A report to

The National Consultative Council Occupational Health and Safety Sub Committee

on

Fatigue Management within Airservices Australia Air Traffic Services

SEPTEMBER 2004

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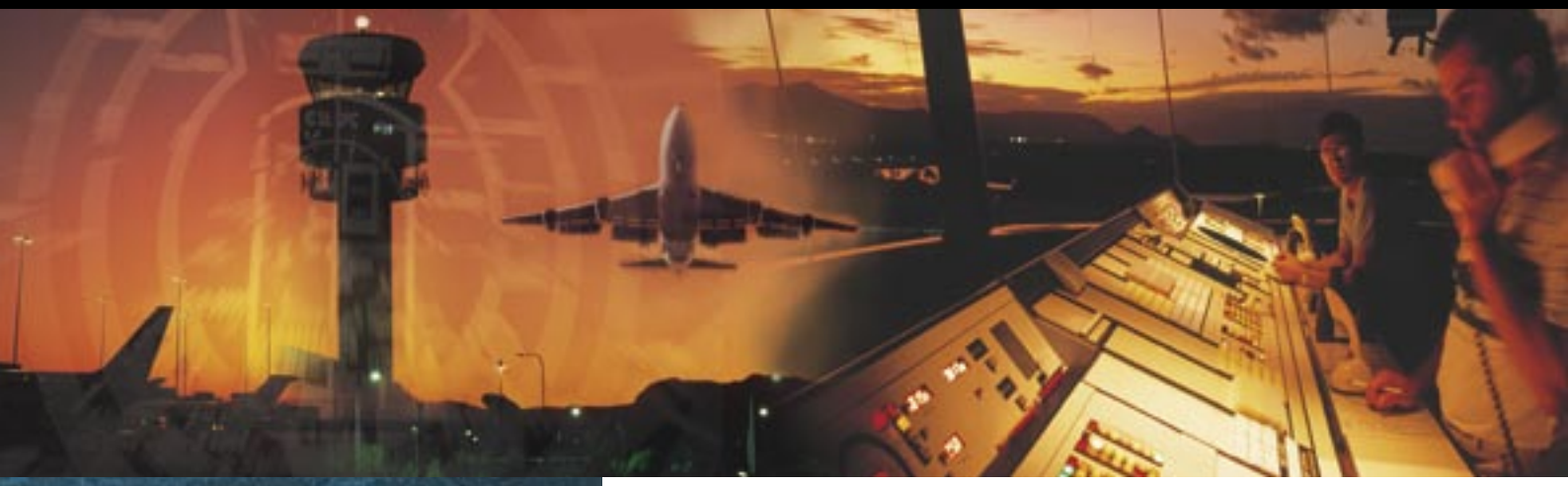

AIRSERVICES AUSTRALIA

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A report to

The National Consultative Council Occupational Health and Safety Sub Committee

From

Tony Allen
Fatigue Management Project Manager

on

Fatigue Management within Airservices Australia Air Traffic Services

This Report is based on the work of the members of the Fatigue Management Working Group

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Foreword

"We live in a world where commerce is conducted around the clock and by the click of a mouse. A world where goods and services are expected to be available when and where the customer wants. Human ingenuity has created these expectations. And, for the most part, they are met. But they come at a cost. One of these costs is human fatigue."

> Paul Neville, Chair, House of Representatives Parliamentary Inquiry into Fatigue in Transportation titled 'Beyond the Midnight Oil'

Aviation is a 24-hour per day, 365-day-per-year industry. It is very unlikely that this will ever change given the intense competition across the industry, the business drive for increased capital utilisation and numerous other factors. Therefore, human fatigue is a risk that will never be eliminated from the aviation industry because the hours of operation are not aligned with the basic need for human sleep and recovery.

Human fatigue can however, be managed in a way that maintains acceptable fatigue risk. Businesses within the aviation industry, including Airservices Australia, are therefore committed to managing fatigue risk to protect its employees, customers and services in general. The Australian air traffic controller's association, Civil Air, are also a committed partner with Airservices Australia to manage fatigue risk.

Historically, there have been no mechanisms for addressing fatigue risk in Airservices Australia beyond the indirect management via industrial agreements related to hours of work. Given increasing scientific understanding of fatigue and interest in more integrated risk management approaches by aviation regulators, Airservices Australia and Civil Air have been moving forward on an approach to meet current and future demands.

The process of research, review and recommendation that has been undertaken by Airservices Australia and Civil Air represents a significant and pioneering effort in the arena of Fatigue Risk Management. This is true not only because of the practical path forward that has been created but also because such a bipartisan management/union process would simply not have been possible in most international jurisdictions. The results of this project will therefore command significant interest from regulators, service providers, labour organisations, researchers and the airlines alike.

Once the recommendations of this report are implemented, Airservices Australia will confidently operate in the knowledge that their Fatigue Risk Management System is as effective as, or more effective than, other international air traffic provider's systems.

Dr Adam Fletcher

Scientific Advisor to the joint Airservices Australia and Civil Air Working Group for Fatigue Management

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Abbreviations and Glossary

ATC	Air Traffic Control or Air Traffic Controller(s)
ATS	Air Traffic Services
AusFIC	Australian Flight Information Centre
CASA	Civil Aviation Safety Authority
CTWG (Report)	Canadian Tripartite Working Group (Report)
EDU.Au	Consulting group associated with the Centre for Sleep Research, University of South Australia
FAID	Fatigue Audit InterDyneTM
Literature Review	A Review of Fatigue Management Research Literature and Current Air Traffic Control Practices for Airservices Australia 2003
FMWG	Fatigue Management Working Group
H24	Twenty Four Hours per Day
OH&S	Occupational Health & Safety
POR	Principles of Rostering
RDO	Rostered Day Off
TOR	Terms of Reference
Shift Cycle	A single block of consecutive rostered/worked shifts
Backward Rotating Shift Cycles	Cycles with shifts starting at an earlier time than the preceding shift (eg Late to Afternoon, Afternoon to Day and Day to Morning)
Slowly Rotating Shift Schedule	Rosters where the shift start time changes between shift cycles
Rapidly Rotating Shift Schedule	A change of shift start times every two or three days
Very Rapidly Rotating Shift Schedule	A daily change of shift start times

Executive Summary

Airservices Australia, like many transport industry participants, is responsible for providing safe and efficient services for 24 hours per day, on every day of the year. Aviation safety requires an air traffic services workforce that is technically skilled, alert and practicing high levels of effective interpersonal communications and teamwork. In this environment the management of fitness for duty, including fatigue, is of critical importance.

The Parliamentary Inquiry Report of the House of Representatives Standing Committee on Communications, Transport and the Arts titled "Beyond the Midnight Oil" released in October 2000 recommended that Airservices Australia and the Civil Aviation Safety Authority carry out further actions to more effectively manage fatigue.

In response to the Beyond the Midnight Oil Report and changes and additions to state OH&S laws, the Head ATC contracted EDU.Au, (a consulting group associated with the University of South Australia's Centre for Sleep Research) to conduct audits of ATS rosters and to develop a fatigue awareness education and training program for shift working staff.

The Airservices Australia Certified Agreement 2002–2005 contained the following: "The parties recognise the need to develop and implement revised rostering and fatigue arrangements. During the life of this Certified Agreement the following steps are being taken and/or are proposed:

The parties will develop an agreed Fatigue Management System and Plan and regularly review rosters against Computer Based Fatigue Management modelling tools.

A Fatigue Management Working Group comprising equal numbers of Airservices Australia and Civil Air representatives and reporting to the national OH&S Committee will develop agreed protocols and policies in relation to fatigue management. This will draw on appropriate outcomes from the external CASA reviews and by accessing external advice and expertise identified in the above House of Representatives Standing Committee Report. The sub-committee shall be provided with agreed terms of reference which will include rostering, leave and duty arrangements and will provide a report three months after commencement with final recommendations to be provided no later than six months after commencement."

Unfortunately, the Fatigue Management Working Group members were unable to reach agreement on the text of a final report. This is regrettable as the group, with significant assistance from Dr Adam Fletcher, reached broad agreement on almost every issue and their work was both comprehensive and meritorious. This report is based on their work, the issues on which broad agreement was not reached are identified in Attachment One of this report.

The result of fatigue audits of ATS rosters reveal that current rostering and extra duty scheduling practice is not achieving what could be termed best practice fatigue management. At times, ATS staff were working in safety critical functions with fatigue levels that were not appropriate for the nature of the work being undertaken. Although the total number of hours that this occurred in was a very small percentage of working time, this report identifies workplace and rostering practice that can be implemented to maintain fatigue at acceptable levels, thus reducing the risk of a fatigue induced error.

The Fatigue Management Working Group (FMWG), supported by Dr Adam Fletcher and colleagues from EDU.Au, has evaluated an extensive collection of scientific literature covering fatigue and the impact of shift work on fatigue and performance. It has also reviewed international air traffic controller shift rostering practice. The findings and recommendations in this report are based on fatigue management evidence contained in the published literature, conclusions drawn from FAID audit results, international ATC rostering practice, expert advice from Dr. Adam Fletcher and other sources.

The FMWG has reviewed current rostering and working practice within ATS and has been able to identify shift rostering and working practice that contribute to elevated workplace fatigue. It has also examined an array of mitigation strategies that could be used to modify current work practice. Implementation of these strategies will reduce the level of workplace fatigue and assist in maintaining, at acceptable levels, the fatigue associated with ATS shiftwork.

The FMWG also sponsored four risk assessment workshops involving shift working ATS staff. The workshops provided the FMWG with input from staff on workplace fatigue issues, and enabled staff to systematically assess fatigue management strategies developed by the FMWG.

This report refers to scientific positions on fatigue and international rostering practice pertinent to shiftwork within the ATS environment. It includes 54 recommendations that provide a basis for best practice fatigue management of shift rostering and working within an ATS environment. Principle among these is the need to implement an integrated Fatigue Risk Management System (FRMS).

FMWG members acknowledge that these recommendations will need to be implemented in a cooperative, thoughtful and flexible manner and understand that safety and business requirements may impact on the implementation process. Fatigue is only one factor in aviation safety and the appropriate use of risk management strategies should enable fatigue management requirements to be balanced against the other factors necessary for safe air traffic service operations.

In summary, this report provides Airservices Australia with the information and strategies necessary to implement a scientifically sound workplace FRMS. This should achieve a safer and healthier workplace and substantially meet any CASA requirements resulting from recommendations in the Parliamentary Inquiry Report. In a time of increasing government-required accountability requirements and fatigue-related OH&S legislation, the FMWG recommendations contained in this report will provide Airservices Australia with a significantly more compliant and consistent approach to the management of fatigue risk.

Working Group Outcomes

Achievements

Audits of Fatigue Levels

All master rosters and in excess of seventy four thousand worked shifts have been tested using the FAID system, which is proprietary software that predicts fatigue levels based on hours of work. Using a nominal FAID benchmark of 80 points, baselines have been established and master rosters with elevated fatigue scores are now being modified to reduce their risk. Responsibility for iterative improvement of fatigue in rosters now rests with Line Managers.

Review of Fatigue Management Research and Literature

EDU.Au has undertaken an extensive review of published fatigue management research literature and international ATC practice and has published the review within Airservices Australia.

Risk Assessment Workshop Report

An extensive report has been produced by QEST Consulting Engineers Pty Ltd on the four ATS workshops undertaken to review the work of the FMWG and to obtain input from staff on workplace fatigue issues within air traffic services.

Summary of Working Group Recommendations

The FMWG acknowledges that the recommendations listed below need to be implemented in a coordinated fashion to avoid unwanted outcomes that may detract from overall fatigue mitigation benefits.

Timelines for Implementation

The implementation timeline for each recommendation will be determined during the implementation planning stage.

Recommendations

Implementation

1) An integrated fatigue risk management system must be implemented for all shift working air traffic service staff
2) Implementation of, and variations to, the parameters contained in these recommendations must be subjected to a formal risk management process

Training

3) Provide fatigue management awareness and integrated fatigue risk management system training to managers, supervisors and support staff responsible for shift working staff or rostering of shift working staff

4) Provide integrated fatigue risk management system training to affected staff

5) Continue fatigue management awareness training for current shift working staff, inductees required to work shift work and the families of shift working staff

6) Review fatigue policy and training material within one year of implementation and at least every three years thereafter

Commuting

7) To reduce the risk associated with commuting, rostered night shifts should not finish prior to 0600 hrs. This general rule may not be applicable when it is daylight prior to this time

8) Staff who feel fatigued at the completion of a night shift should be encouraged to take a short nap prior to driving home. To avoid the risk of sleep inertia, driving should not commence for at least fifteen minutes after awakening

9) If possible, shift start and finish times should avoid peak commuting periods to reduce the exposure to commuting risk. It is likely that the peak commuting times will differ from location to location

Extra Duty

10) Strategies to reduce the requirement for extra duty on H24 rosters should be developed and implemented

11) Prior to allocating extra duty, the fatigue score impact of previous and future shifts should be considered

12) Extra duty should be allocated in a manner that maintains acceptable levels of fatigue

13) Guidelines for the appropriate allocation of extra duty and approval for mutual change of shift should be developed. These guidelines should be provided to supervisors, managers and other employees who make decisions about the approval or acceptance of extra duty and mutual change of shifts

14) The following should be avoided if possible:
    a. Allocation of an extra duty shift on a single day off
    b. Allocation of consecutive extra duty shifts

15) All staff should have at least one clear day off in seven

Fatigue Risk

16) Airservices Australia investigators, who investigate ATS incidents, should be required to ensure recent work attendance, including estimated sleep details and other relevant data is recorded in the incident database. Specifically, these data should include, but not be limited to, the following information:
    a. Start time of shift that the incident occurred on
    b. Time since last rest break, and length of rest break, during the shift that the incident occurred on
    c. Actual hours of work for the previous seven days and number of days since last two-day break
    d. Fatigue score at the time of the incident

e. An estimation by the employee, as soon as is reasonably practical after the incident, of the amount of sleep obtained in the 24 and 48 hours prior to the incident

f. An estimation by the employee, as soon as is reasonably practical after the incident, of the total time awake since a nap or sleep prior to the incident

g. A comment by the employee regarding the presence of any medications or life stressors that could impact on sleep quality and/or quantity or stress level

Facilities

17) Airservices Australia should provide facilities for ATS staff consistent with those recommended in the Final Report of the Canadian Tripartite Working Group on ATC Fatigue. Such facilities are especially important at locations where night shifts are worked

18) To promote alertness, recreation areas should be brightly lit

19) To alert staff in sufficient time to overcome the affects of sleep inertia, a clock with alarm or another alerting mechanism should be in place

20) To ensure good hygiene, facilities that are suitable for the storage of individual sleeping bags and pillows should be provided. Bedrooms should be cleaned regularly and reclining chairs should have easily cleanable surfaces

FAID Audits

21) ATS staff should not work with a FAID score above 80

22) Actual duty hours, including non-operational duty time, should be recorded. These data should be used as the input to determine individual fatigue scores

23) A process to routinely audit and report fatigue scores of planned and worked shifts should be developed. This should be automated using an integration of fatigue predictive software (e.g. FAID) with the rostering system in use

Fitness for Duty Testing

24) The development of objective fitness for duty testing devices (e.g. pupillometers) should be periodically reviewed with a view to implementing a system when it is considered that one is adequately valid and reliable

Leave

25) A common roster system to allocate recreation leave should be used by all shift working groups

26) The common roster system used for allocation of leave should allow, to the best of its capability, for equitable provision of leave within each year and across consecutive years

27) The full allocation of recreation leave each year should be provided as leave and not be allowed to be bought out

28) Staff should be encouraged to take all, or most, of their available recreation leave annually

29) Airservices Australia should ensure that the resource management plan enables the allocation of long service leave and staff should be encouraged to take their long service leave

30) Public holiday in lieu entitlements should not be paid out

Medical and Other Issues

31) Shift workers that fit risk criteria for sleep disorders such as sleep apnoea, and especially those employed in safety critical roles, should be medically screened. The risk of sleep disorders as determined by available criteria should be assessed during routine induction and/or other routine medical examination

Minimum Time Off

32) The minimum time off duty between any two shifts should be 10 hours. It should be acknowledged that this minimum period is unlikely to provide adequate opportunity for full recovery between shifts at certain time of the day

33) Multiple quick changes in the same shift cycle should be avoided

Night Shifts

34) The length of night shifts should be minimised and they should not be longer than 8 hours. This should be consistent with the general requirement that rostered shifts should not start after 0000 hrs and not finish before 0600 hrs

35) Night shifts should be kept to a minimum and be shared reasonably and equitably between eligible staff. Wherever possible, night shifts should be limited to one per shift cycle

36) Due to the higher level of fatigue associated with working night shifts, two days off should be rostered after a shift cycle containing night shifts

37) If a shift cycle includes a series of shifts prior to a night shift, they should be shifts that do not create a significant sleep debt and that maintain acceptable levels of fatigue

Napping

38) Napping should be supported as a fatigue countermeasure where opportunities exist

39) Protocols for napping, including the management of sleep inertia risk, should be developed

40 Provide staff and supervisors with education and guidance on:

a. Benefits of napping

b. Impact of sleep inertia risk

c. Risks associated with voluntary and involuntary napping on duty

41) Napping at operational positions should be expressly forbidden

Rest Breaks

42) Provide all staff with rest breaks to mitigate the effects of work related fatigue and to attend to personal needs

43) Define a rest break as “a period free from operational duty for workers to overcome the fatigue arising from work and to attend to personal needs”

44) In single person towers rest breaks should be provided at least every 4 hours and more often in high workload circumstances. For other ATS staff, rest breaks should be provided from operational duty at least every 2 hours and more often in high workload circumstances.

45) Rest breaks should be 20 to 30 minutes or more and should be consistent with the need to balance handover risk

46) Rest breaks are necessary on night shifts

47) The work and activity level on operational shifts should be reviewed regularly to ensure adequate opportunities exist for them to rest and to attend to personal requirements

48) Sufficient time, outside of rest break allocations, should be allocated to operational staff so they can attend to non-operational requirements (eg administration, & organisational e-mails, etc.)

49) Staff should be provided with guidance on how they can maximise the fatigue mitigating benefit of their rest breaks

Recovery Time

50) A clear day off should include an opportunity for a normal sleep period, which is defined as a sleep period of at least 8 hours in duration between the period 2200 hrs to 0800 hrs

51) Time off over traditional weekends should be equitably shared

Shift Duration

52) The maximum shift length for low workload operations should be ten hours. The maximum shift length for normal to high workload operations should be eight hours

Rosters

53) All rosters should be reviewed using the recommendations in this report and the guidelines for rostering and working practice (Appendix Four) to reduce the fatigue impact of rostered and worked shifts

54) All master rosters should be tested prior to implementation using fatigue predictive software (e.g. FAID).

Recommended Action Plan

Phase One (initial actions):

Implement those recommendations that can be readily implemented within the constraints of the organisational safety and financial requirements, especially those that are likely to achieve immediate and measurable reductions in workplace fatigue.

Phase Two (within 12 months)

Within this period strategies should be developed to implement a continuous program to reduce workplace fatigue and to implement outstanding recommendations.

Phase Three (as soon as practical)

Implement remaining recommendations. The end result of this phase should be a functioning integrated fatigue risk management system.

Introduction

The Fatigue Management Report of the House of Representatives Standing Committee on Communications, Transport and the Arts titled "Beyond the Midnight Oil" and released in October 2000 recommended that Airservices Australia and the Civil Aviation Safety Authority carry out further actions to better manage fatigue. Actions as endorsed by the Government, Airservices Australia and CASA are proceeding (See Appendix Two for pertinent recommendations).

In response to the Beyond the Midnight Oil Report, the Head ATC set up a project to work with EDU.Au, a consulting group associated with the Centre for Sleep Research (CFSR) at the University of South Australia. EDU.Au conducted audits on ATS rosters using fatigue predictive software known as FAID to ascertain the level of work related fatigue associated with hours of work. They also developed a fatigue issues awareness education and training program that was provided to Airservices Australia shift working staff.

As part of the Airservices Australia Certified Agreement 2002 – 2005, Airservices Australia agreed to pursue, through a working group reporting to the OH&S sub committee of the National Consultative Council, the development of industrially agreed protocols and policies in relation to Fatigue.

The Fatigue Management Working Group (FMWG), comprising two members representing management and two members representing unions, supported by Dr Adam Fletcher of EDU.Au, were provided with their Terms of Reference in June 2002. In July 2003, a Project Manager was provided to assist the FMWG to finalise their work program.

