought to be caused by biological factors (e.g. low propensity to sleep), environmental factors (e.g. increased light and noise) and competing social factors (e.g. family commitments). Sleep propensity (the ability to fall asleep) follows a circadian rhythm, which is low during the day and high at night (Lavie, 1986; Mitler & Miller, 1996). Typically, low sleep propensity in conjunction with sleeping strategies which allow for social activities, lead to shortened sleep and extended hours of wakefulness prior to work (Hughes & Folkard, 1976; Akerstedt et al., 1982). Extended hours of wakefulness result in shifts starting 10-16 hours after waking, compared with work starting 1-2

hours after a day worker wakes (Akerstedt, 1995). An increase in the hours of wakefulness prior to testing is known to cause a decrease in performance and alertness, in both sleep deprivation and shiftwork studies (Hughes & Folkard, 1976; Dijk et al., 1992; Dawson & Reid, 1997). Sleep length can be reduced by between 2-4 hours in shiftworkers and is associated with alertness decrements (Gillberg, 1995). In addition to working irregular hours, shiftworkers are often required to work longer shifts than the average 0900-1700h worker (Rosa, 1995). There is conflicting research regarding the effect of increased shift duration on performance and alertness (Peacock et al., 1983; Lewis & Swain, 1988; Daniel & Potasova, 1989; Rosa et al., 1989; Rosa & Bonnet, 1993; Duchon et al., 1994; Tucker et al., 1996). However, research has yet to examine the effects of shift duration in conjunction with the other factors mentioned above that affect performance and alertness.

Independent lines of research have shown that time of day of shift commencement, shift length, sleep length and hours of wakefulness prior to work affect performance and alertness (Dijk et al., 1992; Rosa & Bonnet, 1993; Gillberg, 1995; Tucker et al., 1996).

Objective and subjective testing

Objectively they can be measured using the Occupational Safety Performance Assessment Test (OSPAT). This is a 90-second computer-based performance task that requires subjects to sit at a computer screen and keep a continually moving marker in the centre of a target using a track-ball. After 90-seconds, the test ends and a score is recorded based on a number of measures including hand-eye coordination, vigilance, and reaction time. Higher scores on the OSPAT indicate greater levels of alertness, whilst lower scores indicate greater levels of fatigue.

Subjectively they can be measured using a self-rating form. This rating form asks subjects: 'How alert do you feel?' Subjects rate their level of alertness on a 100-point scale, ranging from 'extremely' to 'not at all'.

4.3.5 Focus groups

This technique allows groups of individuals to have input into the hours-of-work debate and can be less time consuming than one-to-one interviews. In addition, these group sessions can be effective in gathering large amounts of data related to concerns, issues and specific points, rapidly and easily.

4.3.6 Interview methodologies

Interviewing employees, employers (with their families), and community members can be a very useful strategy to discuss issues in relation to hours-of-work. This type of discourse often opens up avenues that may be restricted using a survey technique. In addition, more detailed information or 'stories' may be obtained through this type of strategy.

4.3.7 Survey techniques

Survey techniques have been used both before and after a given schedule has been changed to compare the new work arrangements to those previous.

This type of tool allows for the collection of demographic data and biographical information (age, gender, children, shiftwork experience, marital status etc.), as well as specifics about the roster rotation and duration, health and wellbeing of the worker (abdominal discomfort, chest pains, tiredness), sleep and fatigue, effects on family members/partner/friends, coping strategies (sleeping environment, diet, planning, communication) and morning/evening types. The standard shiftwork survey has been modified by The Centre for Sleep Research for use within Australian industries.

5. POTENTIAL OUTCOMES

It is our hope that this shiftwork policy will help marine pilots to achieve the following outcomes in their quest for better management of shiftwork:

- increased productivity
- improved morale and commitments
- reduced stress
- improvements to employee health and organisational safety record
- increased safety
- decreased absenteeism
- compliance with legislation
- establishment of OH&S policy with shiftwork adequately covered
- increased staff retention
- increased return on training investment
- increased ability to attract and recruit staff
- predictable work arrangement and personal involvement outside the workplace
- decreased domestic problems
- good corporate citizenship
- enhanced corporate image.