Fatigue Management Working Group Strategy

In responding to the Terms of Reference (TOR) the FMWG has reviewed previous work on fatigue management, shift work and international ATC rostering practice. The FMWG has relied extensively on the research and advice provided by Dr Adam Fletcher, other members of EDU.Au and internationally respected reviewers.

The FMWG notes that the approach to managing ATC fatigue in foreign jurisdictions generally remains a process of management by regulation and prescription of hours of work. It has been difficult to ascertain if rostering practices were developed using scientific fatigue management knowledge or are a result of social influences, industrial negotiations or government regulations.

Evidence Base

Airservices Australia contracted EDU.Au to evaluate the current physiological and psychological literature examining fatigue issues. EDU.Au were contracted to provide the FMWG with a review detailing the outcomes and limitations of published scientific research, particularly that pertained to fatigue and associated issues in ATC. This document titled "A Review of Fatigue Management Research Literature and Current Air Traffic Control Practices for Airservices Australia" (referred to in this document as Literature Review) was produced by Cameron van den Heuvel; Adam Fletcher;

Michael Paradowski and Drew Dawson and was reviewed by international experts Crystal Cruz from the USA Federal Aviation Agency and Philippa Gander, Director of the Massey University Sleep/Wake Research Group and formerly of NASA. This review provided the core of the evidence used in reaching the findings identified in this report.

It is worth noting that the quality of scientific studies in the areas of fatigue and its consequences in shift work is considerably variable. In most cases, this can be attributed to the measures used for determining fatigue, sleepiness or performance. Objective measures, those that are not generally subject to introspection by the subjects in a study, are usually more reliable and are often of greater value than subjective instruments such as self-reports or surveys.

While there is a considerable amount of scientific literature detailing general aspects of fatigue, sleep and circadian physiology, much of what is covered in the Literature Review (fatigue within a safety critical shift working environment) remains sparsely studied. The application of scientific knowledge to operational issues, and specifically ATC operations, is often tenuous, especially regarding factors of regulation, scheduling and countermeasures.

Where possible the FMWG has attempted to provide scientific evidence for the conclusions drawn, but where this is not possible, the FMWG has referred to current practice or precedents that may not necessarily be based on evidence but which, nevertheless, are considered to be from reputable and authoritative sources. An example of this is the CTWG Report (Report to the Tripartite Steering Committee on ATC Fatigue); whilst this document lacks definitive scientific evidence, it is a recent attempt to fully examine fatigue within the ATC environment and was therefore a useful reference for the FMWG.

The findings and recommendations in this report are based on examination of available published literature and international practice relating to fatigue. The FMWG is confident that an integrated fatigue risk management system embracing these findings and recommendations will enhance worker and customer safety, productivity and health, without any loss of operational flexibility.

Fatigue

What is Fatigue?

There are no widely accepted definitions of fatigue and this often contributes to confusion when discussing fatigue and sleepiness. The Bader Commission's 1972 inquiry into flight crew fatigue (cited in CRATCOH, 1990), gives an operational definition of fatigue as, "a markedly reduced ability to carry out a task. It is a condition of reduced performance from which there is no certainty that a person can be aroused in an emergency, even when considerable stimulus is present". Fatigue has also been described as, "a primarily subjective experience that includes physiological performance detriments and psychological impairments such as decreased morale, judgement and mood" (Brown, 1994).

While fatigue can occur following long periods awake, it can also be compounded by factors such as stress, over-exertion, dehydration or poor nutrition. According to Heslegrave (cited in CAMI/FAA Shift work Coping Strategies, 2001), "Fatigue cannot be prevented by personality, intelligence, education, training, skill, motivation, size, strength or professionalism". According to these definitions, it can be seen why managing fatigue is such a critical issue in the safety-oriented occupations found in Airservices Australia.

Impact of Fatigue

General

"The potential impact of fatigue includes increased anxiety, decreased short term memory, slowed reaction time, an increase in time taken to complete tasks, reduced motivational drive, decreased vigilance and attention narrowing, increased variability in work performance, reduced audio-visual scan, increased errors of omission, which lead to increased errors of commission when time pressure is added to the task, and increased lapses in performance occurring in both quantity and time." (Battelle Institute, 1998)

Performance

In 1997, Heslegrave and Rhodes reported on several performance measures compared in ATC workers between backwards rotating rosters and 5 consecutive night shifts. Performance was consistently worse during night shifts than on evening or day shifts, showing increasing impairment of performance from the 2nd night onwards. The direct relationship between progressive sleep loss and decrements in psychomotor performance has also recently been demonstrated by Belenky and colleagues (2003). Similarly, van Dongen and colleagues (2003) recently demonstrated that limiting sleep to 6 hours or less per night for 14 nights produced cognitive performance deficits equivalent to that observed with up to 2 nights of total sleep deprivation. The authors conclude that even relatively moderate restriction of sleep can significantly impair waking neurobehavioral functions in healthy adults. Subjective sleepiness ratings also indicated that the subjects were "largely unaware of these increasing performance deficits", which may explain why the impact of chronic sleep restriction on waking cognitive functions is often assumed to be benign.

Accidents and Incidents

Studies of fatigue and accident risk, such as those by Folkard (1997) and Hänecke and colleagues (1998) typically confirm the suggestion that sleepiness and fatigue translate into accident risk. Folkard (1997) studied previously published trends of traffic accident risk over the 24-hour day, and confirmed that the maximum accident risk occurred near 0300 hrs coinciding with the circadian maximum in sleepiness reported by others (Mitler *et. al.*, 1988; Lavie and Segal, 1989; Horne and Reyner, 1995). However, there are other influences on accident risk, the most prominent of these is perhaps time on task (time into journey in Folkard's study of driving). This risk was found to peak between 2 to 4 hours into time on duty and this peak was not exceeded until after 12 hours on duty (Folkard, 1997). In this study it was presumed that the result was due to exponentially increasing fatigue levels after 12 hours on duty. It was further suggested that this distinct peak in risk at the start of duty periods reflects the additive influence of two trends that exist in controlled and automated processing of incoming information (see Folkard, 1997 for more detailed explanation).

While there is documented evidence that ATC Specialists working various shift schedules in the US have shortened sleep periods (Saldivar, 1977; Cruz and Della Rocco, 1995), it was only relatively recently that assessments of the involvement of fatigue in incidents and errors in ATC specific operations have been made (Della Rocco, 1999). According to the CRATCOH Report (1990), about 13% of self reported ATC incidents (also known as operational errors) that were logged on the UK confidential safety reporting system (CHIRP), related directly to fatigue or fatigue related factors. In the US however, a review of the Aviation Safety Reporting System (ASRS), a confidential reporting system, revealed that controller fatigue was linked to only 2.7% of incident reports from 1988-1996 (Gregory *et. al.*, 1999). It is possible that this represents an under-reporting of fatigue.

In 1996, Rosekind and colleagues stated, "sleep and circadian physiology are complex, and 24-hour operational requirements are varied. It is not possible therefore, that a single approach or strategy will be successful in managing all fatigue factors engendered by 24-hour demands".

A review of recent (2003) Australian ATS incidents revealed scant and incomplete information on fatigue factors. Despite this, a number of "simple controller errors" were reported as occurring on extra duty shifts and during shifts that commenced prior to 0600 hrs, where fatigue may have been a contributing factor.

Health

Shift work, particularly night shift, is one of the primary causes of circadian dysrhythmia. The reason for this is that it requires a relocation of work duties from daytime, which is a time when our biological systems are primed to be awake and active. The relocation is from daytime into the dark phase of the day, when our bodies and minds are prepared for rest and sleep. In the long-term, shift work causes desynchrony between the internal circadian system and environmental time cues (e.g. light from the sun). More than twenty years ago, Reinberg and Smolensky (1983) associated the loss of internal circadian synchronisation with general health impairment or even clinical manifestations of disease. More recently, studies have shown that circadian desynchrony results specifically in poor performance, increased errors and accidents, decrements in social relations, and decreased sleep, fitness, digestive, neurocognitive and cardiovascular health (Costa, 1996; Waterhouse *et. al.*, 1992).

Apart from circadian disruption, shift work has also been identified as a significant source of stress for the shift worker, due to disruption of sleep, fatigue and social and domestic disturbances (OTA Report, 1991).

General health complaints higher amongst shiftworkers than day workers include:

1) Sleeping difficulties
2) Stomach upsets
3) Irritability and moodiness
4) Fatigue
5) Colds & Flu and/or
6) Headaches

More specific complaints associated with longer periods of working shiftwork include:

1) Gastrointestinal disorders
2) Cardiovascular disease and
3) Difficulties with pregnancy and general reproductive health in females (Baker A; Fletcher A; Dawson D; 2001)

The domestic and social consequences of shift work pose significant problems. The requirement for shift workers to alter sleep, meal and recreational patterns contributes not only to sleepiness and fatigue but also to the disruption of the social lives of the shift worker and other family members as well.

With regard to sleep disturbances, a review by Åkerstedt (1998) supports the view that shift work causes increased subjective, behavioural, and physiological indicators of sleepiness. The main finding in the context of this report is that sleepiness becomes markedly higher during the night shift, and increases the likelihood of falling asleep while on duty. In relation to safety-critical occupations such as ATC, “this clearly constitutes a hazard that may endanger human lives and have large economic consequences” (Literature Review p8).

Response to Terms of Reference

Overview

The content below is based on FMWG research and investigation into the fatigue issues identified in the Terms of Reference (TOR) and provides fatigue risk management strategies that are applicable to the air traffic services function.

TOR 1

Examine and review the progress of current Airservices Fatigue Management initiatives including, but not limited to:

i. Airservices Fatigue Policy development;

ii. Adequacy of current provisions relating to time away from duty between shifts, rest periods during shift, leave arrangements and amount of leave available;

iii. Whole of system audit, including progress on testing of rosters against a fatigue management package (FAID software, Microster etc)

iv. Risk assessment exercise as part of the whole of system audit; and

v. Provision of Training materials and "train-the-trainer" education packages.

TOR 1 Part (i) Policy

Airservices Australia Fatigue Management Policy

Airservices Australia has provided the following draft Fitness for Duty Policy:

Airservices Australia is a provider of safe, environmentally friendly and efficient air traffic and related aviation services.

To achieve our goal of safety and performance, employees must have the physical and mental capability to perform their jobs in a safe, secure, productive and effective manner. For the purposes of this policy, this is referred to as "fitness for duty". An employee shall not attend for work or remain at work unless they are fit for duty.

Factors that may impact adversely upon an employee's fitness for duty include impairment due to fatigue, stress, illness, mental health, and alcohol and other drugs.

Airservices Australia is committed to the implementation of occupational health and safety procedures targeted at the factors impacting adversely on fitness for duty. These procedures will complement existing legislative and regulatory requirements and will ensure that:

- *employees are aware of their rights and responsibilities with respect to fitness for duty;*
- *a supportive environment exists in which issues regarding fitness for duty can be discussed and resolved with dignity, sensitivity and requisite confidentiality; and*
- *appropriate operational, behavioural and medical standards guide determinations on fitness for duty; and*
- *all reasonable efforts are made to accommodate the special needs of employees with disabilities.*

Airservices Australia, its managers and employees share responsibility for the implementation of this policy. Roles, responsibilities and protocols will be enunciated in the relevant occupational health and safety procedure.

Chief Executive Officer

Finding

The FMWG agrees that the inclusion of the Fatigue Management Policy within an overarching Fitness for Duty Policy is appropriate.

TOR 1 Part (ii) Current Provisions

Adequacy of current provisions relating to time away from duty between shifts, rest periods during shift, leave arrangements and amount of leave available

Currently Airservices Australia manages the rostering of shift working ATS staff through the use of prescriptive clauses in the ATS Certified Agreements.

Shifts that start or end during the normal sleep period, generally accepted to be a window between 2200 hrs and 0800 hrs, or involve long commuting times, may impact adversely on the restorative sleep period.

Staff are very much involved in the design of shift cycle patterns applying throughout ATS. It is clear that, generally speaking, staff prefer a shift and roster system that maximise the period of time off duty between shift cycles. This is sometimes achieved by the use of rapidly backward rotating shift cycles, long shifts or the rostering of five or six shifts within a single shift cycle. Each of these strategies can result in increased workplace related fatigue. Staff also have flexibility to mutually swap shifts (within the terms of the POR) to meet personal and family needs. Parameters within which mutual shift swaps are required to comply have sometimes been relaxed and this can contribute to the higher fatigue levels noted in fatigue audits.

TOR 1 Part ii (a) Time Away from Duty

Adequacy of current provisions relating to time away from duty between shifts

From a workplace fatigue management viewpoint, the reasons for time off duty between shifts are to provide time to achieve sufficient restorative sleep (to recover from fatigue associated with the previous period of duty), to rest (to enjoy personal, family and social activities) and to prepare for the next period of duty.

Current Principles of Rostering (POR) Relating to Time Away From Duty Between Shifts

- Ten hours between consecutive shifts (eight hours if recalled to duty)
- Three clear days rostered off following a run of six consecutive shifts or following a run of consecutive shifts totalling more than forty hours
- Two clear days off following a run of five consecutive shifts or following a run of consecutive shifts totalling more than thirty hours
- In each 28 day period, measured with reference to the commencement of the roster cycle concerned, a minimum of eight days off shall be rostered, including a minimum of two clear days off on at least two occasions
- A roster shall not require an individual to undergo more than seven quick changes in any six week period, measured continuously. Eight quick changes in a six week period may be rostered with the agreement of the local rostering committee.

Refer to Appendix Three for full list of POR and definitions.

The basic function of a roster is to balance customer service (hours and level of service), safety (fatigue risk), cost and a satisfactory social and family life for employees. The above POR are a currently agreed combination of rules aimed at achieving this balance. FAID audits have shown that the majority of hours worked by ATS staff are completed within acceptable fatigue levels, however the POR do permit working arrangements that can result in elevated fatigue levels. As a result, a small percentage of planned work and a higher percentage of extra duty work produce fatigue scores that may not be compatible with the nature of the duties being undertaken. On the basis that some H24 rosters routinely contain rostered or extra duty shifts with elevated fatigue scores, it is reasonable to state that the application of current shift rostering provisions, relating to time away from duty between shifts, is not entirely satisfactory.

Time Off Duty Between Consecutive Shifts Within a Shift Cycle

One of the major contributing factors to fatigue is “attempting to work after inadequate restorative sleep; both duration and quality of sleep are important for restoring wake time function” (Rosekind *et. al.*, 1996). It is generally necessary to obtain up to eight hours of sleep during the normal sleep period in order to gain “sufficient restorative sleep”. Thus, the period during which the time off duty occurs is of significant importance. Providing a given number of hours (e.g. 10 hours) between periods of duty will not necessarily enable adequate quality sleep opportunity if the time of day available is biologically inappropriate for sleep.

An additional issue arising from providing minimum time off between shifts is that it increases the likelihood of the employee using part of the time necessary for restorative sleep to undertake other activity necessary to meet family and social responsibilities.

From this, it can be seen that rosters that include a morning and night shift commencing on the same day will elevate fatigue levels. A run of early morning starts (particularly prior to 0600 hrs) also increases fatigue levels, likewise a run of late night finishes. The primary reason these shifts increase fatigue levels is that such shifts require sleep to be cut short.

FAID audits have confirmed that the use of early morning start times followed by a night shift on the same day is a regular cause of elevated FAID scores in ATS rosters.

Findings

- The value of time off duty in combating fatigue is as much related to the time of day it occurs as to the number of hours away from work
  - Consecutive shifts that do not provide an opportunity for overnight sleep are highly unlikely to allow for sufficient restorative sleep and will normally result in elevated levels of fatigue
- Eight hours off duty between shifts will not normally allow sufficient time for a complete restorative sleep.

Recommendations

- The minimum time off duty between any two shifts should be 10 hours. It should be acknowledged that this minimum period is unlikely to provide adequate opportunity for full recovery between shifts at certain time of the day (Recommendation 32)
- Multiple quick change shifts in the same shift cycle should be avoided (Recommendation 33).

Time Off Duty Between Shift Cycles

Totterdell and colleagues (1995) considered the practicalities for scheduling acute rest days in shift work schedules after studying the recovery of sleepiness, fatigue, performance and sleep. As they state, “Although regulations on work hours usually include a minimum weekly rest period, there is little empirical evidence concerning recovery from work.” They suggest that subjective and objective ratings of mood and performance in a shift working population do improve with only one scheduled rest day but continued improvements are seen with an additional day off work.

Van Dongen and colleagues (2003) recently demonstrated that limiting sleep to 6 hours or less per night for 14 nights produced cognitive performance deficits equivalent to that observed with up to 2 nights of total sleep deprivation. The authors conclude that even relatively moderate restriction of sleep can significantly impair waking neurobehavioral functions in healthy adults. Subjective sleepiness ratings also indicated that the subjects were “largely unaware of these increasing performance deficits, which may explain why the impact of chronic sleep restriction on waking cognitive functions is often assumed to be benign”. Based on these current studies, it would also appear that at least 2 nights is required for adequate recovery after a block of shifts, not only to regain a normal pattern of sleep, but also to return performance to normal levels (Literature Review p9).

Apart from recovering from fatigue, the period of time off between cycles of duty is of particular personal importance as it is the primary period during which a shift worker can effectively attend to family, social and other obligations. A two-day period between duty cycles provides far more opportunity to meet these obligations than a one-day break from work. It is also valid to claim that time off duty over traditional weekends is of greater (family and social) benefit than time off at other times.

The period of time off necessary to recover from the fatigue associated with a particular shift cycle is largely dependent on the level of fatigue existing at the start of the rest period and the availability of normal sleep periods to assist in achieving sufficient restorative sleep. The level of fatigue associated with any particular shift cycle within ATS is highly dependent on the number of night and/or early morning shifts worked and the total number of hours worked during the shift cycle. A minimum of two days off between shift cycles should be rostered often, particularly after and preferably prior to, any shift cycle containing a night shift.

Roster audits indicate the most significant cause of high FAID scores is rostered and non rostered extra duty, particularly when night shifts are also worked. Some extra duty is planned (to enable essential training programs to be delivered, for example); however, a significant amount is for replacement of unplanned staff absences. Many groups have only sufficient qualified resources available to meet their minimum roster and recreation leave requirements. To maintain critical staffing levels, management often has little option but to allocate extra duty to replace short term absences. Staff that elect to perform extra duty on their Rostered Day Off (RDO) have a reduced opportunity to successfully recover from fatigue associated with previous work episodes. This is particularly true if their extra duty shift occurs on a single RDO, is a night shift, or involves consecutive extra duty shifts. A further reason not to allocate extra duty to staff on a single day off is that staff working more than six consecutive shifts are increasingly likely to use sleep opportunities for other purposes such as socialising or attending to other needs.

Generally, international ATC practice, which does not appear to be based solely on fatigue mitigation principles, is to allocate the number of hours and days a controller can be rostered to work rather than to specify the period of time off duty a controller should receive after one or more work episodes. In practice, allocating a minimum number of rostered days off after a number of days of work may achieve little, if staff work extra duty on these rostered days off. Available data indicates that many air traffic services staff are working regular extra duty shifts. The current rostering provisions do not always ensure controllers have the opportunity to achieve sufficient restorative sleep prior to attending for subsequent duty.

Findings

- For a day off to effectively provide an adequate restorative sleep opportunity, it needs to provide an eight hour period for sleep during the normal sleep period
- Time off over traditional weekends is valuable for recovery as well as family and social demands
- Two days off between shift cycles improves the opportunity for adequate recovery from fatigue associated with the previous shift cycle and provides increased opportunity to meet family, social and other obligations
  - Providing two days off prior to a shift cycle containing a night shift will assist in minimising the initial fatigue level and result in a lower fatigue score on the night shift
- Extra duty, especially on H24 rosters, can significantly increase the level of workplace fatigue
  - The provision of FAID data or advisory tables may assist supervisors to assess the fatigue risk associated with extra duty allocation

- The following shifts are likely to result in elevated fatigue levels:
  - An extra duty shift on a single day off
  - Allocation of consecutive extra duty shifts
  - Allocation of an extra duty night shift
  - Extra duty resulting in more than six consecutive shifts
- Self assessment of impairment due to fatigue can be unreliable, particularly if high levels of fatigue are being experienced.

Recommendations

- A clear day off should include an opportunity for a normal sleep period, which is defined as a sleep period of at least 8 hours in duration between the period 2200 hrs to 0800 hrs (Recommendation 50)
- All staff should have at least one clear day off in seven (Recommendation 15)
- Due to the higher level of fatigue associated with working night shifts, two days off should be rostered after a shift cycle containing night shifts (Recommendation 36)
- Time off over traditional weekends should be equitably shared (Recommendation 51)
- Strategies to reduce the requirement for extra duty on H24 rosters should be developed and implemented (Recommendation 10)
- Prior to allocating extra duty, the fatigue score impact of previous and future shifts should be considered (Recommendation 11)
- Extra duty should be allocated in a manner that maintains acceptable levels of fatigue (Recommendation 12)
- Guidelines for the appropriate allocation of extra duty and approval of mutual change of shift should be developed. These guidelines should be provided to supervisors, managers and other employees who make decisions about approval or acceptance of extra duty and mutual change of shifts (Recommendation 13)
- The following should be avoided if possible (Recommendation 14):
  a. Allocation of an extra duty shift on a single day off
  b. Allocation of consecutive extra duty shifts.

TOR 1 Part ii (b) Rest Periods During Shift

Adequacy of current provisions relating to rest periods during shift

Rest breaks were identified in the ATS Risk Assessment Workshops as being a significant issue.

A diary study by Spencer *et. al.* (1997, 1999) found that when workload was low, fatigue ratings remained relatively stable for continuous work periods of up to four hours. However, when workload was high, a rapid increase in fatigue was observable after two hours of continuous work.

There are also some suggestions in the literature relating to the commonsense scheduling of rest breaks, such as:

- The need for rest breaks to recover from mental fatigue is greater with work requiring acute mental attention (Sharmin and Rahman, 1997)

- Some forms of work, especially those requiring sustained mental vigilance, may benefit from a rigidly structured work/rest regime (Boucsein and Thum, 1997).

One recent definition of rest breaks according to Ahasan (2002) is that they are scheduled periods during work, "designed to provide time for workers to overcome the fatigue arising from the work and to allow workers to attend to personal needs (such as going to the toilet)". In the ATS context, The Canadian Tripartite Working Group (CTWG) defined a break in the following terms: "The CTWG considered that a meaningful relief break means that the individual controller is not responsible for an operating position." Hopkin (1995) suggests that, "all rest breaks should be away from the air traffic control work environment so that the controller can relax and cannot continue to watch the displays. It should never be necessary to resume control duties immediately and unexpectedly during a break. Rest breaks should always be taken whether the controller has been busy or not....Light traffic loading is not an adequate reason for dispensing with rest breaks." Although Hopkin does not provide referenced experimental research to support his statements, he is considered a reputable and authoritative sources in the field of human factors issues in air traffic control.

Alertness

Boredom may be described as an absence of stimulating tasks when attention must be maintained, and is typically encountered in repetitive or monotonous situations. Arousal and boredom are thus subjective states, relating to the perceptions of operators.

Boredom has been suggested to cause greater problems in ATC operations than stress (Hopkin, 1980). These early reviews were primarily concerned with aspects of system design that may contribute to ATC boredom. These factors include increased passivity and monitoring with less active involvement, decreased professional opportunity for skilled or trained behaviours, less need for human intervention and restrictions on human cognitive functions such as decision making, problem solving and prediction.

As ATC increasingly adopt technological advances and automation, it is important that the human factors implications of these advances be considered. Of particular interest may be the potential contribution of task automation to increased boredom, particularly if the aids are designed to alleviate workload.

The CTWG concluded, "Periods of low workload can negatively influence the alertness of individuals whose performance may already be degraded by fatigue. This is a recognized operational condition, the results and risks of which may be exacerbated when a person is fatigued."(CTWG Report p16) Its following recommendation is of particular importance to night shifts; "Consider the heightened importance of reduced workload when it coincides with conditions that induce fatigue and apply such countermeasures as rest and caffeine, naps, relief breaks, social interaction or a fitness break." (CTWG Report p16).

Controlling large enroute sectors with crossing or converging air routes near sector boundaries requires constant vigilance, even during relatively low traffic levels. The traditional coordination process involving specific verbal interchange between controllers is being replaced by silent electronic communication protocols. It may be appropriate to vary the parameters of electronic safety alerts and alarms, during known periods of increased fatigue risk, to provide more reaction time for controllers to respond to a developing situation.

Irrespective of workload, alertness levels can be assisted by rotation of tasks and changing posture (Literature Review p21). This can be particularly effective in towers where staff should rotate positions at least every two hours.

ATC Factors

Three significant factors are at play when rest breaks for ATC are discussed. Firstly is the known increase in the prevalence of operational error in the period immediately after commencing duty and returning from a rest break. Hopkin (1995) however notes that "... there could be some tenuous evidence that a controller might be most vulnerable whilst still building the traffic picture after coming on duty, but this trend is too weak to provide a basis for executive action. Its apparent corollary, that incidents could be minimised by long shifts that reduce the frequency of handovers and the need to rebuild the picture, seems false because the resultant fatigue would act in the opposite direction." Again, Hopkin does not provide referenced experimental research to support this statement, however it is included due to his reputation in this field.

The second factor is related to the variability of traffic levels. Some ATC experience periods of very little or no traffic (especially in provincial towers or TCU/TMA on night shift). On some positions, ATC workload varies from busy to very busy.

The third factor is the nature and purpose of the rest break. The normal concept of a rest break is a period of personal time in which the worker can go to the toilet, prepare and consume food and/or drink and make personal arrangements. Undertaking these activities whilst responsible for aircraft safety is not sound practice.

The issue of rest break requirements for ATC was also recently examined by the CTWG. It reported that "Prolonged time on position, under certain conditions, can lead to fatigue that degrades performance. The conditions that may induce fatigue include traffic levels, complexity and operations that require sustained vigilance. Degraded performance might take the form of reductions in vigilance and alertness. The literature review and the CTWG's own research indicates that two hours in position (adjusted downward for busier traffic periods) followed by a relief break, is considered the norm, however it was noted that under certain circumstances this period may be extended to four hours, subject to certain mitigating measures." (CTWG Report p15) The CTWG recommended that "Where circumstances do not permit the norm (such as in single person tower operations), the period between breaks should not exceed 4 hours".

Despite research undertaken in the United Kingdom by Spencer et. al. (2000) which found that where workload is low, the contemporary UK regulatory limit of 2 hours before mandatory breaks of 30 minutes are taken is unnecessary, and could be increased, "even to 4 hours", a recent (2003), revision of The Scheme for the Regulation of Hours in Air Traffic Control (UK CAA) maintained the requirement for a break after two hours. Under certain "exceptional or extraordinary" circumstances this period can be extended to four hours, but only by express permission of the Regulator.

Current Principles of Rostering Relating to Rest Breaks

- Employees should not be required to work a shift without a period of relief from their operational duties
- In a shift of less than eight hours, an employee shall be entitled to a break(s) totalling twenty minutes. In a shift of eight hours or more, a break(s) totalling one hour shall be available
- Where the break or breaks are available as a result of the nature of the duties and/or workload patterns of particular positions no further provision need be made for relief. Where this is not the case, the break or breaks may be provided by combining positions where this is possible or where necessary by rostered relief staff

- The above provisions do not apply to night shifts
- In situations where only single person staffing is provided, the parties will monitor the OH&S aspects of shift lengths and operational duty requirements.

Refer to Appendix Three for full list of POR and definitions.

International ATC practice is to provide rest breaks approximately every two hours (or more frequently in high workload circumstances), however periods of up to four hours between breaks are worked in some circumstances. Research findings support the allocation of regular rest breaks for ATC to maintain the required level of alertness. Researchers suggest that continuous working periods should be limited to between 2 and 4 hours depending on workload. Airservices Australia's current POR are insufficient to maintain the levels of alertness required for operational ATC staff and to meet OH&S guidelines. However, current practice often provides for rest breaks more frequently than provided for in the POR. Current practice should be examined and documentation updated to ensure rest breaks are appropriately provided. New strategies may need to be developed to enable rest breaks to be allocated to all staff at appropriate intervals.

The lack of specific procedures to be followed by staff to obtain relief from operational activity on night shift and in single person operations requires attention. The requirement to continuously monitor frequencies, due to the unpredictability of aircraft movements, together with, on many combined en-route positions, more aircraft in the airspace for longer, may have reduced the number of opportunities available to take informal rest breaks. Furthermore, rest breaks when available, are not without responsibility for the ongoing service. The need for regular rest breaks on night shifts is at least as important as, if not more important than, the need for breaks during other parts of the day.

It is essential that activity requirements of staff working alone be routinely examined to ensure that the shift contains periods when work activity is sufficiently low to enable staff to attend to personal requirements (e.g. going to the toilet, food and drink preparation and consumption, etc.) Written procedures should be provided to ensure that these staff can be temporarily absent from their workstation in order to attend to personal needs without compromising operational safety.

Irrespective of the workload, the allocation of breaks during a period of duty is essential to maintain an appropriate level of alertness. However, in ATC operations the frequency of break allocation should be balanced against the known increase in operational error rates that occur during handover and within the first thirty minutes of control responsibility.

The FMWG has been advised that many ATC spend at least some of their assigned rest break performing routine non operational duties (eg accessing e-mail accounts for administrative and operational documentation, attending meetings or undertaking project work, etc). Activity of this nature, particularly when screen based, precludes staff from achieving the intended and necessary recuperative benefits of the assigned rest break; a period outside of a designated rest break should be allocated for it.

Findings

- The availability and nature of rest breaks are issues for ATS staff
- The allocation of rest breaks during a period of duty is essential to maintain alertness and performance, and to enable staff to attend to personal needs
- Some fatigue countermeasures are also effective in dealing with low levels of alertness associated with low workload and boredom; eg. position rotation, break away from operational duty, social interaction, caffeine, fitness break, etc.

- The frequency and length of rest breaks should be determined by the nature of the work being undertaken and the environment in which the work is being performed
- The ATS POR section 8 requirement for 20 minutes of break(s) in a shift of less than eight hours is inadequate under most circumstances
  - Despite the POR, most ATS staff appear to have access to sufficient rest periods during their shifts
  - Current practice should be examined and, where appropriate, documentation updated
- In single staffing functions individual staff members retain responsibility for the service for long periods (often for the entire night shift) and rely on natural breaks in operational activity, if any, to rest and to attend to personal requirements
  - Current practices should be examined to establish if breaks that are available as a result of the nature of duties and/or workload patterns at particular positions are sufficient
- Changing posture and rotation to a less busy or less complex position is an effective method of sustaining alertness
- Rest breaks are being used to undertake non operational (eg administrative) duties.

Recommendations

- Provide all staff with rest breaks to mitigate the effects of work related fatigue and to attend to personal needs (Recommendation 42)
- Define a rest break as “a period free from operational duty for workers to overcome the fatigue arising from work and to attend to personal needs” (Recommendation 43)
- In single person towers rest breaks should be provided at least every 4 hours and more often in high workload circumstances. For other ATS staff, rest breaks should be provided from operational duty at least every 2 hours and more often in high workload circumstances. (Recommendation 44)
- Rest breaks should be 20 to 30 minutes or more and should be consistent with the need to balance handover risk (Recommendation 45)
- Rest breaks are necessary on night shifts (Recommendation 46)
- The work and activity level on operational shifts should be reviewed regularly to ensure adequate opportunities exist for them to rest and to attend to personal requirements (Recommendation 47)
- Sufficient time, outside of rest break allocations, should be allocated to operational staff so that they can attend to non-operational requirements (eg administration & organisational e-mails, etc.) (Recommendation 48)
- Staff should be provided with guidance on how they can maximise the fatigue mitigating benefit of their rest breaks (Recommendation 49).

TOR 1 Part ii (c) Leave Arrangements

Adequacy of current provisions relating to leave arrangements

Recreation leave provides shift workers with a valuable opportunity to mitigate the potential adverse impact of long term shift work. Taking recreation leave as one long annual holiday may maximise the health benefits of the available recreation leave.

The full annual allocation of recreation leave is generally available throughout ATS; however occasionally a major training or project requirement can interrupt normal leave allocation programs. In locations with only a small workforce access to leave may be limited to a period when additional resources can be provided, thus restricting the leave options available to staff.

Several ATC have claimed it is difficult to access recreation and long service leave because of insufficient staff to meet operational and training requirements. It may be that in some instances the recreation leave is available but not taken because the allocated period is incompatible with the preferences of the individual shift worker.

TOR 1 Part ii (d) Amount of Leave

Adequacy of current provisions relating to amount of leave available

The significant recuperative benefits of a vacation in addressing chronic work related fatigue and in meeting family responsibilities are generally well accepted. It is also obvious that 365 day shift work reduces the opportunity for shift workers and their families to participate in vacations during the preferred holiday periods (i.e. Christmas, Easter and school holidays).

A need for extra annual leave for shift workers is often advocated on the basis that it may mitigate some of the effects of the family and social disruption, and ill health effects due to shift work (Literature Review p22). Whilst available evidence provides clear guidelines around topics such as consecutive night shifts in a certain period and length of shift, there is little or no evidence for other topics, such as some aspects of age and gender issues, as well as leave requirements relating to shift work.

The research on the benefits of leave from work to recover has been in the main limited to a single health outcome such as “burn out”. There is evidence that a period of leave from work enhances recuperation from physical complaints, improves quality of sleep and improves mood for a period beyond the actual period of leave. The limited research available indicates that both frequent breaks from work and long breaks from work are beneficial.

In one of the few studies of this type regarding recuperation from shift work, Andlauer and co-workers (1982) suggested that a chronic period of “6 weeks of unbroken rest per year is a minimum requirement to compensate the adverse effects of shift work”. However there is currently no other objective evidence available, that either supports or argues against such a large, single block of leave being necessary for total recovery from fatigue. While this period is thought to allow an effective recovery of biological functions, it reflects the stance on preventative measures that has typically been adopted in Germany and other European countries over the past 20 years.

According to the CTWG Report (2001), most ATC providers vary provision of recreation leave according to length of service or age. While illustrative, these examples are typically not supported by any definitive evidence from published studies:

In Canada, leave per year is:

- 15 days (less than 8 years service)
- 20 days (8 to 18 years service)
- 25 days (19 to 29 years service) and
- 30 days for 30+ years' service

In the USA, leave per year is:

- 13 days (less than 3 years service)
- 20 days (3 to 15 years service) and
- 26 days for 15+ years' service

In the UK, leave per year is:

- 28 days (less than 8 years service)
- 30 days (8 & 9 years service) and
- 33 days for 10+ years' service

In Spain, leave per year is 45 days including 15 days during Summer, with 6 additional days given to shift workers

In Germany, leave per year is up to 32 days

In the Netherlands, leave per year is 24 days plus

- 1 day if between 30-40 years old
- 2 days if between 41-45 years old
- 3 days if between 46-50 years old and
- 4 days if 51-55 years old

In Switzerland, leave per year is 27 days if <40 years old and 32 days if 40+ years old.

In addition to recreation leave, Airservices Australia staff are eligible for three months of long service leave after 10 years of service and an additional 9 calendar days per year thereafter. Staff should be encouraged to take this additional leave when eligible to mitigate the possible adverse impact of long term shift work. To ensure long service leave is available it should be included in resource management planning.

The FMWG accepts that additional recreation leave would reduce individual exposure to the fatigue and ill-health effects of shift work if the leave was used appropriately. This may lead to increased feelings of well being. There is a lack of specific research evidence for the FMWG to identify an optimum period of leave from work to obtain health benefits with respect to shift-work and fatigue.

Findings

- A need for extra annual leave for shift workers is often advocated
- Recreation leave provides shift workers with a valuable opportunity to mitigate the potential adverse impact of long term shift work
- The limited research available indicates that both frequent holiday breaks from work and substantial holiday breaks from work are beneficial

- Access to long service leave entitlements enable shift working staff an additional opportunity to overcome the potential adverse impact of long term shift work after 10 years employment
- The FMWG is unable to provide a recommendation on the adequacy of current provisions relating to leave allocation to ATS shift workers
- Further research into the relationship between the recuperative benefits of leave and the detrimental effects of long term shift work is required before a recommendation could be made on the adequacy of current provisions.

Recommendations

- A common roster system to allocate recreation leave should be used by all shift working groups (Recommendation 25)
- The common roster system used for allocation of leave should allow, to the best of its capability, for equitable provision of leave within each year and across consecutive years (Recommendation 26)
- The full allocation of recreation leave each year should be provided as leave and not be allowed to be bought out (Recommendation 27)
- Staff should be encouraged to take all, or most, of their available recreation leave within annually (Recommendation 28)
- Airservices Australia should ensure that the resource management plan enables the allocation of long service leave and staff should be encouraged to take their long service leave (Recommendation 29).

Availability and Access to Other Forms of Leave

Depending on the country, demographic characteristics and industry specific factors, sick leave may account for up to 70% and injuries another 20% of certified absences from work. The balance may be called “healthy worker absences”, such as leave taken with or without prior permission or post-facto justification (Reviewed in Luz and Green, 1997).

The provision of sick leave, like recreation leave, often varies significantly between different countries and also between different industrial sectors. In 1998, Kleiven et. al. studied the incidence of certified sick leave episodes longer than three days in a large Norwegian chemical plant. Workers were engaged in three slowly rotating shifts, 2 shifts without night work, or daytime schedules. The risk of sick leave did not change with the number of years in shift work nor were there any meaningful differences between shift or day workers. These results are generally in line with those of previous studies (e.g. Aguirre and Foret, 1994; Campolo *et. al.,* 1998). However, while the incidence of morbid health problems is increased in shift workers it is not yet possible, on the basis of available evidence, to suggest that the provision of sick leave should or should not be adjusted from that of non-shift workers within an industry or organisation.

Public Holidays

The Airservices Australia ATS Certified Agreement provides for shift workers who are not rostered to work on the public holiday to be allocated an additional day’s leave and for that day to be paid out if the leave is not taken within one month. Shift workers who are rostered to work on a public holiday are paid a penalty rate payment but do not have access to the day off in lieu. An arrangement that provides for different fatigue outcomes within the same roster is inequitable from a fatigue management viewpoint. The period

during which the day in lieu may be taken severely restricts access to this concession and should be increased.

Public holidays are often associated with very high air traffic activity and high ATS workload but the current arrangements generally result in many seven day a week shift working staff effectively working most public holidays (i.e. they still work their normal weekly hours irrespective of the public holiday). From a fatigue management viewpoint, this inequality of access to public holiday benefits is an issue of concern. This is particularly so when a public holiday falls adjacent to a traditional weekend. A strategy should be developed to ensure the fatigue mitigation benefits associated with the provision of public holidays are equitable across all staff.

Finding

- The current arrangements for public holiday benefits deliver different outcomes to staff on the same roster; this is inequitable.

Recommendation

- Public holiday in lieu entitlements should not be paid out (Recommendation 30).

TOR 1 Part (iii) System Audit

Whole of system audit, including progress on testing of rosters against a fatigue management package (FAID software, Microster, etc.)

Overview

This TOR is understood to refer specifically to the testing of rosters against the FAID software to provide an indication of the level of workplace fatigue attributable to each roster. Although significant progress has been made with the auditing of master and worked rosters, it has not been possible to obtain the necessary data to test every line of every worked roster.

Fatigue Audit InterDyne TM (FAID)

Background

Traditionally, shift work and associated fatigue have been 'managed' by limiting the length of shifts and total number of hours worked per week, month or year. This has been regulated by employee awards and more recently by industrial arrangements such as enterprise bargaining agreements. However, this approach generally fails to consider key fatigue issues such as the time-of-day of work and rest periods. Therefore considerable effort has recently gone into developing and validating tools that account for work-related fatigue in a more scientific and objective manner.

A recommendation contained within the House of Representatives Federal Parliamentary inquiry into fatigue in transportation (Beyond the Midnight Oil, October 2000) and supported in the response of the Federal Government (June 2001) was that Airservices Australia should routinely test the shift rosters of air traffic control staff against a reputable computer-based fatigue-modelling package. This was recommended to assist Airservices Australia in determining the cause and nature of any workplace fatigue associated with hours-of-work.

Following discussions between Airservices Australia and EDU.Au Pty Ltd, it was agreed that a comprehensive work-related fatigue assessment would be undertaken using proprietary software called Fatigue Audit InterDyne™ (abbreviated to FAID). FAID software is used by a significant number of Australian companies and government bodies with a requirement to manage fatigue within their workplace. A number of other software packages were considered, however FAID was identified as currently the most appropriate for Airservices' needs.

FAID Program

An Australian software company, InterDynamics has developed the FAID program under licence from the University of South Australia. This software incorporates algorithms developed by members of the Centre for Sleep Research at the University of South Australia. FAID is a fatigue modelling program that produces a fatigue index (score) based on a number of relevant factors known to affect work-related fatigue.

The FAID model allocates fatigue or recovery value to work and break periods based on four factors:

- Length of shift and period between shifts,
- Time of day of each shift and period between shifts,
- Prior (seven day) work history of individuals, and
- Biological limitations on sleep and recovery.