6. BIBLIOGRAPHY

Achermann, P., Werth, E., Dijk, D. J. and Borbely A. A. Time course of sleep inertia after nighttime and daytime sleep episodes. Archives Italiennes de Biologie. 1995, 134(1): 109-19.

ACTU Code of Conduct on Twelve Hour Shift Work, December 1988.

Åkerstedt, T., Czeisler, C. A., Dinges, D. and Horne, J. A. Accidents and sleepiness: a consensus statement. J. Sleep Res. 1994, 4: 195.

Åkerstedt, T. Shift work and sleep disturbances. In: J. H. Peter, T. Penzel, T. Podszus, P. von Wichert (Eds) Sleep and Health Risk. Springer Verlag, Berlin, 1991: 265-278.

Åkerstedt, T. Sleepiness as a consequence of shift work. Sleep. 1988, 11(1): 17-34.

Åkerstedt, T. Work hours, sleepiness and the underlying mechanisms. J. Sleep Res. 1995, 4(Suppl 2): 15-22.

Australian Medical Association. Draft national code of practice – hours-of-work, shiftwork and rostering for hospital doctors and background research. September 1998.

Baker, A., Roberts, T. and Dawson, D. Improving shiftwork management III: Changing hours-of-work. Journal of Occupational Health and Safety – Australia and New Zealand 1997, 13(5): 451-460.

Baker, D. The use and health consequences of shiftwork. International journal of health and services 1980, 10 (3): 405-420.

Balkin, T. J. and Badia, P. Relationship between sleep inertia and sleepiness: cumulative effects of four nights of sleep disruption/restriction on performance following abrupt nocturnal awakenings. Biol. Psych. 1988, 27(3): 245-58.

Berger, Y. Standby periods as workloads. Health and safety bulletin. Carlton South, Australia: 52, ACTU-VTHC OH&S Unit, 1991.

Bonnet, M. H. and Arand, D. L. We are chronically sleep deprived. Sleep 1995, 18(10): 908-911.

Bonnet, M. The effect of varying prophylactic naps on performance, alertness and mood throughout a 52-hour continuous operation. Sleep 1991, 14(4): 307-315.

Bonnet, M.H., Gomez, S., Wirth, O. and Arand, D.L. The use of caffeine versus prophylactic naps in sustained performance. Sleep 1995, 18(2): 97-104.

Costa, G. The problem: shiftwork. Chronobiology International 1997, 14(2): 89-98.

Dawon, D. and Reid, K. Fatigue, alcohol and performance impairment. Nature 1997, 388: 235.

Dijk, D-J, Duffy, J. F. and Czeisler, C. A. Circadian and sleep/wake dependent aspects of subjective alertness and cognitive performance. J. Sleep Res. 1992, 1: 112-117.

Dinges, D. F., Orne, M. T., Whitehouse, W. G. and Orne, E. C. Napping can enhance alertness during sustained wakefulness, but the importance of the temporal placement of the nap between days and within the circadian cycle remains controversial. Sleep 1987, 10(4): 313-329.

Dinges, D.F. An overview of sleepiness and accidents. J. Sleep Res. 1995, 4: 4-14

Dinges, D.R., Orne, E.C., Evans, F.J. and Orne, M.T. Performance after naps in sleep-conducive and alerting environments. In L.C. Johnson, D.I. Tepas, W.P. Colquhoun and M.J. Colligan (Eds) Biological rhythms, sleep and shift work: Advances in sleep research, New York, Spectrum Publications, 1981: 539-52

Downey, R. and Bonnet, M. H. Performance during frequent sleep disruption. Sleep 1987, 10(4): 354-363.