FAID is a practical tool to screen rosters for opportunities for individuals to obtain recuperative sleep between work episodes. It is important to note however that FAID is purely a predictive tool and that the FAID model does not account for individual issues (e.g. inability to sleep due to environmental factors). Therefore, although FAID may predict an acceptable level of fatigue, individual circumstances may result in higher or lower levels of fatigue than predicted by FAID.

The model does not make decisions on which work schedules are most appropriate in specific workplaces. The model does provide information that can be useful when decisions about fatigue need to be made. Tracking fatigue scores in relation to incident frequency, absenteeism levels, employee sick days or other meaningful data would allow a clearer illustration of relationship between hours of work and its related costs.

Furthermore, FAID scores need to be interpreted in the context of the nature of the work being performed. That is, a FAID score that is acceptable for one type of work may not be acceptable for another type of work. Generally, the more safety-critical the function, the lower the maximum acceptable FAID score will be.

FAID Scores

By analysing a planned or actual set of work hours using the FAID system, a score is produced. The FAID score is not a percentage but a number and can range from zero up to more than 140. To differentiate between work schedules, four levels of work-related Fatigue Scores are defined:

- Standard fatigue represents fatigue scores up to the maximum fatigue scores produced for a Monday to Friday 0900 hrs to 1700 hrs standard work week; that is, a score of approximately 40
- Moderate fatigue scores are those which are up to a score of approximately 80
- High fatigue scores are those that are between 80 and 100

- Very high fatigue score is a score of 100 or greater.

During FAID validation experiments the performance impairment observed at a particular FAID score differed depending on the test used. This reflects the fact that different tests are more or less sensitive to fatigue. Of all of the tests, the vigilance score was the measure that was most highly correlated with fatigue predictions. The performance decrements observed for vigilance at a FAID score of approximately 80 to 100 are associated with decrements seen in individuals with a blood alcohol concentration of 0.05% or greater.

While the unit of measurement used by FAID is arbitrary, benchmarking and validation studies suggest that fatigue scores below 80 are broadly consistent with a safe system of work. However, it is critical to note that even though scores below 80 have been shown to be consistent with a safe system of work, this does not negate the need for risk assessments to take place. Risk assessments provide information on acceptable levels of work-related fatigue associated with specific tasks that employees may be required to perform. In comparison, FAID calculates work-related fatigue associated with the hours-of-work. Furthermore, in cases where sleep occurs during a work shift, FAID will not account for the reduction in fatigue unless the sleep is input as part of the data.

FAID and Fatigue Risk Management

Individuals performing tasks or operating in environments that either require a higher level of alertness to perform safely, or are such that an error may result in significant risk or damage, should operate at a lower level of fatigue than those accepted in the general context above. Specifically, the higher the level of alertness required and the higher the consequences of error, the lower the acceptable fatigue level and the lower the acceptable FAID score. However, when identifying an appropriate FAID level for a specific task, consideration must also be given to the specific risk mitigators available to manage the task related risk.

Until a model to account for such factors can be developed and validated, a practical method for accounting for factors not accounted for by FAID is by using a risk management approach such as the Australian Standard for Risk Management (AS/NZS4360). With assistance and guidance from Dr Fletcher, the FMWG has undertaken some pioneering work in this area (see Fatigue Risk Assessment Workshops).

The definition of a job or task does not affect the accumulation of fatigue points within FAID; however, it is likely that the maximum level of fatigue that would be accepted for a task assigned as ‘high’ risk would be lower than for a task assigned as a ‘low’ risk. In summary, the most appropriate interpretation of a FAID score only occurs when it is used as part of a fatigue risk management process. Therefore, to determine acceptable maximum fatigue scores for different work tasks and conditions, all of the significant factors that might impact on a person’s capacity to do a job safely need to be taken into consideration. The FMWG considered the issue of FAID scores applicable to ATS work and agree that the current interim FAID score benchmarks need to be reviewed as part of an ongoing fatigue risk management strategy.

FAID Audit Results

All of the data so far examined is from the period prior to the availability of fatigue management guidance within Airservices Australia. Its value is twofold, firstly it establishes a baseline from which improvements in fatigue management can be measured and secondly it identifies rostering practices that have a significantly adverse fatigue impact.

Overview

Audits were conducted on various supervisor, ATC, AusFIC and TFDC rosters covering the following periods:

a) November 2000 to October 2001 of approximately 1000 staff rostered at 25 locations (actual hours worked)

b) October 2001 to January 2002 on 3,601 assigned roster lines in eight Districts

c) May 2002 to July 2002 on 892 staff working on 48 rosters (actual hours worked)

d) September 2002 and December 2002 on 915 staff working on 46 rosters (actual hours worked).

The change from Rosterman to Microster and the introduction of SAP have significantly hindered the continuous collection of data for this aspect of the project, particularly in regard to ATS rosters.

No audit of Sydney Tower roster was possible due to the lack of actual worked hours data. Only incomplete data has been available from Sydney TCU. As a result, it has not been possible to obtain comparative reports on identical work groups. The summary of results below can therefore only be taken as indicative of the overall fatigue impact of ATS rosters.

Whilst some ATS rosters are consistent with the traditional set format roster (i.e. a regular pattern of shifts and days off is repeated throughout the roster), many of the larger rosters appear to have limited structure with significant variations of shift cycles within the same roster. This may partially be explained by the use of FPC and Journeyman endorsements within the same roster group.

FAID audits of air traffic services rosters reveal that the larger the number of staff on a single roster, the more likely it is for elevated FAID scores to be found. A solution may be for group HR plans to provide for a two part roster. One part (FPC roster) containing sufficient FPC lines to operate the FPC component of each roster and the second part providing roster lines suitable for either FPC or Journeymen. This would avoid the necessity of transferring FPC shifts from a Journeyman to an FPC during routine roster preparation. A roster of this nature would provide staff with more certainty of routine progression through the roster lines, which in turn would enhance the likelihood of maintaining a transparent and soundly structured roster delivering predictable fatigue outcomes.

The summary of data below relates to the four audits (a to d) above. Detailed findings are available in separately-published audit reports. A FAID score of 80 was used as the threshold score in these reports. This score was used because it is the conservative edge of the 80 to 100 “high” fatigue score band. A conservative score was considered desirable due to the highly safety critical nature of ATS tasks.

Audit Findings

First Audit

This audit was of worked shifts and that Sydney data was not analysed because many shift changes were not recorded.

Findings:

- 72% of locations had 99% of rostered shifts below a FAID score of 80
- Three locations had more than 5% of shifts with a FAID score above 80
  - Melbourne (6.8%)
  - Adelaide Tower (6.4%)
  - Brisbane (5.2%)
- Fourteen locations had no staff exceed a FAID score of 80
- Nine locations had more than 10% of staff exceed a FAID score of 80 on at least one occasion
- Five locations had more than 50% of staff exceed a FAID score of 80 on at least one occasion
- Five locations had at least one staff member exceed a FAID score of 100
  - Brisbane
  - Melbourne
  - Canberra
  - Adelaide Tower and
  - Perth Tower
- Three factors were found to be the primary cause of high FAID scores
  - High number of hours worked (i.e. extra duty)
  - Compressed work periods (i.e. backward rotating rosters and irregular allocation of RDO)
  - Morning and night shifts on the same day.

Audit 1 Conclusions

From this audit, EDU.Au concluded:

“Stated clearly and simply there is not a widespread fatigue problem across the air traffic controllers hours of work assessed. However, there are some specific issues that should be addressed. For example:

- The ability of individuals to compress large amounts of work together without taking adequate breaks (these include the use of double shifts in a day); and
- The ability of shifts to span long blocks of the night and early morning.

Additional areas that are of less serious nature but could also improve fatigue risks if addressed are:

- The compression of shifts that don't necessarily occur at night time or during the early morning hours; and
- Extended work sequences that do not allow for at least one full day of rest per seven days.

It is clearly desirable that Airservices implement system wide analysis of rosters on a regular basis. As can be seen from the analysis undertaken, this would enable Airservices Australia to develop a systematic organisation-wide analysis tool for managing work-related fatigue. This would support management processes and policy frameworks that would target problem areas with respect to work-related fatigue. Most importantly, this would permit and encourage Airservices to direct resources and organisational attention to the locations and individuals where the maximum risk reduction could be achieved most cost effectively. Furthermore, the use of such systems will partially fulfil the recommendations of the parliamentary inquiry and the whole-of-government response."

Second Audit

Audit of data produced between October 2001 and January 2002 covering 3,601 assigned roster lines in eight Districts.

Note that this audit was of proposed rosters only and did not include data from Sydney Tower.

Findings:

- 99% of all rostered shifts were below a FAID score of 80, however this distribution was not even across ATS
- Approximately 15% of all roster lines contained at least one shift with a FAID score in excess of 80
- Three locations had more than 10% of roster lines reach a FAID score in excess of 80
  - Melbourne 21.7% of roster lines
  - AusFIC 15.5% of roster lines
  - Brisbane 10.7% of roster lines
- Adelaide TCU; Perth TCU; Northern and Western Airport Services had no staff rostered to exceed a FAID score of 80
- Brisbane had one staff member rostered to exceed a FAID score of 100
- Two factors were found to be the primary cause of high FAID scores
  - Compressed work periods (i.e. backward rotating rosters and irregular allocation of RDO)
  - Morning and night shifts on the same day.

Audit 2 Conclusions

From this audit EDU.Au concluded:

"On the whole it can be said that there is not a widespread problem of work-related fatigue at the level of planning. Fatigue appeared to be well distributed among the lines of the roster. This means that where high fatigue shifts were observed, they were not concentrated on any particular roster lines but rather spread among a proportion of lines.

This has the effect of spreading the fatigue within the employees of each district. This leads to the higher fatigue risk levels being brought lower, and the lower risk levels higher, spreading risk more evenly, so the highest risks are eliminated.

More specifically however, several high fatigue scores were observed in master rosters. It was observed that this instance of high fatigue was related to characteristic shift patterns. Specific issues arising from the analyses that may be addressed in regard to roster planning are:

- Extended work sequences that do not allow for at least one full day of rest per seven days
- The capacity for night time work that follows morning work on the same day to increase fatigue levels.

Predicted fatigue associated with planned work hours can be compounded by several factors (such as overtime work) when the roster is implemented. This means that actual work-related fatigue may exceed the levels originally predicted from planned rosters. Given that the planned rosters included in the present analysis contained work shifts with fatigue scores as high as 100.6, there are clearly challenges to be met in isolated cases."

Third Audit

Audit of data produced between May 2002 and July 2002 on 892 staff working on 48 rosters.

Note that this audit was of worked shifts and that Sydney data was not analysed because many shift changes were not recorded.

Findings:

- Nineteen rosters had 99% of shifts below a FAID score of 80
- Sixteen rosters had more than 5% of worked shifts above a FAID score of 80
  - Melbourne TFDC (12.0%)
  - Melbourne OSS (11.3%)
  - Adelaide Tower (9.8%)
  - West (8.9%)
  - Ocean (8.8%)
  - Brisbane Tower (8.7%)
  - Brisbane Ops Managers (8.4%)
  - Melbourne Tower (8.0%)
  - Cairns (6.9%)
  - Bight (6.8%)
  - Melbourne TMA (6.6%)
  - Tops (6.5%)
  - Barossa (6.2%)
  - Byron (6.1%)
  - Perth TCU(5.5%) and
  - Moreton (5.3%)

- Fourteen rosters had no staff exceed a FAID score of 80
- Twenty seven rosters had more than 10% of staff exceed a FAID score of 80
- Four rosters had more than 50% of staff exceed a score of 80
- Eighteen rosters had at least one staff member exceed a FAID score of 90
- Barossa and Melbourne TFDC rosters had at least one staff member exceed a FAID score of 100
- Three factors were found to be the primary cause of high FAID scores
  - Extended work sequences (i.e. extra duty, particularly on a single day off)
  - Morning and night shifts on the same day
  - Long shifts, particularly early morning or night shifts.

Audit 3 Conclusions

From this audit EDU.Au concluded:

"In general, no widespread problem of work-related fatigue has been identified for the Airservices air traffic controllers actual work hours that were included in the analyses. However there were significantly more concerns in the actual hours relative to the master rosters. Some specific issues that should be considered are:

Quick changeovers between morning or afternoon shifts to night shifts

Extended work sequences that do not allow at least one full day of rest per seven days;

The ability of shifts to continue for long periods, particularly when these periods span long blocks of the night and early morning.

Work-related fatigue was not distributed evenly across the 48 Responsibility Codes (RCs). Indeed fatigue was far more prevalent among the air traffic controllers that worked in Melbourne and Brisbane operations. Furthermore, the Melbourne, Adelaide, Brisbane and Perth airport towers had a higher incidence of fatigue than the more regional sites. Surprisingly this did not seem to be influenced by shift length. However the sites with higher fatigue were generally characterised by a higher number of overall shifts than the sites that scored lower fatigue.

Another point of interest was that units with restricted opening hours (i.e. non 24h operations) were not characterised by high fatigue scores. This is not particularly surprising given the general absence of early morning and night shifts. This suggests that non 24h operations may have the ability to be more flexible with their work hours without impacting on work-related fatigue."

Fourth Audit

Audit of data produced between September 2002 and December 2002 on 915 staff working on 46 rosters.

Note that this audit was of worked rosters and did not include data from Sydney Tower.

Findings:

- 78% of rosters had 99% of worked shifts below a FAID score of 80
- 52% of rosters had more than 5% of worked shifts above a FAID score of 80
- Nineteen rosters had no staff exceed a FAID score of 80

- Twenty seven rosters had more than 10% of staff exceed a FAID score of 80
- Five rosters had more than 50% of staff exceed a FAID score of 80
  - West; 77% of staff exceeded a FAID score of 80
  - Ocean; 64%
  - Adelaide Tower; 63%
  - Perth TCU; 60%
  - Brisbane Tower; 58%
- Twenty one rosters had at least one staff member exceed a FAID score of 90
- Five rosters had at least one staff member exceed a FAID score of 100
  - West; 3 staff
  - Sydney TMA; 2 staff
  - Adelaide Tower, Bass and Bight; 1 staff member each
- Three factors were found to be the primary cause of high FAID scores
  - The higher the number of staff on a roster the higher the likelihood of high FAID scores (i.e. possibly less structure to basic roster)
  - Morning and night shifts on the same day
  - Extended work sequences (i.e. extra duty, particularly on a single day off).
- The locations/rosters that consistently exceeded a FAID score of 90 for more than 5% of the time were; Adelaide Tower; Brisbane Tower; and the enroute groups of Tops; Bight and West. Additionally, incomplete data suggests shift supervisors and MCO TFDC may also have consistently exceeded the interim actual worked FAID benchmark.

Audit 4 Conclusions

In its conclusions EDU.Au noted the following:

"These analyses suggest that for Airservices air traffic controllers at the 46 locations studied, the work related fatigue situation is far from dire. However, some specific issues are identified as needing to be addressed:

- The existence of Fatigue Scores in excess of 100 at 10% of locations
- Over half of all locations registering Fatigue Scores above 80 for 10% or more of employees; and
- The fatiguing effects of quick changeovers between morning or afternoon shifts to night;

Significantly, the worst case scenarios encountered in the present analysis were influenced by quick shift changeovers, as was the case for the previous Airservices Fatigue Analysis Report of air traffic controllers' actual hours of November 2002. Further comparison with the previous analyses confirm that high fatigue was not influenced by the measures of average shift length that was obtained. However the trend for RCs with large numbers of shifts to produce proportionately more moderate to very high Fatigue Scores was replicated in this report. Statistical procedures confirmed that a relationship between the number of shifts and the proportion of employees that attain Fatigue Scores above a threshold of 90 exists. Finally, as in previous analyses, the RCs of 3389 West Enroute and 3362 Adelaide Tower (particularly the former) showed among the highest fatigue levels. These results provide potential areas to target in the aim of controlling and reducing the impacts of work-related fatigue.

It should be noted that the nature of the fatigue model used to undertake these assessments is not concerned with the type of work that is undertaken during work shifts. Thus, work tasks that may be associated with a high degree of risk may require a lower theoretical threshold compared with tasks that represent little risk. The use of a Fatigue Score of 80 as a theoretical threshold may not be considered appropriate once a full risk-management process has been completed. Furthermore, it is seen as beneficial to conduct additional task risk assessment procedures as a part of a broader risk management process.

Several findings of the present report, in conjunction with previous findings, suggest that benefits can be obtained from continued, regular and system-wide analysis of rosters at Airservices Australia. Continued analyses of employee actual work hours can lead to Airservices Australia establishing a systematic organisation-wide analysis tool for managing work-related fatigue. This would support management processes and policy frameworks that would target areas of potential improvement with respect to work-related fatigue. Most importantly, this would permit and encourage Airservices Australia to direct resources and organisational attention to the locations and individuals where the maximum risk reduction could be achieved in a cost effective manner. Furthermore, the use of such systems will partially fulfil the recommendations of the parliamentary inquiry and the whole-of-government response."

Findings

- Only a small number of hours were recorded when the FAID score would have exceed 80
  - These were normally on a night shift and usually on the fifth or sixth consecutive shift within a cycle
- All rosters involving night shifts recorded at least one staff member exceeding a FAID score of 80
- Some rosters had limited periods of time when staff were on duty with FAID scores that were not compatible with the nature of the work they were undertaking; this was mainly due to extra duty shifts
- Audits have identified common factors associated with high FAID scores in ATS rosters:
  - Night shifts included in shift cycles of more than four shifts
  - Extra duty on a single rostered day off, consecutive extra duty shifts or an extra duty night shift
  - Single days on which two shifts are worked; i.e. early morning and night shift, these shifts are often preceded by additional early morning shifts
  - Two or more consecutive night shifts
- High night shift FAID scores can be largely addressed by providing two days off prior to the shift cycle containing the night shift
- There was no significant change in FAID scores across audits.

Recommendations

- All rosters should be reviewed using the recommendations in this report and the guidelines for rostering and working practice (Appendix Four) to reduce the fatigue impact of rostered and worked shifts (Recommendation 53)

- All master rosters should be tested prior to implementation using fatigue predictive software (eg FAID) (Recommendation 54)
- ATS staff should not work with a FAID score above 80 (Recommendation 21)
- A process to routinely audit and report fatigue scores of planned and worked shifts should be developed. This should be automated using an integration of fatigue predictive software (eg FAID) with the rostering system in use (Recommendation 23).

TOR 1 Part (iv) Risk Assessment

Risk assessment exercise as part of the whole of system audit

To meet this TOR the FMWG undertook a risk management assessment of the risks associated with a single hazard (i.e. fatigue) in the workplace. The process was based on AS/NZS 4360 (Risk Management) with reference to AS/NZS 4801 and AS/NZS 4804 (OH&S Management systems), the outcomes or risk events of this hazard were identified as any of the following:

- Work place injury to self or others
- Ill health, either short term or chronic
- A commuting injury to self or others
- A workplace performance error (that has the potential to impact adversely, directly or indirectly, on safety).
- The following should be noted:
  a) The risk assessment undertaken and detailed below did not include a business risk assessment or Safety Management System assessment that will be required prior to the introduction of any business or operational changes resulting from implementation of recommendations included in this report. However, the material below and that contained in the Workshop Reports should provide most of the data required to complete these risk assessments
  b) The consequence of a workplace performance error was not progressed beyond an initial error or linked to other specific outcomes as an initial error is already examined in each SMS risk assessment. In practice, this risk assessment exercise was concerned with reducing the likelihood of an initial workplace error
  c) Although the identified adverse outcomes occur occasionally, it has been difficult to identify Australian ATS incidents where fatigue was probably the primary, or even a contributing, causal factor associated with the adverse event. This is likely to be related to the fact that fatigue is rarely investigated in incident or accident assessment procedures.

Two separate approaches were taken to provide a risk assessment of workplace fatigue within the air traffic services environment. The first involved a review of ATS incident data for incidents which may have had a fatigue causal factor and the second involved a comprehensive assessment of possible workplace fatigue issues and mitigation strategies.

Review of Incident Data

Approximately 1700 entries in the Electronic Safety Incident Report (ESIR) data base (covering the period January to September 2003) were searched for incidents involving experienced ATS staff making operational errors or omissions in apparently non

complex situations. These incidents were then examined for data relating to recent work attendance, time of occurrence and time since commencement of shift. Although this was a very basic approach, it did provide sufficient information to identify the need for more careful consideration of fatigue as a possible causal factor in ATS incidents.

Approximately 50% of the incidents identified as of interest had insufficient data available on recent work history to enable further assessment. Twenty five incidents were assessed as having workplace fatigue as a possible contributing causal factor due to various indicators including a high level of work attendance immediately preceding the incident (associated with extra duty on a single day off or a number of extra duty shifts) or the occurrence of the incident during a known circadian danger time.

Finding

The significant finding from this review is the lack of fatigue-related data available.

Recommendation

- Airservices Australia investigators, who investigate ATS incidents, should be required to ensure recent work attendance, including estimated sleep details and other relevant data, is recorded on the incident database. Specifically, these data should include, but not be limited to, the following information (Recommendation 16):
    a. Start time of shift that the incident occurred on
    b. Time since last rest break, and length of rest break, during the shift that the incident occurred on
    c. Actual hours of work for the previous seven days and number of days since last two day break
    d. Fatigue score at time of incident
    e. An estimation by the employee, as soon as is reasonably practical after the incident, of the amount of sleep obtained in the 24 and 48 hours prior to the incident
    f. An estimation by the employee, as soon as is reasonably practical after the incident, of the total time awake since a nap or sleep prior to the incident
    g. A comment by the employee regarding the presence of any medications or life stressors that could impact on sleep quality an/or quantity or stress level.

Identification of Possible Fatigue Risk Factors

Given that fatigue research and fatigue audits identify H24 shift work rosters as producing higher fatigue level baselines, the second approach taken in the risk assessment process involved a two-phase review of causal workplace fatigue factors within the ATS shift working environment. This work formed the major activity of the FMWG which has focused on ATC rostering and workplace practice. It sought to examine all issues which may contribute to workplace fatigue and to identify any mitigation strategies that could assist in reducing the fatigue impact.

The first phase involved the FMWG undertaking a comprehensive review of current ATC rostering and work practice. This review was significantly assisted by Dr Adam Fletcher from EDU.Au and the research literature he was able to provide to the group. The second phase of this risk assessment process involved the output from the FMWG being provided to a representative cross section of shift working ATS staff for review, validation and staff input.

The FMWG listed possible workplace fatigue causal factors and associated issues. At times considerable debate occurred within the FMWG on whether an issue was a significant fatigue issue or was more associated with an industrial agenda. Issues were included if it was thought they could impact on fatigue irrespective of any industrial aspect. The extensive list of possible ATC workplace fatigue issues were cross referenced to pertinent fatigue research and international ATC rostering practice. This work included examining the following issues:

- Night shifts
- Rest breaks
- Impact of age
- Direction of shift rotation
- Slow verses rapid rotation of shifts
- Hours per week
- Length of shift
- Start and finish times of shifts
- Time off between shift cycles
- Overtime and recall to duty (Emergency Duty)
- Notification of rosters
- Mutual change of shifts
- Recreation leave
- Sick leave
- Long service leave
- FULS
- Special leave
- Public holidays
- Additional work activity
- Non workplace fatigue.

Identification of Possible Fatigue Mitigation Strategies

The FMWG reviewed each of the above issues and identified possible mitigation strategies. Despite strong debate within the FMWG it was agreed to identify all possible mitigation strategies without regard to the level of fatigue risk posed by the issue or the level of impact on fatigue reduction achievable; i.e.. at this point any mitigation strategy that could be applied to reduce the likelihood of fatigue was identified. This work included:

- Time off duty between shifts and between shift cycles
- Maximum shift lengths
- Maximum number of consecutive shifts including limits on consecutive night shifts
- Equitable allocation of night shifts
- Equitable allocation of days off over traditional weekends
- Limiting single manning
- Provision of routine rest breaks
- Allocating extra duty on the basis of fatigue level using fatigue predictive software (e.g. FAID)

- Reducing extra duty
- Requiring recreation leave to be available and taken.

Fatigue Risk Assessment Workshops

The FMWG arranged four workshops where shift working ATS staff undertook a review and validation of the FMWG output and (led by an independent consultant) completed their own risk assessment of fatigue issues within their workplace. This process enabled staff to provide input to the FMWG and ensured that fatigue issues were identified and examined within the context of actual workplace practice and shiftwork environment. The reports from these workshops have assisted the FMWG to expand and prioritise issues and will assist management to identify and develop appropriate fatigue management strategies. The workshops were facilitated by Julia Clancy of QEST Consulting Engineers Pty Ltd. Twenty four Air Traffic Management and ten Airport Services staff participated in the ATS workshops.

Workshop Details:

29 September 2003; Brisbane Centre and Northern TCU Workshop – nine ATC

30 September 2003; Towers Workshop – ten ATC

1 October 2003; AusFIC, ATC & TFDC Workshop – four AusFIC, two ATC and one TFDC

2 October 2003; Melbourne Centre and Southern TCU Workshop – seven ATC.

Workshop Information Package

Workshop participants were provided with an information package containing:

- Extract from the Fatigue Management Working Group Terms of Reference
- Summary of identified fatigue risk factors
- List of possible workplace fatigue risk mitigation options
- Examples of ATS incidents where fatigue may have been a contributing casual factor
- Final draft copy of a review of international fatigue management research literature and current air traffic control practice
- General overview article on the linkage between fatigue and accidents
- Extract from the Airservices Australia Certified Agreement 2002-2005
  - Fatigue Management Agreement (clause 8)
  - ATS Principles of Rostering (clause 32, attachment 6).

A comprehensive report on the workshops was provided to the FMWG (copy available from the Fatigue Project Implementation Manager). The Workshop Report will assist the prioritisation of mitigation options and will also assist in the development of the fatigue risk management documentation necessary to implement a Fatigue Risk Management System for ATS.

Significant information from the workshops includes data on:

- Exposure to fatigue factors in the air traffic services shift working environment
- Experience of fatigue in the air traffic services shift working environment
- Assessment of fatigue factors and their contribution to fatigue
- Assessment on the potential effectiveness and desirability (acceptance) of specific fatigue mitigation options identified by the FMWG

- Current strategies used by staff to identify and combat fatigue in the workplace.

During the workshops staff emphasised their belief that it is important for fatigue awareness education and fatigue management training to continue.

Workshop Outcomes

- The occurrence and consequence of fatigue in the workplace varies between different types of work, between locations and between individuals at a location
- Staff performing H24 shift work indicated significantly more exposure to and higher levels of fatigue than other shift workers
- Staff performing H24 shift work indicated significantly less satisfaction with roster design factors than other shift workers
- Tower and Centre staff responded differently to some issues, this may indicate that one set of rules may not be an appropriate fatigue management strategy
- Older staff advise that they have found shift work more fatiguing as they have aged.

Most Frequent Causes of Fatigue

- Roster Design Factors
- Night shifts (this included rostering and working arrangements for night shifts)
- Inadequate restorative sleep.

It should be noted that these three factors are highly inter-related and as such need to be managed in a co-ordinated manner.

Top Ten Mitigation Strategies

The response to possible fatigue mitigation strategies identified by the FMWG often varied depending on the nature of shifts being worked (H24 or non-H24) and the location or nature of work performed (responses between Centre and Tower staff varied noticeably). Participants were asked to rank their top 5 mitigation strategies, and the top 10 of these are shown below. The number after the strategy indicates the number of staff who identified it as a top five option (n=34):

- Equal sharing of night shifts and as few as necessary (21)
- Napping permitted as a fatigue management strategy with appropriate procedures (18)
- Roster two clear days off as frequently as possible (14)
- Maximum of six consecutive worked shifts (including Emergency Duty and overtime) (10)
- Access to full allocation of recreation leave annually (9)
- Rest breaks to be at least 20 to 30 minutes (8)
- No single manning (not supported by tower staff and subject to no increase in number of individual night shifts) (8)
- Staff should be able to report unfit for duty due to fatigue (8)
- Rest breaks after a maximum of two hours work in multi staffed positions, more frequent in high workload circumstances(7)
- Minimum of ten hours off between rostered or worked shifts (7).

These rankings were probably influenced by current practice, e.g. in many workplaces breaks in excess of the minimum required under POR are routinely available without being mandated.

Fatigue Management Strategies Agreed to Reduce Fatigue and to be Desirable

Proposed fatigue mitigation strategies that were considered by all workshops as both likely to be effective in reducing fatigue and being desirable were:

- The definition of a work break should be "a period of uninterrupted time to overcome fatigue arising from the assigned work and to enable the worker to attend to personal needs"
- Equal sharing of night shifts and limited to as few as necessary
- Amend the definition of "one clear day off" to "a minimum of 30 hours off duty including 24 hours commencing at midnight and also including an opportunity for a normal sleep period (2200 hrs to 0800 hrs) to ensure complete recovery
- Not more than 6 consecutive working days (including Emergency Duty and overtime)
- Two clear days rostered off as frequently as possible
- Minimum of two clear days rostered off after two or more Night Shifts
- Equal sharing of rostered days off over traditional weekends between all eligible staff in that workgroup
- Minimum of 10 hours between rostered or worked shifts
- Minimise extra duty
- Shift workers able to access full allocation of recreation leave in the year it accrues
- Napping permitted as a fatigue management strategy with appropriate procedures.

Once again these results were probably influenced by current practice. There were differences between workplaces, particularly between Towers and En Route/TMA.

Findings

- The fatigue risk assessment workshops generally validated the work of the FMWG
- The workshops agreed with the 13 causal factors identified by the FMWG (but made minor changes and additions)
- The impact and desirability of many mitigation strategies were assessed differently by different workshop
- Differing outcomes were probably reflective of variations in work practices at different locations and between Tower and other work groups.

TOR 1 Part (v) Training

Provision of training materials and "train the trainer" education packages

Following earlier work by Bob O'Keeffe and EDU.Au, shift working staff in ATS have been provided with fatigue management awareness training. The training program consists of a workshop and online training module. The online module is suitable for refresher training. Other training materials developed include a training video, a booklet for inductees, a personal workbook and trainer notes. Audits indicate that the agreed training modules have been completed by almost all ATC and that managers are endeavouring to ensure a 100% completion rate.

Staff will require additional training covering the content and operation of the fatigue risk management system when implemented. Staff have indicated a desire to receive ongoing fatigue management awareness information and procedures should be put in place to ensure that this is provided.

Dr Adam Fletcher has revised the material provided in the on line training package. Whilst the modules available reflect current fatigue management research, it is important that they be routinely reviewed by an expert in the field and a process to update the current training packages will be required.

Management Training

Recommendation 41 of the Beyond the Midnight Oil Report recommends; "Fatigue and fatigue management training should be incorporated into management training programs for all those engaged in a management role in all sectors of the transport industry, whether they be a private company or a government entity which is responsible for contracting transport related services."

Fatigue management awareness and fatigue risk management system training needs to be undertaken by management and rostering staff as soon as practical. Work is required to develop management training modules.

Recommendations

- Provide fatigue management awareness and integrated fatigue risk management system training to managers, supervisors and support staff responsible for shift working staff or rostering of shift working staff (Recommendation 3)
- Provide integrated fatigue risk management system training to affected staff (Recommendation 4)
- Continue fatigue risk management awareness training for current shift working staff, inductees required to work shift work and the families of shift working staff (Recommendation 5)
- Review fatigue policy and training material within one year of implementation and at least every three years thereafter (Recommendation 6).

TOR 2 Fatigue Factors in the Workplace

[The working group will] Clearly define fatigue factors (i.e. possibly as the consequence of inadequate restorative sleep combined with an individual's job, availability and extent of access to recreation and all other forms of leave, hours of work, workload, job tasks, adequate rest and time away from duty, medical conditions, family and social commitments, and relationship pressures);

Overview

There are three factors that are generally accepted to contribute to workplace fatigue in a key manner, these are:

- Working contrary to the circadian biological clock, which prepares the body for sleep at night and wakefulness during the day (i.e. the circadian rhythms rarely adapt significantly to any other pattern, even in permanent shift settings)
- The duration of the duty periods, and the workload levels and breaks they contain
- Attempting to work with inadequate duration or quality of prior sleep (Literature Review p7).

An additional fatigue factor particularly associated with afternoon, evening and night shifts, is the length of time since awakening.

Gander (2001) notes additional sleep loss factors attributable to roster design. Examples of roster design factors that impact adversely on workplace fatigue include morning to night quick change shift patterns and early morning start times, which were consistently found to cause excessive sleep loss and progressive increases in sleepiness across the duty period. Recent research into comparisons between clockwise and counter-clockwise rapidly rotating shift patterns indicates that "evidence is growing that direction of rotation, particularly in rapidly rotating shift schedules, does not affect outcomes such as sleep and subjective ratings of fatigue" (Cruz, Detwiler, Nesthus & Boquet, 2002, p.11). It should be noted that this research was conducted on staff working standard hours (5 consecutive shifts of 8 hours per week; M; M; A; A; N and A; A; M; M; N; where M equals a morning shift; A equals an afternoon shift and N equals a night shift) without any overtime and therefore the conclusions drawn may only be valid under these conditions.

The three most frequent causes of fatigue (as measured jointly by exposure and probability) reported by ATS at the ATS Fatigue Risk Management Workshops are in line with the above research findings, i.e. roster design factors, working night shifts and inadequate restorative sleep.

Impact of Circadian Rhythms

Humans are a diurnal species, which is of particular interest in the context of work, as we are predominantly active and awake during the day and geared for rest and sleep at night. While we are physiologically capable of overriding our normal tendencies and thereby live on a nocturnal schedule, we may never fully adapt to a night work/day sleep pattern, meaning that sleep is compromised and not adequately restful, leading to fatigue when awake.

It is not only sleep and wakefulness that alternate in response to daily changes in the light/dark cycle, but nearly all biological functions, including but not limited to hormone production, digestion, temperature regulation, cardiovascular and neurocognitive functions. All circadian rhythms in mammals are co-ordinated by an internal "clock" located in the hypothalamus of the brain.

Attempting to work contrary to the circadian biological clock is a major cause of workplace fatigue. Although preferred sleep periods vary between individuals, it can be assumed that any work undertaken between 2200 hrs and 0800 hrs is likely to result in elevated levels of fatigue. Excessive commuting times can extend this period.

Costa (1999) states that, "It is common knowledge that work efficiency during the night is not the same as during the day". The general population typically understands this intuitively through experience with prolonged wakefulness. Self-report studies of mood, fatigue and sleepiness further support the suggestion that night shifts have significantly greater negative impacts than other shifts (Saldivar *et. al.*, 1977; Costa, 1993; Luna *et. al.*, 1997).

A large body of evidence (reviewed in Folkard and Tucker, 2003) shows that most psychomotor performance functions improve progressively after awakening to a peak in the afternoon, between 8-10 hours later. Performance on most tasks then progressively declines to a trough in the early morning. It should be noted however, that there are so-called circadian "danger zones" between approximately 0200 hrs and 0500 hrs for night work, and to a lesser degree 1400 hrs and 1700 hrs for day work, when fatigue is typically greatest and routine tasks can become difficult to perform (Westfall-Lake, 2000). Nevertheless, the performance decrements experienced are typically much greater in the early morning compared to the early afternoon.

The evidence therefore suggests that rostering and working arrangements should take into account problems caused by the circadian troughs.

Findings

- Performance decrements are associated with the circadian troughs, especially at night
- Consecutive night shifts result in increasing levels of fatigue
- The more shifts in a cycle containing night shifts the higher the level of fatigue
- The longer the night shift the higher the fatigue level
- Two days (and nights) off duty are usually required to provide the necessary opportunity for recovery sleep following a night shift.

Recommendations

- The length of night shifts should be minimised and they should not be longer than eight hours. This should be consistent with the general requirement that rostered shifts should not start after 0000 hrs and not finish before 0600 hrs (Recommendation 34)
- Night shifts should be kept to a minimum and be shared reasonably and equitability between eligible staff. Wherever possible, night shifts should be limited to one per shift cycle (Recommendation 35)
- If a shift cycle includes a series of shifts prior to a night shift, they should be shifts that do not create a significant sleep debt and that maintain acceptable levels of fatigue (Recommendation 37).

Duration of Duty Period

Shift Duration

In 1992, Miller adapted the guidelines from earlier works (Knauth *et. al.*, 1979; Hildebrandt, 1976) which mostly compared 8 and 12 hour shift schedules. Miller (1992) thereby proposed that maximum shift lengths across the board should be 8 hours, except where vigilance demands or stress levels were low. These recommendations are typically supported by other published guidelines, such as those by Knauth (1997). For example, Knauth suggests that shifts of greater than 8 hours duration should be considered only if the workload and nature of work are suitable, given sufficient breaks and a roster designed to also minimise fatigue accumulation and allow complete recovery after work.

Using data on more than 1.2 million work accidents in Germany during 1994, Hanecke and colleagues (1998) observed an exponentially increasing accident risk beyond the 9th hour at work. The relative accident risks varied according to the particular time of day when work commenced; specifically, the later the starting times, the greater accident risk was posed beyond the 8th hour at work.

The CTWG Report recently noted the increased probability of degraded performance when prolonged consecutive hours are worked and recommended the active application of fatigue countermeasures whenever ATC shift length exceeded 10 hours.

Recording of Hours of Duty

The FMWG is concerned that all hours of duty performed within the ATS workplace may not be accurately recorded. Some ATC spend considerable time, before or after paid hours, on non operational activity (administration, meetings, projects, rosters, etc) in addition to their operational activity. This time contributes additional fatigue that is unable to be measured under the current recording system. All hours of duty need to be recorded so that fatigue can be accurately assessed.

Findings

- Actual hours of duty need to be recorded if accurate fatigue levels are to be calculated and appropriate fatigue mitigation strategies implemented
- There is evidence that fatigue risk levels increase markedly after eight hours of work, this is particularly so on afternoon and night shifts.

Recommendations

- Actual duty hours, including non operational duty time, should be recorded. These data should be used as the input to determine individual fatigue scores (Recommendation 22)
- The maximum shift length for low workload operations should be ten hours. The maximum shift length for normal to high workload operations should be eight hours (Recommendation 52).

Workload

The diary study of Spencer et. al. (1997), found that the time since commencing duty, the time since the last work break and workload independently influenced controller rating of fatigue. Importantly the study also demonstrated that workload modified the effects of other factors on fatigue, as follows:

- Workload modifies fatigue caused by continuous operational duty. Under low workload conditions, fatigue ratings remained relatively stable for continuous work periods of up to four hours long. When workload was high, a rapid increase in fatigue was observable after two hours of continuous work
- Workload increases fatigue with periods of wakefulness greater than twelve hours in length. Thus, given a similar wake up time, fatigue is markedly greater on the afternoon shift than on the morning shift
- Workload influences fatigue according to the time of day, with higher fatigue experienced by those working with low and high levels of workload compared to intermediate levels.

Both high and low workloads present a problem for ATC. High workload creates stress and fatigue and low workload can result in lower levels of alertness and boredom. Both stress and boredom can impact adversely on performance, particularly if the controller is already fatigued. Despite the many subjective methods proffered for measuring ATC workload, there remains no universally accepted method for objective assessment due to its highly complex nature.

Finding

- The level of workload has a direct impact on the level of fatigue.

Total Time Awake

While day workers are typically awake for 1 to 2 hours before commencing work, night shift workers are usually awake for between 10 and 16 hours (Akerstedt; 1995). Furthermore, research has shown that 50% of shift workers typically spend at least 24 hours awake on the first of a series of night shifts. In addition, due to the subsequent desynchronisation of the wake/sleep cycle the circadian system, the day time sleep of night workers is of shorter duration and poorer quality than the night sleep of day workers (Costa 1996). Therefore, shift worker fatigue is usually due to the combination of cumulative sleep loss and circadian desynchrony, rather than simply acute sleep loss.

Spencer *et. al.* (1997) argues that there were additive effects of time of day and time on duty, such that the greatest fatigue levels were recorded around 0600 hrs.

Research findings identify increased accident rates on afternoon shifts (Folkard *et. al.* 1999). He suggests that this may be associated with increased fatigue resulting from the greater period awake prior to commencing duty.

Hours of Work

A report by the Office of Technology Assessment (USA Congress1991) showed that 42 of 49 countries studied at that time had national regulations in place for minimum weekly rest (i.e. non-work time). Most countries specified a weekly minimum rest equivalent to one day, often mandating a day each weekend for rest. The ILO currently has two conventions on weekly rest, which have been ratified by up to two-thirds of its member countries (OTA, 1991).

Still, there is very little objective data investigating fatigue and sleepiness due to work hours accumulated over long periods, for example up to 12 months in length. There is simply insufficient good scientific evidence available to provide specific guidelines, beyond the general indication to adjust duty periods downward over increasing periods of time

Most current practices and regulations are expressed in terms of hours off duty, not in terms of adequate opportunity for sleep.