Fletcher, A. and Dawson, D. Predictive model of work-related fatigue based on hours-of-work. Journal of Occupational Health and Safety – Australia and New Zealand 1997, 13(5): 471-485.

Gillberg, M, Kecklund, G., Axelsson, J. and Åkerstedt, T. The effects of a short daytime nap after restricted night sleep. Sleep 1996, 19(7): 570-575.

Gillberg, M., Kecklund, G., Axelsson, J. and Åkerstedt, T. The effects of a short daytime nap after restricted night sleep. Sleep 1996, 19(7): 570-5.

Härmä, M. Individual differences in tolerance to shiftwork: a review. Ergonomics 1993, 36(1-3): 101-109.

Harrison, Y. and Horne, J.A. Sleep deprivation affects speech. Sleep 1997, 20(10): 871-877.

Horne, J.A. Sleep loss and 'divergent' thinking ability. Sleep 1998, 11: 528-36.

International Labour Organisation, convention 171 (night work) 1990, pages 2-8.

International Labour Organisation. The hours we work: new work schedules in policy and practice. Conditions of work digest 1990, 9(2).

Knauth, P. Changing schedules: shiftwork. Chronobiology International 1997, 14(2): 159-171.

Kogi, K. and Thurman, J. Trends in approaches to night and shiftwork and international standards. Ergonomics 1993, 36(1-3): 3-13.

Leger, D. The cost of sleep-related accidents: A report for the national commission on sleep disorders research. Sleep 1994, 17: 84-93.

May, J. and Kline, P. Measuring the effects upon cognitive abilities of sleep loss during continuous operations. Br. J. Psychol. 1987, 78: 433-55

Miltler, M., Carskadon, M., Czeisler, C., Dement, W., Dinges, D. and Graeber, C. Catastrophes, sleep and public policy: consensus report. Sleep 1987, 11(1): 100-109.

Monk, T and Folkard, S. Making shiftwork tolerable. Taylor and Francis, London, 1992.

Mullaney, D.J, Kripke, D.F., Fleck, P.A. and Johnson, L.C. Sleep loss and nap effects on sustained continuous performance. Psychophysiology 1983, 20:634-651

Naitoh, P. Chronobiological approach for optimising human performance. In: F.M. Brown and R.C. Greaber (Eds) Rhythmic aspects of behaviour. Laurence Erlbaum, Hillsdale, NJ, 1982: 41-96

Naitoh, P., Kelly, T. and Babkoff, H. Sleep inertia: best time not to wake up? Chronobiol. Int. 1993, 10(2): 109-18.

Reid, K., Roberts, T. and Dawson, D. Improving shiftwork management II: Shiftwork and health. J. Occup. Health Safety – Aust. NZ 1997, 13(5): 439-450.

Roger R. Rosa and Michael J. Colligan, Plain Language About Shiftwork, US Department of Health and Human Services, National Institute for Occupational Safety and Health, July 1997.

Sallinen, M., Härmä, M., Åkerstedt, T., Rosa, R. and Lillqvist, O. Promoting alertness with a short nap during a night shift. J. Sleep Res.

Tassi, P., Nicolas, A., Dewasmes, G., Eschenlauer, R., Ehrhart, J., Salame, P., Muzet, A. and Libert, J. P. Effects of noise on sleep inertia as a function of circadian placement of a one-hour nap. Perceptual and Motor Skills 1992, 75(1): 291-302.

Tepas, D. and Carvalhais, A. Sleep patterns of shiftworkers. Occupational Medicine 1990. 5(2): 199-208.

Wederburn, A. and Scholarios, D. Guidelines for shiftworkers: trials and errors? Ergonomics 1993, 36(1-3): 211-217.

Williamson, A. The Effects Of Workloads And Hours-of-work On Medical Officers, A Review Of The Literature, National Institute of Occupational Health and Safety, 1995.

7. APPENDICES