International ATC Hours of Work

When reviewing contemporary international ATC fatigue management practice it is difficult to know the background to the conditions of employment. In some cases current rostering and leave allocation practice is the result of collective bargaining, in others it may be a national or public service standard. There is very little published research that identifies the role played by scientific research and the study of fatigue management in the development of overseas ATC rostering practice. Recent work in New Zealand and to a lesser extent in Canada precedes this attempt by Airservices Australia to review ATS fatigue using scientific research with an aim of implementing a scientifically sound fatigue management approach to ATS rostering.

The collective bargaining agreement for operational Canadian ATC (1999) provides for a 36 hour week averaged over a 12-month period, inclusive of a mandatory 15-minute briefing period at the start of each shift. The agreement for shift cycles comprises 17 days of work and 11 days of rest over each 28-day period.

Examples of typical, current practice ATC work hours from other countries include:

- 40 hrs per week, comprising five eight hour days in the USA and UK,
- 120 hours per month (maximum 40 per week) in Spain up to a maximum of 1200 hours work per year. Shift lengths are typically of 7 hours duration,
- 38.5 hours per week, comprising five 7.7 hour days including meal and rest breaks in Germany,
- 38 hours per week, comprising 7 - 8 hour shifts in the Netherlands,
- 35 hours per week, comprising five 7 hour days, up to a maximum of 220 days per year in Switzerland.

Current regulations for maximum ATC hours per shift are:

- 6–11 hours in Canada,
- Maximum 10 hours in the USA,
- Maximum 8 hours in the UK,
- 6–12 hours in Spain, with an exception made for up to 14 hours at small facilities,
- Maximum 10 hours in Germany,
- 7–8 hours in the Netherlands, and
- 7–9 hours (maximum 10 hours in Towers) in Switzerland.

From this representative list it can be seen that most countries restrict shift lengths to no more than 10 hours.

Where regulated, shift cycles in representative countries typically are less consistent than regulations for hours per week or shift length:

- 3 consecutive days of rest between cycles in Canada,
- Maximum 6 consecutive shifts followed by a minimum 1 day off in the USA
- Variable by location in the UK, usually 6 days on and 4 days off
- Usually either 3 days on and 3 days off or 4 days on and 2 days off in Spain
- Either 4 days on and 2 days off or 5 days on and 3 days off in Germany
- Usually 5 days on and 2 days off in the Netherlands with a maximum of 9 days on and 2 days off within a 38 hour per week limit
- Usually 4 days on and 2 days off in Switzerland including a minimum of 8 days off per month.

Australian ATC Hours of Work

Australian ATC work various rosters that average 35 hours per week plus 12 minutes handover/takeover time per shift when necessary.

The following rostering patterns are in common use:

- Roster cycles of 5 days on and 2 days off consisting of, or averaging, 7.0 hour shifts (approximately 236 work days per year exclusive of public holiday arrangements)
- Roster cycles of 4 days on and 2 days off consisting of, or averaging, 7.5 hour shifts (approximately 220 work days per year exclusive of public holiday arrangements)
- Roster cycles of 5 days on and 3 days off consisting of, or averaging, 8.2 hour shifts (approximately 207 work days per year exclusive of public holiday arrangements)
- Roster cycles of 3 days on and 3 days off consisting of 10.0 hour shifts (approximately 165 work days per year exclusive of public holiday arrangements)
- Non shift work staff work 5 days on and 2 days off, averaging a 7.35 hour work day (approximately 230 work days per year).

However, the above data may not be reflective of actual work attendance of Australian ATC as the use of significant rostered extra duty (overtime) and non rostered extra duty (emergency duty) is common on many Australian ATC rosters.

Appendix Three (Principles of Rostering) provides additional detail on rostering arrangements that may be implemented and impact on actual hours of work.

Findings

- Most countries continue to operate a prescriptive ATC rostering system and many specify the number of days to be rostered off after each shift cycle
- Most countries specify a minimum weekly rest equivalent to one day
- There are diverse rostering patterns available to meet differing service provision and workload requirements in Australia
- The use of extra duty appears to be more prevalent in Australia than in most other countries.

Insufficient Restorative Sleep

If fatigue is primarily the result of insufficient sleep, then rest periods between shifts need to be of sufficient duration to allow employees to recover from the accumulated effects of the previous work period. Note however, that the critical factor in recovery from fatigue is the amount of sleep obtained, not simply time off work. There is a suggestion that a "normal, uninterrupted sleep length" of 7–8 hours (Saldivar *et. al*., 1977) requires a minimum of 10 hours between shifts to accommodate commuting, meals and social necessities, in addition to obtaining this requisite amount of sleep. However, as discussed earlier, this break also needs to occur at a time of day (or circadian phase) that is conducive for sleeping; otherwise insufficient sleep length and in adequate recovery from fatigue will result (Literature Review p17).

Heselgrave & Rhodes (1997, reported in Gander 2000) reported on a survey of Canadian air traffic controllers that found that sleep and fatigue-related problems were more prevalent than mood or gastro-intestinal complaints. In this study 19% of participants reported frequent difficulty sleeping at night, but this rose to 63% who reported difficulty sleeping during the day. Approximately 8% reported that they had excessive lapses in attention and 2.5% had experienced momentary motor paralysis on the job while remaining conscious (so-called 'night shift paralysis').

US Federal Aviation Administration air traffic controllers have been the subjects of scientific studies for at least the last 30 years (e.g. Melton *et. al.,* 1973; Della Rocco and Cruz, 1995; Della Rocco and Cruz, 1996; Della Rocco, 1999). Together, they overwhelmingly show that air traffic controllers engaged in shift work suffer from disrupted sleep and increased fatigue at various times within their schedules as well as reduced performance on laboratory tasks on the night shift, compared to the day shift. These studies are typically supported by research in military, airline and other safety-critical industries. Consistently, shift workers usually report highest levels of fatigue on night shift duty, negligible fatigue during afternoon shifts, and intermediate levels on morning shifts (Wyatt and Marriott, 1953; Thiis-Evansen, 1958; Menzel, 1962; Mott *et. al.,* 1965; Andersen, 1970; Åkerstedt and Torsvall, 1978; Åkerstedt, 1988; Tucker *et. al.,* 1998; Spencer *et. al*., 2000).

Early Morning Start Times

Early morning start times are consistently found to cause excessive sleep loss and progressive increases in sleepiness across the duty period (Cruz and Della Rocco, 1995b; Spencer *et. al.,* 1997). Earlier start times shorten the normal sleep period before the shift begins and directly increase fatigue for the first part of a morning shift, in both rotating and straight morning shift schedules (Monk & Folkard, 1992). The early starting times of some morning shifts have also been associated with objectively increased sleepiness, as reflected in EEG waveforms (Åkerstedt *et. al.,* 1991), higher error rates and increased accidents in professional drivers (for example, Pokorny *et. al.,* 1987). Because the early wake up cuts off the last hours of sleep, a significant reduction of the 'paradoxical or REM sleep' can be recorded, which is prevalent during the second part of the sleep period and is essential for the maintenance of the psychological well being (Costa 1993). In retrospective reports of alertness, Tucker and co-workers (1998) found that industrial shift workers who started morning shifts at 0600 hrs, were significantly less alert from 0800 hrs to 1200 hrs, than those starting at 0700 hrs.

Early morning start times are also associated with significant sleep loss among ATC (Cruz and Della Rocca, 1995b; Mollard *et. al.,* 1997) and a cumulative increase in tiredness by the end of the duty period (Spencer *et. al.*, 1997).

From the above it can be seen that significant levels of fatigue are associated with working a night shift or a series of early morning starts. The practice of working two consecutive night shifts on some ATS rosters consistently produces FAID scores at or above the interim benchmarks. Invariably, any extra duty associated with a night shift cycle produces high fatigue levels.

It appears that some start and finish times are more associated with acquittal of nominal hours than aircraft activity. The practice of requiring shift working staff to attend for, or to remain at work when not required to meet operational or other requirements, is not conducive to good fatigue management. On the other hand, the excessive use of different shift start times within a shift cycle to maximise efficiency is also not conducive to good fatigue management as it requires staff to use a different living routine every day which, for most people, will add to their fatigue levels. (Cruz and Della Rocco, 1995).

ATS rostering and work practice that impacts on the availability of restorative sleep include:

- Working two shifts commencing on the same day
- Working during the normal sleep period
- Working extra duty
- Working early morning starts or late evening finishes
- Excessive commuting time.

Roster Patterns

Where H24 continuous ATC operations are necessary, two separate approaches are typically used to adequately staff the operation: fixed (block) shifts and rotating shifts (Miller 1992). Rotating shifts are further divided into fast or slow, forward and backward rotations. When rotating patterns are employed, ATC may prefer rapidly backward rotating rosters as this compresses the work cycle and maximises time away from work between cycles. A direct consequence is reduced opportunity to sleep between shifts within a cycle, but more time to recover between cycles.

Roster patterns have been studied extensively in a variety of contexts, with varying results. In terms of ATC H24 operations it would appear a rapidly rotating schedule is beneficial because it keeps workers oriented on a diurnal pattern (i.e. oriented for daytime wakefulness and sleep at night). Many researchers have postulated that forward rapidly-rotating roster patterns are preferable to backward rotations however, as noted above, the latest research by Cruz, Detwiler, Nesthus & Boquet (2002) suggests that there are negligible differences in sleep and subjective feelings of fatigue if the roster pattern is limited to no more than five consecutive 8 hour shifts per week.

Findings

- The critical factor in recovery from fatigue is the amount of sleep obtained, not simply time off work
- Air traffic controllers engaged in H24 shift work are likely to suffer from disrupted sleep and increased fatigue

- Shifts commencing prior to 0800 hrs impact on the amount and quality of sleep obtained prior to shift
  - Early morning start times are consistently found to cause excessive sleep loss
  - Early morning start times can result in lower levels of alertness and significantly increased levels of fatigue during the shift
- Greater regularity in shift start and finish times promotes better recovery and enables staff to arrange personal activities more easily.

Additional Fatigue Factors

Workplace Environment

A hostile work environment can greatly hasten the onset of fatigue. Excessive heat, cold, noise, vibration etc are not generally associated with the ATS work environment however the Tower cab is often subjected to significant changes in temperature, glare and light conditions. The TAAATS Centres and TCUs are an artificial environment where competing requirements (eg room lighting verses screen clarity) can result in less than optimum environmental conditions. Several staff noted in the risk management workshops that the temperature within the TAAATS environment may suit the majority of staff but individuals find the temperature too hot or too cold.

The almost total reliance on screen based information systems within ATS Centres impose a requirement for ATS Centre staff to spend most of their operational time interacting with a variety of screen based equipment and systems. In particular, the TAAATS environment requires constant monitoring of several screens which could contribute adversely to fatigue levels.

The dim lighting at night in Towers and Centres can contribute to fatigue and evidence suggests that spending time in a brightly lit recreation area when not on task may help mitigate acute drowsiness, fatigue and the long term debilitation of health associated with night work (Costa, 1999).

Workplace Relationships

Adversarial workplace relationships between staff and/or supervisor/manager can contribute to the onset of fatigue. This is particularly so within the ATS environment where a shift working environment is combined with safety critical team work requiring a very high level of interpersonal trust.

Commuting

Participation in shift work and the associated restriction of sleep has implications not only for safety and performance whilst on duty (see for example, Dinges, 1995), but also while commuting to and from the work site. Most prior research in this area has concentrated on the prolonged wakefulness (equivalent to that seen after a day of wakefulness and working a night shift) and subsequent declines in driving performance. However, surveys of the incidence of vehicle accidents relating to sleep also show peaks at around 0400 hrs to 0600 hrs, corresponding to the circadian peak in sleepiness (for example, Horne and Reyner, 1995; Mitler *et. al.,* 1988; Pack *et. al.,* 1995). This early morning trough in alertness can pose particular problems for shift workers returning home after a night shift, as increasing prior sleep loss causes cumulative decrements in performance (Horne and Reyner, 1999). While most sleepy individuals seem to be aware of their impaired state,

poor judgement of the severity of their impairment is often observed as well as a lack of awareness of having fallen asleep (Horne and Reyner, 1995; Åkerstedt, 1995).

Importantly, there are also likely to be performance decrements for shift workers driving to work, as the amount of sleep they obtain is regularly less and of a poorer quality than normal day workers (reviewed by Åkerstedt, 1995). Thus, driving to an early morning shift may be worse than to an afternoon or night shift for several reasons. Firstly, it may still be dark. Secondly, morning shift workers may be sharing the road with truck and taxi drivers who have been driving overnight, and with sleep deprived night shift workers travelling home. Finally, the morning shift driver has more than likely received 6 or less hours of sleep, an amount typical even for permanent early morning shift workers. The adverse performance and safety consequences of all the above factors are well recognised, and therefore need to be factored into the design of early morning rosters.

Transit time to and from the workplace is clearly an issue if the duration and stress associated with commuting is excessive. Employees need to be somewhat accountable in ensuring their commute does not significantly reduce their capacity to recover from fatigue and present fit for duty.

Finding

- Shift workers have an increased commuting risk driving to and from work during the early morning due in part to their generally higher levels of fatigue.

Recommendations

- To reduce the risk associated with commuting, rostered night shifts should not finish prior to 0600 hrs. This general rule may not be applicable when it is daylight prior to this time (Recommendation 7)
- Staff who feel fatigued at the completion of a night shift should be encouraged to take a short nap prior to driving home. To avoid the risk of sleep inertia, driving should not commence for at least fifteen minutes after awakening (Recommendation 8)
- If possible, shift start and finish times should avoid peak commuting periods to reduce the exposure to commuting risk. It is likely that the peak commuting times will differ from location to location (Recommendation 9).

Conclusion

By its very nature, ATS operations require a wide range of work structures. This can include shift work in many forms including night work, weekend work, emergency duty and in some cases standby duty. Considerable evidence indicates that such shift work is generally associated with fatigue and performance impairment. One of the most significant reasons for the fatigue and performance impairment associated with shift work relates to reduced sleep. That is, shift work limits opportunity for recuperative sleep and allows fatigue to accumulate. In the context of operational environments such as ATS, it is therefore the management of sleep opportunity that is vitally important when trying to avoid fatigue. It could also be argued that sleep opportunity becomes even more critical when longer shifts are being worked and/or when the risk associated with a particular task is high.

The general balance to be achieved therefore includes:

- Managing sleep opportunity between shifts as opposed to simply managing time away from the workplace
- Managing availability of breaks on shifts, which may include managed napping opportunities
- Developing rules for rostering, overtime, emergency duty and standby duty that support the physiological principles underlying recovery from fatigue.

The most important of these is arguably the provision and appropriate use of adequate opportunity for recuperative sleep between shifts and shift cycles.

TOR 3 Recommended System

Provide recommended systems and procedures to ensure that an holistic national approach is taken to the management of fatigue

Overview

To some degree the likelihood of a fatigue-induced error varies with each ATS task due to, among other factors, the interaction of human factors and technology interface and the influence of fatigue on the specific performance requirements of the tasks required to be accomplished. More obvious is the variation associated with the consequence that a fatigue-induced error may have. This could range from incorrect record keeping with no safety consequence to an error that, by itself or as one in a sequence of errors, leads to death or major disaster.

CASA has recently provided a Notice of Proposed Rule Making (NPRM) proposing a new approach to the management of aircrew fatigue (currently regulated under CAO 48). CASA proposes moving away from the current industry-wide prescriptive hours of duty regime, defined by agreed limitations that have little or no scientific basis, and towards an enterprise specific system based on scientifically predicted levels of fatigue and the management of the associated risks by use of accepted AS/NZS 4360 risk management principles.

Fatigue Risk

Incident investigation should include a full assessment of fatigue factors and all ATS investigation reports should include data on actual shifts worked in the previous 7 days. When available a fatigue score for the shift should be recorded.

A brief summary of research findings relating to fatigue risk contained in the Literature Review prepared by EDU.Au Pty Ltd is:

- Fatigue impairs alertness, decision making, communication, reaction time, etc.
- Fatigue is normally higher on night, early morning and late evening shifts
- The peak circadian danger zone is between 0200 hrs and 0500 hrs with an additional, lower risk period between 1400 hrs and 1700 hrs
- Fatigue levels increase with:
  - Prolonged exposure to high workload
  - Complexity
  - Requirement for sustained vigilance
  - Length of time on duty
  - Time since awakening and
  - Length of continuous operational duties since a rest break
- Full recovery from fatigue generally requires a minimum of one, probably two, full periods of natural sleep (normally about eight hours of uninterrupted good quality sleep between 2200 hrs and 0800 hrs)

It is reasonable to expect that the risk of a fatigue induced error will increase:

- During the period between late evening and early morning

- The greater the cumulative sleep debt (i.e. the greater the number of nights since the staff member successfully obtained a full restorative sleep)
- Towards the end of a shift, particularly if appropriate rest breaks have not been available or taken
- After a long period awake

It is also apparent that the consequence of the fatigue induced error depends on:

- The opportunity to recognise, correct and/or recover from an error
- The capacity of the operator to recognise and appropriately react to the error
- The defences in place to prevent a single error escalating into an incident or accident and
- The magnitude of the consequence should an incident or accident occur.

The evidence summarised in this document indicates that the likelihood of human error increases with increased fatigue and the likelihood of appropriate response to an abnormal situation decreases with increased fatigue.

Fatigue Risk Management

It is therefore reasonable to prioritise fatigue risk management within air traffic services in a manner that controls the risks with higher probability and consequences, for example:

- Staff on H24 rosters who have a direct impact on the safety of life or a high value asset
- Staff on H24 rosters who have an indirect impact on the safety of life or a high value asset
- Staff working shift work not involving night work who have a direct impact on the safety of life or a high value asset
- Staff working shift work not involving night work who have an indirect impact on the safety of life or a high value asset
- Other staff.

To manage fatigue risk within the organisation a suitable combination of the following strategies should be used:

- Education of management, staff and families on fatigue causal factors and mitigating strategies
- Strategies to combat fatigue inducing conditions and to reduce the occurrence and consequence of degraded human performance associated with fatigue
- Strategies to reduce the probability of unacceptable levels of fatigue from occurring
- Strategies aimed at continuous improvement through the identification and reporting of fatigue risk events.

The strategies recommended above are compatible with AS/NZS 4360 & AS/NZS 4801/4804 OH&S Management Systems and also the recently proposed CASA NPRM in relation to the introduction of Fatigue Risk Management Systems. More detailed information on the proposed CASA Fatigue Risk Management System is provided at Appendix Five.

Fatigue Risk Management Models

There are several fatigue management strategies available including prescriptive with and without modifications and risk management based systems. Apart from the CASA model referred to above, Dr Adam Fletcher and Kirsty McCulloch from the CFSR are also developing a risk based model compatible with AS/NZ 4360. Both of these models have been incorporated into the following proposal.

Fatigue Risk Management System

The recommended fatigue management system for air traffic services is an integrated fatigue risk management system which:

- Is applicable to all air traffic services shift workers
- Involves a shared responsibility for fatigue management
- Is based on risk management principles identified in AS/NZS 4360 and AS/NZ 4801/4804
- Encourages the use of rostering strategies acknowledged to reduce the impact of fatigue associated with shift work
- Discourages the use of rostering practices that result in elevated fatigue levels
- Provides rosters designed to balance organisational risk profiles, staff lifestyle entitlements and organisational economic objectives
- Includes the use of FAID, or other valid system, to ensure fatigue levels associated with rostered and worked shifts are maintained within nominated parameters
- Uses FAID, or other valid system, to assess the fatigue impact of extra duty and, when necessary, applies appropriate risk mitigation strategies to manage any identified increased fatigue risk
- Uses standard procedures to support:
  - Roster development,
  - Allocation of extra duty,
  - Reporting implementation of risk mitigation strategies to maintain services
  - Reporting instances of staff unable to perform rostered tasks due to excessive fatigue
  - Undertaking and reporting of routine FAID, or other valid system, audits
  - Undertaking and reporting on routine audits of risk management documentation
  - Assessment and reporting of fatigue as a causal factor in commuting or workplace OH&S incidents
  - Assessment and reporting of fatigue as a causal factor in operational incidents
- Identifies a control process
- Identifies a continuous review process
- Meets all of the Safety Management System (SMS) requirements.

Key elements of this integrated FRMS would include:

- Policy
- Commitment by management to the establishment, implementation and maintenance of a FRMS
- Agreed working arrangements that enable staff satisfactory opportunity for family and social activity
- Procedures & responsibility allocation
- Resources
  - Good roster design guidelines
  - Fatigue score limits
  - Fatigue risk management procedures for allocating extra duty
  - Contingency plans containing procedures and responsibility assignment for continuing operations beyond FAID score limits
  - Training and education content and program
- Reporting procedures for staff and supervisors who identify a fatigue risk
- Reporting requirements when contingency plans are activated
- Monitoring process
- Regular audit requirements
- Safety Case (internal SMS process).

Finding

- Implementation of an integrated fatigue risk management system for shift working air traffic services staff should reduce OH&S fatigue risk and increase operational safety.

Recommendations

- An integrated fatigue risk management system must be implemented for all shift working air traffic service staff (Recommendation 1)
- Implementation of, and variations to, the parameters contained in these recommendations must be subjected to a formal risk management process (Recommendation 2).

Transition & Implementation Process

To transition to a fully functioning integrated FRMS will require the following steps:

- Assignment of responsibility and resources to achieve identified outcomes
- Consultation with staff representative bodies
- Development of:
  - Policy, standards and procedures
  - Local consultation and review procedures
- Contingency rules and responsibilities for exceeding nominal FAID score limits
- Complete Safety Management System Change Management Documentation
- Complete Operational Documentation changes

- Review all rosters using the recommendations in this report and the guidelines for rostering and working practice (Appendix Four) to reduce the fatigue impact of master rosters
- Provide supervisors with a tool or table to identify fatigue impact of extra duty options
- Implement procedures to allocate extra duty on a lowest risk basis
- Implement audit and continuous improvement process.

Access to FAID Output

The FMWG received a report on various fatigue predictive tools that are currently available. The FAID programme was determined to best meet the requirements of Airservices Australia at this time.

Ongoing operation of the FRMS would be enhanced by local automated capacity to test proposed master rosters and review the impact of extra duty prior to allocation.

In practice the FAID score needs to be assessed on the basis of previous work episodes including the extra duty (backward looking) and planned future work episodes including the extra duty (forward looking). The ability to run real time FAID assessments automatically via the SAP Microster system could provide the required FAID scores for off duty staff prior to the allocation of the extra duty and thereby enable supervisors to minimise the fatigue level in the workplace.

Fit for Duty Responsibility

"While it is an employees' responsibility to present himself or herself for work in a fit state to carry out their duties, it is also the employer's responsibility to ensure that it is not actively causing unfitness to work by not having adequate and effective fatigue management practices. When it is recognised by employers that fatigue is a factor which creates risk in the workplace, then it is arguable that employers who construct their rostering systems in such a way as to create a fatigued workforce are in fact tortfeasors. They are in breach of their duty of care to their employees, and may be liable for any economic or other damage which flows from that breach of duty"; (Penning & Cameron; 2003).

The management of fatigue is a dual responsibility between management and employees. That is, employees are required to utilise their time away from work in order that they obtain adequate recovery between shifts. This is an extension of the general fitness for duty principle, which of course includes fatigue but also includes impairment from sources such as alcohol and other drugs (Literature Review p30).

A recent report on fatigue management within NZ ATC operations states that, "Fatigue may be influenced as much by choices and activities outside of work, as by what is required during scheduled working hours. Thus, comprehensive fatigue management must be a shared responsibility of both company and workforce" (Gander; 2001).

Personal Responsibility and Self Assessment

ATC have responsibility to comply with various legislative and regulatory fit for duty requirements in addition to their obligation to Airservices Australia. Unlike some other fitness for duty impairments, fatigue can be the result of either personal choice or circumstances beyond the control of the individual. For example, one cause may be choosing to go fishing for most of the night rather than obtaining sufficient restorative sleep, whereas another cause could be disturbed sleep due to a sick child.

It is also important that staff do not incorrectly or improperly assess themself as fit for duty when requested to perform extra duty.

Routine Fitness for Duty Testing

The FMWG has spent some time reviewing research and other material relating to the ability of pupillometers to accurately detect fatigue. Some evidence is available to support a claim that impairment resulting from fatigue and other causes can be identified using pupillometers. Pupillometers are non invasive, can be self administered, can automatically report via email to supervisors and are now routinely used to assess fitness for duty of staff prior to commencement of duty in a range of Australian industries. Debate exists however as to the accuracy and validity of currently commercially available machines to provide objective fit for duty assessments. There is limited scientific support for the currently available packages' ability to detect major sources of impairment. Also, there are no agreed standards from which we may obtain guidance on acceptable measurements of accuracy, impairment parameters or on individual tolerance levels. The FMWG therefore cannot recommend use of this equipment at this time.

Recommendation

- The development of objective fitness for duty testing devices (eg pupillometers) should be periodically reviewed with a view to implementing a system when it is considered that one is adequately valid and reliable (Recommendation 24).

Fatigue Data Collection

Whereas ATC currently have "unlimited" sick leave arrangements, the issue of paid leave for fatigue associated absence is unclear. It can be expected that, until this issue is resolved, many ATC who "self assess" that they may be excessively fatigued will report "sick" rather than "excessively fatigued". As a result, it is probable that data relating to absence due to fatigue will understate the contribution of fatigue to absenteeism until this culture is addressed.

TOR 4 Audit System

Examine and review a fatigue management audit system and program as it would apply within Airservices Australia

The FMWG recommends a standard audit process complying with recommended procedures in AS/NZS 4801 OH&S Management Systems and AS/NZS 4804 General Guidelines on Principles, Systems & Supporting Techniques.

Overview

An annual audit of key elements of the Fatigue Risk Management System should be conducted. This audit should review each component of the FRMS to ascertain that it is actively in place and providing a contribution to the effective management of workplace fatigue. The audit objectives should include:

- Ascertaining:
  - Awareness level of policy and procedures
  - Application of risk management procedures
  - Compliance with Safety Management System.
- Review of:
  - Routine FAID data output based on planned and actual hours of work
  - Routine exception reporting
  - Sample of worked rosters
  - New or amended master rosters
  - Education and training material
  - Continuous improvement program.

Effectiveness Survey

In the first year after implementation and at least every third year thereafter conduct a survey of shift working staff to measure the perceived effectiveness of fatigue management strategies and the impact of fatigue on work and family/social life.

Report

Provide a written report to the CEO and senior executives. Staff should also have access to this report.

Audit Team

The audit team should include at least one person with a sound knowledge of Fatigue Risk Management Systems.

Related Shift Work Issues

Workplace Rest & Recreation Facilities

The CTWG Report recommended:

"Evaluate each site in the context of the type of operations conducted and the number of persons at the site, and provide, where appropriate:

- Suitable napping facilities (for pre/post shift naps and night shifts)
- Facilities that allow for quiet, restful breaks
- Brightly lit rest break facilities that are suitably located and furnished to promote fatigue recovery
- Suitable physical fitness facilities
- Accessible outdoor rest and relax facilities".

Every 24/365 environment requires specific attention to the provision of facilities to assist staff with:

- Hot and cold food and drink preparation and storage facilities
- Storage of personal items including a pillow and sleeping bag
- Rest and relaxation facilities
- Napping facilities.

The FMWG supports the recommendations of the CTWG Report and has found that attention should be given to providing staff with access to good quality resting and napping facilities to encourage sound personal fatigue management practice. This is particularly important at locations at which night shifts are worked.

Recommendations

- Airservices Australia should provide facilities for ATS staff consistent with those recommended in the Final Report of the Canadian Tripartite Working Group on ATC Fatigue. Such facilities are especially important in locations where night shifts are worked (Recommendation 17)
- To promote alertness, recreation areas should be brightly lit (Recommendation 18)
- To alert staff in sufficient time to overcome the affects of sleep inertia, a clock with alarm or another alerting mechanism should be in place (Recommendation 19)
- To ensure good hygiene, facilities that are suitable for the storage of individual sleeping bags and pillows should be provided. Bedrooms should be cleaned regularly and reclining chairs should have easily cleanable surfaces (Recommendation 20).

Medical and Associated Issues

Medical

There are more general health complaints amongst shift workers than day workers. This is particularly true for those whose shift work incorporates night work. It is quite probable that the higher incidence of health issues in shift workers is due to a range of other lifestyle factors, including poor diet, low levels of fitness, other casual factors and higher levels of stress due to balancing competing needs (Practical Living for Shiftworkers Workbook; Baker; Fletcher & Dawson 2002).

According to several authors, about 20% of all workers have to leave shift work in a very short time because of serious troubles; on the other hand, only 10% of all workers do not complain about shift work during their working life, while the remaining 70% withstand shift work with different levels of intolerance, that can become more or less manifest at different times, and with different intensity in terms of discomfort, troubles or diseases. (Costa, 1993)

Since the impact of shift work may be quite different among shift workers, having both positive and negative effects, the occupational physician should pay particular attention to shift workers both as concerns pre-employment screening and medical surveillance (Scott and LaDou, 1990)

Sleep apnoea and other sleep disorders can severely impact on the quality of restorative sleep and thereby significantly increase the level of fatigue a shift worker suffers.

Finding

- Shift work, particularly shift work involving night shifts, has an adverse impact on general health.

Recommendation

- Shift workers that fit risk criteria for sleep disorders such as sleep apnoea, and especially those employed in safety critical roles, should be medically screened. The risk of sleep disorders as determined by available criteria should be assessed during routine induction and/or other routine medical examination (Recommendation 31).

Physical Fitness

On average, female shift workers are 5 to 10 Kilograms heavier than their non shift working colleagues, while male shift workers are 10 to 12 Kilograms heavier (Practical Living for Shiftworkers Workbook; Baker; Fletcher & Dawson 2002). A good level of general health and fitness will assist in delaying the onset of fatigue and also improve the quality of recuperative sleep.

Finding

- On average shift workers have a lower level of physical fitness than non shift workers and this may contribute to adverse fatigue outcomes.

Age

Generally speaking, the available scientific literature suggests that with increasing age, workers subjectively report a declining ability to cope with work-related fatigue (e.g. Costa, 1999; Costa *et. al.,* 1995; Rhodes *et. al.,* 1994; Rhodes *et. al.,* 1996). While it may seem intuitive that age might negatively impact on sleepiness due to shift work there remains limited definitive research in this area. While sleep disturbance reportedly increases with worker age and experience (Åkerstedt and Torsvall, 1981; Foret *et. al.,* 1981), objective EEG-based studies do not typically support a significant relationship between increasing age and sleepiness independent of other factors (Torsvall *et. al.,* 1981).

A study by Bonnefond, Rohmer, Hoeft, Muzet, Tassi (2003) assessed whether age was related to task complexity as a function of time of day and time-on-task in a rapid rotating work-rest schedule. Analysis indicated that a performance deficit was present in older individuals on a more complex cognitive task which was demanding in attention resources and memory load. That is time of day was a factor for older workers when coupled with

other factors. The effect of time of day was restricted to simple tasks for participants of all ages and was not evident on a more complex cognitive task. However, some differential strategies appear to distinguish juniors and seniors, specifically on accuracy during the night, suggesting that subjects of different ages cope with cognitive tasks in different ways and that perhaps some adverse effects apparently associated with aging could be counteracted by efficient strategies, but not others. However, exactly what the differences are have not been definitively documented.

A link between age and ATS performance is made in a paper by Becker and Milke (1998) which found that "Chronological age affects the performance of demanding cognitive tasks within the aviation environment. Within the domain of air traffic control (ATC), the ability to handle simultaneous visual and auditory input, or to return to a task after a break to complete another task, is critical to success and is the sort of cognitive function most affected by age. The limited available data suggests a strong relationship between age and job performance among ATC specialists, whether measured at the time of entry into the system or during the working lifetime of a full-performance-level controller.

It is worth noting that at the Risk Assessment Workshops a number of older shift workers identified an increasingly adverse impact of shift work on their sense of wellbeing.

Findings

- Older shift workers report a decreasing ability to cope with shift work
- There is some scientific literature that suggests that older workers have more difficulty completing complex tasks demanding attention resources and memory load.

Female Specific Issues

In many groups of female shift workers, disruptions of the menstrual cycle as well as increased frequencies of menstrual pain, sleep disturbance and fatigue are recognized. Lower pregnancy rates, higher ratios of miscarriage to pregnancy and higher prevalence of premature births in female shift workers have been recorded (Colquhoun *et. al.,* 1996; Scott and LaDou, 1990, cited in Costa, 1997). However, it is possible that a lower pregnancy rate might also relate to a choice by women faced with irregular work schedules and other social and family life difficulties to prioritise work over family (Uehata and Sasakawa, 1982, cited in Costa 1997). Nevertheless, it is suggested that an increase in shift work-related complaints by female workers might be associated with increased complexity in hormonal rhythms linked to reproductive function and also additional demands related to social and domestic commitments (Costa, 1997).

Finding

- Shift work poses additional reproductive difficulties for women.

Family, Social and Relationship Issues

The most commonly reported activities that workers engage in outside of work and sleep include family meals (breakfast, lunch and dinner) and watching television. The positive and (personally perceived) recuperative value of such activities during non-work time has not only been validated by research, but is also widely recognised by the general population. However, studies typically reveal that shift workers and day workers report significant differences in the amount of time and frequency they have available to engage in leisure activities (Fischer *et. al.,* 1993).

It has been argued that the disruption of workers' social and domestic lives by shift work has implications just as great as the physiological consequences (Walker, 1985; cited in Isaac and Ruitenberg, 1999). This may be difficult to quantify, yet it is clear from the literature that irregular shift patterns have greater potential for disrupting workers' home life and social relationships (ILO; Shapiro *et. al.,* 1997). Rotating shifts, for example, pose greater difficulty for the scheduling of social gatherings and may therefore decrease social contact, communication and companionship, acting to increase family friction. Night shifts pose the greatest disruption to sleep and circadian patterns, but may pose slightly less risk of disruption to social lives by improving the predictability of time with friends or family. Clearly, afternoon shifts of all possible shift schedules cause the least circadian, sleep and health disturbances, yet are often found to be highly disruptive to families by leaving little common leisure time.

Monk has previously proposed the principle that domestic factors interact with and influence circadian and sleep factors to determine an individual's ability to cope with shift work and safety at work (Monk and Wagner, 1989). For example, the ability to sleep is largely determined by social, domestic and circadian factors. In the case that a shift worker does successfully balance circadian rhythms and sleep at the expense of domestic harmony, stressful situations are still present. A balance between all these factors may often necessitate a compromise in one or more areas in order to prevent undue impairment in the others (Literature Review p19-20).

Findings

- Shift-work has a significant impact on family and social relationships.
- Ongoing fatigue management awareness education and support can assist shift workers and their families to overcome the adverse impact of shift work.

Other Issues

Napping

In field studies, it has been shown that many shift workers spontaneously fall asleep during the night shift, particularly between 0300 hrs to 0500 hrs (for example, Torsvall et. al., 1989). Muzet and colleagues (1995) have suggested that in specific industries and situations, authorised napping in the workplace should be encouraged. Indeed, as a countermeasure to fatigue, short naps could be beneficial to mental and physiological function. Saito and Sasaki (1995) demonstrated that naps during scheduled breaks of at least 30 minutes were associated with improved alertness during night work. There are also abstracted reports of a short nap during night shifts producing significant improvements in alertness (Muzet *et. al.,* 1997 and Sallinen *et. al.,* 1997; cited in Ahasan, 2002), linearly related to the amount of sleep obtained.

Cruz and co-workers (2000) studied 60 ATC in a laboratory environment, rotating from 3 early morning shifts into a night shift (similar to the change experienced at the end of a 2-2-1 schedule). A significant dose-response relationship was found between napping and protective effects on vigilance, such that a 2-hour nap was better than a short nap of 45 minutes, which was in turn better than no nap. The results of this study suggested that naps taken during night shift are a useful countermeasure to performance decrements and also subjective feelings of sleepiness on the night shift.

The DSEA report titled "Review of Human Factors Issues Related to Curfew Operations in the Sydney TCU" reported, "evidence from the review identified that the ATC on duty do take the opportunity to sleep or nap either in the stand-down room or at the console. Splitting the shift allows at least some opportunity to sleep and thereby reduces the sleep debt. Some controllers during the interview also noted that they had on occasion "nodded" off at the console or suffered micro sleeps." Napping at the console is a high-risk activity, in part due to the effects of sleep inertia (see below).

Costa (1999) states that "the proper use of naps can be very effective in compensating for sleep loss. Useful naps can be taken before night shift or extended operations ('prophylactic naps'), during night as 'anchor sleep' (Minors &Waterhouse, 1981), to alleviate fatigue ('maintenance naps'), or after early morning and night shifts to integrate normal sleep ('replacement naps') (Akerstadt & Torsvall, 1985; Bonnet, 1990; Naitoh, Englund, & Ryman, 1982; Rosa *et. al.,* 1990)." Kogi (1982) found that naps improved the tolerability of night work, whilst Matsumoto, Matsui, Kawamori & Kogi (1982) and Minors & Waterhouse (1981) found that naps improved physiological adjustment to night work. Costa (1993) "showed that the strain connected with night duty among air traffic controllers is considerably reduced, with consequent maintenance of a satisfactory performance level, when a short sleep is allowed. Therefore the use of naps during the night shift should be promoted and negotiated officially..."

Napping can be an effective fatigue mitigation strategy, particularly during night shifts and consideration should be given to the possible use of napping as a fatigue mitigation strategy under some circumstances. However if napping opportunities are routinely provided an additional fatigue risk requires attention. Staff expecting a napping opportunity during their shift may elect not to properly prepare for their night shift by obtaining sufficient sleep. If, due to any circumstances, napping is not available on the night shift, the individual may be required to complete the shift with insufficient alertness and vigilance. This additional risk would require active mitigation.

Findings

- Controlled napping is recognised as an effective fatigue countermeasure, especially on night shifts
- Any expectation of being provided with a napping opportunity creates additional issues
- Successful napping cannot be guaranteed and therefore cannot negate the requirement for proper preparation prior to attending for a shift
- There are a range of factors that need to be considered before a nap is approved. These factors include:
  - Seep inertia risk (unavailable for immediate recall),
  - Temporary changes to normal workload (eg weather, software update, etc.)
  - Reduced staffing level
  - Impact on operational safety of absent staff
- An employee who naps during duty hours will need to comply with any approved procedures that may be in place.

Recommendations

- Napping should be supported as a fatigue countermeasure where opportunities exist (Recommendation 38)
- Protocols for napping, including the management of sleep inertia risk, should be developed (Recommendation 39)
- Provide staff and supervisors with education and guidance on (Recommendation 40):
  a. Benefits of napping
  b. Impact of sleep inertia risk
  c. Risks associated with voluntary and involuntary napping on duty.

Sleep Inertia

A significant limitation to successful workplace napping is the occurrence of sleep inertia. Performance deficits are not only evident following extended wakefulness (i.e. sleep deprivation effects) but also immediately upon awakening from sleep. This phenomenon has been termed sleep inertia, and describes a period of lethargy, fatigue and performance impairment observed immediately after waking. Sleep inertia appears to manifest regardless of the time sleep occurs, both during the night or day (Dinges, 1989), but has only relatively recently started to be studied systematically.

A laboratory study by Bruck and Pisani (1999), shows clearly that sleep inertia negatively affected decision making performance and subjective sleepiness for at least 30 minutes after arousal from sleep, with most impairment in the first 3 minutes where decision making fell to almost 50% of baseline levels. The ability to make decisions was still impaired by up to 20% after 30 minutes. It furthermore appeared that there were no sustained differences in decision-making impairment between arousal from slow wave sleep or REM sleep, although this is not always the case experimentally. Memory or logical reasoning tasks involving a high demand of attention are more easily impaired than easy or monotonous tasks. While more research is needed into this area, the results of these studies nevertheless warrant caution if there is a requirement for workers to perform shortly after awakening from a nap.

An article in Flight Safety Australia (September – October 2002) indicates that the transition from sleep to wakefulness should not be under estimated. The article notes that sleep inertia will last longer for those napping between 0300 hrs and 0700 hrs and will also be greater if the nap is longer than 45 minutes.

Finding

- Sleep inertia presents a significant operational hazard unless properly controlled.

Recommendation

- Napping at operational positions should be expressly forbidden (Recommendation 41).

Summary

The Fatigue Management Working Group (FMWG) was tasked to review current ATS rosters and rostering practice, review relevant scientific literature including fatigue mitigation strategies and to undertake a risk assessment of fatigue issues in ATS. The recommendations provided in this report result from the work undertaken to achieve these tasks.

The FMWG has been able to identify shift rostering and working practice that contributes to elevated workplace fatigue. The result of fatigue audits of ATS rosters reveal that current rostering and extra duty scheduling practice is not achieving what could be termed best practice fatigue management. At times ATS staff have been working in safety critical functions with fatigue levels that were incompatible with the nature of the work being undertaken, however the total number of hours that this occurred in was a very small percentage of working time. The FMWG has been able to identify shift rostering and working practice that contributes to elevated workplace fatigue and has identified workplace and rostering practice that can be implemented to maintain fatigue at acceptable levels, thus reducing the risk of a fatigue induced error.

The FMWG, supported by Dr Adam Fletcher and colleagues from EDU.Au, has evaluated an extensive collection of scientific literature covering fatigue and the impact of shift work on fatigue and performance. It has also reviewed international air traffic controller shift rostering practice. The FMWG examined an array of fatigue risk mitigation strategies and sponsored a series of risk assessment workshops with ATS shift working staff in order to obtain a first hand assessment of fatigue issues in the workplace, systematically assess fatigue management strategies developed by the FMWG and to validate its work to that time.

This report refers to scientific positions on fatigue and international rostering practice pertinent to shiftwork within the ATS environment. It includes 54 recommendations that provide a basis for best practice fatigue management of shift rostering and working within an ATS environment. Principle among these is the need to implement an integrated Fatigue Risk Management System (FRMS). To achieve an optimum outcome, the recommendations will need to be implemented in a cooperative, thoughtful and flexible manner. Fatigue is only one factor in aviation safety and the appropriate use of risk management strategies should enable fatigue management requirements to be balanced against the other factors necessary for safe air traffic service operations.

It must also be acknowledged that workplace activity is not the only contributor to fatigue. Individuals need to be educated to assure that they give appropriate consideration to activities prior to commencing their shift or undertaken during rest periods provided by the employer. For example, prolonged or intense activity outside of the workplace environment (eg second job, housekeeping, study or endurance sport) may also contribute significantly to the level of fatigue experienced at the workplace.

This report provides Airservices Australia with the information and strategies necessary to implement a scientifically sound workplace FRMS. This should achieve a safer and healthier workplace and substantially meet any CASA requirements resulting from recommendation 10 of the Parliamentary Inquiry Report. In a time of increasing government-required accountability requirements and fatigue-related OH&S legislation, the FMWG recommendations contained in this report will provide Airservices Australia with a significantly more compliant and consistent approach to the management of fatigue risk.

Appendix One

Terms of Reference

The Terms of Reference for the Fatigue Management Working Group are listed below.

The working group will provide recommendations on the following:

1. Examine and review the progress of current Airservices Fatigue Management initiatives including, but not limited to:
    i. Airservices Fatigue Policy development;
    ii. Adequacy of current provisions relating to time away from duty between shifts, rest periods during shift, leave arrangements and amount of leave available;
    iii. Whole of system audit, including progress on testing of rosters against a fatigue management package (FAID software, Microster etc)
    iv. Risk assessment exercise as part of the whole of system audit; and
    v. Provision of Training materials and "train-the-trainer" education packages.
2. Clearly define fatigue factors (i.e. possibly as the consequence of inadequate restorative sleep combined with an individual's job, availability and extent of access to recreation and all other forms of leave, hours of work, workload, job tasks, adequate rest and time away from duty, medical conditions, family and social commitments, and relationship pressures);
3. Provide recommended systems and procedures to ensure that an holistic national approach is taken to the management of fatigue;
4. Examine and review a fatigue management audit system and program, as it would apply within Airservices Australia.

Appendix Two

Beyond the Midnight Oil Recommendations

The fatigue management report of the House of Representatives Standing Committee on Communications, Transport and the Arts titled "Beyond the Midnight Oil" and released in 2000 recommended that Airservices Australia and the Civil Aviation Safety Authority carry out further actions. Actions as endorsed by the Government, Airservices and CASA are proceeding. Airservices is committed to improving the safety, wellbeing and health of its employees and there are shared responsibilities both by Airservices, as an employer, and by individual employees, in a total fatigue management program.

Airservices Australia specific recommendations

The parliamentary report contained three principal recommendations affecting Airservices Australia. They are:

Recommendation 10

The Civil Aviation Safety Authority should

- *develop comprehensive hours of duty regulations for air traffic controllers, incorporating basic fatigue management principles;*
- *require all air traffic service providers to maintain auditable fatigue management systems; and*
- *in determining whether an air traffic control service provider has implemented an adequate fatigue management system, consider whether shift rosters for air traffic controllers are routinely tested against a reputable computer based fatigue modelling package.*

Note: Since this recommendation was made CASA have provided a Notice of Proposed Rule Making (NPRM) proposing a new approach to the management of aircrew fatigue (CAO 48). They propose moving away from the current industry wide prescriptive hours of duty regime, defined by agreed limitations that have little or no scientific basis, and towards a system based on scientifically predicted levels of fatigue and the management of the associated risks by use of accepted AS/NZS 4360 risk management principles.

Recommendation 11

Airservices Australia and other providers of air traffic services should, as a matter of urgency, test the shift rosters for air traffic control staff against a reputable computer based fatigue modelling package and develop an interim fatigue management plan to mitigate the risks of a fatigue related air traffic control incident.

Recommendation 41

Fatigue and fatigue management training should be incorporated into management training programs for all those engaged in a management role in all sectors of the transport industry, whether they be a private company or a government entity which is responsible for contracting transport related services (paragraph 3.211).

Related Recommendations

Recommendation 1

The Australian Transport Safety Bureau should:

- Develop cross-modal national standards for identifying, assessing and recording fatigue related accidents and incidents; and
- Establish a national database to provide figures on the extent, impact and associated cost of fatigue in all modes of transport on a national level (paragraph 1.95).

Recommendation 4

The Civil Aviation Safety Authority should ensure that the proposed new Civil Aviation Safety Regulations relating to Air Operator Certification (CASR Part 119) clearly state that the maintenance of sound fatigue management practices is an essential component of an air operator's safety system (paragraph 2.66).

Recommendation 9

The Civil Aviation Safety Authority should:

- Require that operators of commercial transport services introduce and maintain effective systems to monitor staffing levels and anticipated workloads: and
- Routinely review these records to satisfy itself that effective staffing levels are maintained (paragraph 2.115).

Recommendation 12

The Civil Aviation Safety Authority should:

- Take immediate steps to address the concerns raised by the Bureau of Air Safety Investigation and the Australian National Audit Office regarding the effectiveness of its aviation safety auditing; and
- Within three months of this report being tabled in Parliament, report back to this committee on the steps that have been taken to address those concerns and improve its aviation safety auditing, with particular reference to fatigue management in the aviation sector (2.147).

Recommendation 22

The Australian Transport Safety Bureau should establish guidelines for the use of computer-based fatigue modelling packages in all modes of transport (paragraph 2.277).

Recommendation 26

The Minister for Transport and Regional Services, in consultation with the Treasurer, should direct the Productivity Commission to include fatigue and fatigue management as key features of any future inquiries into transport (paragraph 3.38).

Recommendation 27

The Employment Advocate should, when providing information to parties to an Australian Workplace Agreement (in accordance with Section 170V0 of the Workplace Relations Act 1996) include explicit information on fatigue and fatigue management, particularly about the requirements of any industry codes of practice or government regulations in the transport industry (paragraph 3.60).

Recommendation 28

The Australian Industrial Relations Commission should ensure that explicit information on fatigue and fatigue management is provided to all parties engaged in negotiating an Enterprise Bargaining Agreement in the transport industry (paragraph 3.61).

Recommendation 29

The Minister for Transport and Regional Services, in consultation with the Minister for Employment, Workplace Relations and Small Business, should review a representative selection of the Australian Workplace Agreements and Enterprise Bargaining Agreements applying to the transport industry to ensure compliance with existing occupational health and safety requirements and to assess how they rate against accepted fatigue management principles (paragraph 3.65).

Recommendation 30

The National Occupational Health and Safety Commission should:

- Develop and declare a national standard on fatigue in the workplace, identifying fatigue as a workplace hazard in the transport industry and setting out common elements for inclusion in State and Territory occupational health and safety legislation; and
- Declare a corresponding code of practice to provide guidance to employers and employees on how best to comply with the national standards (paragraph 3.85).

Recommendation 31

The Minister for Transport and Regional Services should:

- Work with the Australian Transport Council, transport industry representatives and occupational health and safety specialists to develop workplace safety codes of conduct for each sector of the transport industry to provide guidance on how best to manage fatigue; and
- Ensure that these codes are national in application, complement existing regulatory and occupational health and safety requirements and, where appropriate, are given status by being referenced in relevant transport or occupational health and safety legislation (paragraph 3.99).

Recommendation 32

The Minister for Transport and Regional Services should propose to the Australian Transport Council a strategy to encourage:

- Transport companies to seek quality management accreditation through Standards Australia and the International Organization for Standardisation; and
- The road, aviation and maritime sectors, in conjunction with Standards Australia, to develop sector specific Australian Standards for Safety, incorporating fatigue management principles (paragraph 3.107).

Recommendation 34

The Minister for Transport and Regional Services should:

- Promote, through the Australian Transport Council, the development of State and Territory laws making driving while fatigued an offence;
- Promote the development of additional laws with the effect of suspending the registration of a vehicle if a driver is found guilty of driving while fatigued; and
- Fund the Australian Transport Safety Bureau to commence a program of research to validate the accuracy and reliability of fatigue testing technologies; in particular, those technologies which might be used at the roadside and workplace (paragraph 3.134).

Recommendation 36

The Australian Transport Safety Bureau, in consultation with peak industry bodies should develop an industry-wide drug-free workplace program and associated counselling program, aimed equally at discouraging employees from taking drugs and encouraging employers to establish work practices which respect basic fatigue management principles (paragraph 3.151).

Recommendation 37

The Australian Transport Safety Bureau should take a leadership role in coordinating research and evaluating fatigue issues and initiatives (paragraph 3.163).

Recommendation 39

The Australian Transport Safety Bureau, with assistance from the National Occupational Health and Safety Commission and in conjunction with industry and the scientific community, should establish a cross-modal working group to develop and coordinate fatigue awareness education material and programs for the transport sector (paragraph 3.188).

Recommendation 40

The National Occupational Health and Safety Commission, in conjunction with Commonwealth and State and Territory transport authorities, should develop and disseminate customer focused information and education packages on:

- Best practices in fatigue management;
- Legal obligations and responsibilities for fatigue management; and
- The legal and fatigue implications of inadequate slotting management (paragraph 3.201).

Appendix Three

Principles of Rostering

Subject to the outcome and development of Fatigue Management Principles as referred to in this Agreement, the following conditions will apply for the rostering for all operational employees engaged on shift work. Where the Fatigue Management outcomes provide for recommended or regulated variations to rostering and duty arrangements the Principles of Rostering will be varied.

Management shall consult with staff before the introduction of changed rostering arrangements. A local rostering committee shall be established at each functional unit/location/station for the purposes of this consultation and any other staff/management discussions required under these principles.

Where these principles require agreement of the local rostering committee before certain arrangements may be included in rosters, such approval, once given, may only be withdrawn with three months notice or at any time by mutual consent.

1. Hours of Duty

The total rostered ordinary hours of duty of employees engaged on shift work shall not exceed seventy-two (72) hours per fortnight on average. The ordinary fortnightly total of seventy-two hours is made up of seventy (70) hours, on average, comprising rostered shifts and up to twelve (12) minutes additional per shift, where required, for 'hand-over' duties. The seventy-two ordinary hours and seventy rostered hours shall be averaged over the acquittal period devised for the roster concerned.

2. Length of Shift

Except when agreed by the local rostering committee the length of a shift shall not exceed eight hours and in any case shall not be less than six (6) hours.

Except when agreed by the local rostering committee the length of a shift shall not exceed:

- eight (8) hours for individuals working in teams.
- seven (7) hours for individuals not working in teams.

In all cases the length of a shift shall not be less than six (6) hours.

In acknowledging that there are variations in activity within each 24 hour cycle and in an effort to provide longer breaks between shift, shifts of greater than 8 but not exceeding 10 hours duration (plus hand-over time where necessary) may be incorporated into a roster with the agreement of the local rostering committee.

3. Commencement and Cessation of Work

No rostered shift shall commence or cease between the hours of 0001 and 0459 local. Shifts may be only rostered to commence before 0600 local with the consent of the local rostering committee. In special circumstances a shift may be extended beyond 0000 local with the consent of the employee(s) concerned.

This provision does not prejudice any existing arrangements for rostered starts before 0600 and, where applicable, will apply until implementation of team arrangements at each location.

Where shifts commence before 0600, hours worked before 0600 shall be acquitted three times (i.e. a shift nominally of 8 hours duration commencing at 0500 shall cease at 1100 but be acquitted as 8 hours worked).

Special circumstances (eg. holiday peaks) shall be the subject of prior consultation in the local rostering committee.

4. Extension of Rostered Shift

A rostered shift may be extended by up to two (2) hours prior to the scheduled commencement time. A shift may be extended beyond the nominal finishing time, provided that the total length of the shift worked does not exceed ten (10) hours.

Shift extension should be with employee consent. Such consent should not be withheld unreasonably particularly having regard to the likely impact on the level of service available to the industry.

Notes:

1) Any extension of a rostered shift shall not breach principles relating to shift commencement times or maximum shift length.
2) Extended shifts shall accrue all conditions listed in item 8 of these principles associated with a shift of length equivalent to the time actually worked.

5. Roster Cycles

The maximum number of consecutive rostered shifts shall be five except that six consecutive shifts may be rostered with the consent of the local rostering committee. The maximum number of hours that may be rostered in consecutive shifts shall be forty-eight.

The minimum number of consecutive rostered shifts shall be three.

The maximum number of consecutive shifts worked (including under extra duty provisions) shall be ten. Further, the maximum number of hours, not including extra duty worked continuous with a period of ordinary duty, worked in consecutive shifts shall be eighty.

6. Time Off

The minimum duration of a time off period between successive shifts of duty, rostered or worked, shall be ten hours except in the case of recall to emergency duty, when the minimum shall be eight hours.

Three clear days off shall be rostered following a run of six consecutive shifts or following a run of consecutive shifts totalling more than forty hours. Two clear days off shall be rostered following a run of five consecutive shifts or consecutive shifts totalling more than thirty hours.

In each twenty-eight day period, measured with reference to the commencement of the roster cycle concerned, a minimum of eight days off shall be rostered, including a minimum of two clear days off on at least two occasions.

A roster shall not require an individual to undergo more than seven quick changes in any six week period, measured continuously. Eight quick changes in a six week period may be rostered with the agreement of the local rostering committee.

7. Notification of Rosters

Rosters are to be posted with at least fifteen days notification.

Individuals are entitled to expect that they will progress through the roster pattern in an orderly way and that their progress shall only be interrupted by their absence on leave.

In the event that Airservices Australia initiates a change to the published roster which results in changes to the time of an employee's rostered shift, that employee shall be entitled to receive payment at the appropriate overtime rate for that part of the shift which falls outside the hours of the published shift, unless the employee has been given 48 hours notice of the alteration.

Where an employee is not given seven days notice of a shift change as outlined above, the employee shall be entitled to receive payment at the appropriate overtime rate, unless Airservices Australia could not reasonably have given seven days' notice of the change.

8. Breaks

Employees shall not be required to work a shift without a period of relief from their operational duties.

In a shift of less than eight hours, an employee shall be entitled to a break(s) totalling twenty minutes. In a shift of eight hours or more, a break(s) totalling one hour shall be available.

Where the break or breaks are available as a result of the nature of the duties and/or workload patterns of particular positions no further provision need be made for relief. Where this is not the case, the break or breaks may be provided by combining positions where this is possible or where necessary by rostered relief staff.

The above provisions do not apply to night shifts.

In situations where only single-person staffing is provided, the parties will monitor the OH&S aspects of shift lengths and operational duty requirements.

9. Amenities

Airservices Australia shall, in the provision of new operational buildings, provide suitable areas for the provision of breaks. Airservices Australia will further endeavour to provide such amenities at existing workplaces.

10. Stand-by Rosters

Where Airservices Australia considers it economical to do so, rosters may be drawn so as to include provision for staff to be on stand-by for relief in the event of absence of rostered duty staff.

Staff on stand-by are to be rostered for a specific shift on the day concerned, termed the "nominal shift". The nominal shift shall not commence before 0600 local and shall not be of more than eight (8) hours duration.

Staff on stand-by will not attend for work unless called to do so. They must be available to perform duty for a period representing twice the length of the nominal shift. They must be 'on call, for a period of 9 hours or such other period as agreed by the local rostering committee; provided that they will be stood-down one hour after the commencement of the last shift in the stand-by period. They must be available to report for duty at the nominated start time or in any event not later than two hours after notification.

Telephone paging systems will be provided at each station where stand-by arrangements are put in place for the purpose of facilitating contact with staff on stand-by.

Payment will be made in respect of the nominal shift whether or not an individual is required to attend for duty.

Provisions of these principles relating to shift commencement, cessation and extension and time off apply to the time actually worked by stand-by staff.

11. Mutual Changes of Shift

Mutual changes of shift between employees are permitted subject to management approval and provided that shifts worked are in accordance with the maximum shift runs, hours worked and time off provisions of these principles.

Where staff members elect to mutually change shifts of differing lengths, financial considerations, including shift allowances, are a matter for the staff members concerned and not for Airservices Australia.

Within teams, mutual changes for a single shift or between teams are permissible with the concurrence of both team leaders concerned.

Management shall not withhold approval unreasonably.

12. Dispute Settling Provisions

Dispute settling arrangements will be undertaken by Airservices Australia and Civil Air in accordance with the relevant provisions of this Agreement and/or the Airservices Australia Award as appropriate.

A Central Rostering Committee comprising management and Civil Air nominees shall be established to interpret these principles and, where possible, to settle differences relating to their application.

13. Definitions

One clear day off

Consists of a minimum of thirty (30) hours including twenty-four (24) hours commencing at midnight.

Two clear days off

Consists of a minimum of fifty-four (54) hours including forty-eight (48) hours commencing at midnight.

Three Clear Days off

Consists of a minimum of seventy-eight (78) hours including seventy-two (72) hours commencing at midnight.

Quick Change

Rostered return to duty after less than fourteen (14) hours time off constitutes a quick change unless it occurs over a sleeping period.

Sleep Period

The hours between 2300 and 0600 local time.

Night Shift

A shift which includes the hours from 0001 to 0559 local.

Stand-by

A system whereby employees are rostered to attend a nominal shift but do not attend unless called upon as relief for absence among actively rostered staff.

Local Rostering Committee

A committee comprising one representative each of management and of the members of the roster concerned formed for the purpose of consultation and discussion about rosters, as required under these principles.

Appendix Four

These guidelines should be read in conjunction with the Recommendations contained within this report. It should be noted that some guidelines may contradict each other if read independent of the broader context.

Guidelines for Rostering and Working Practice

Background

Fatigue cannot be eliminated from the workplace, however adopting the guidelines identified below will assist in managing workplace fatigue and provide rosters which maintain an acceptable fatigue level. To ensure acceptable fatigue levels are maintained, all rosters and extra duty shifts should be tested using fatigue predictive software (eg FAID) and staff should use a self reporting system to report possible instances of elevated fatigue.

The most effective time for the vast majority of individuals to achieve good quality restorative sleep is between 2200 hrs and 0800 hrs. It is important that this period be rostered off regularly and equitably.

Consecutive Shifts

- Consecutive night shifts are not recommended
  - If consecutive night shifts are worked they should be limited to two consecutive night shifts in a shift cycle of four or less shifts
- More than three (3) consecutive shifts that impinge on the normal sleep period are not recommended.

Days Off

- Roster at least two days off between shift cycles frequently and at least every second cycle.

Rosters

- Rosters should follow a regular pattern both within and between shift cycles (the exception is that shifts that impinge on the normal sleep period should not be grouped together).

Start Times

- Avoid rostering morning starts prior to 0600 hrs unless this is required to avoid an additional night shift to meet early morning traffic demand.

Days Off

- Single days off should be minimised as they have less social and recuperative value
- Two days off prior to shift cycles containing one or more night shifts will assist in maintaining acceptable fatigue levels on the night shift.

Equitable Distribution of Shifts

- Share shifts that impinge on the normal sleep period and extra duty shifts between all eligible staff when possible.

Appendix Five

Proposed CASA Fatigue Risk Management System

Background

CASA have released a draft "Manual of Standards for Fatigue Management Systems", which contains information on how a risk management approach could be applied within the general aviation industry to managing workplace fatigue.

The proposed CASA Fatigue Risk Management System (FRMS) requires compliance with AS/NZS 4360. Compliance with internal AsA Safety Management System requirements should be acceptable.

The following is an extract from the CASA Notice of Proposed Rule Making re Civil Aviation Order 48

3.4 Key Proposal - Fatigue Risk Management Systems

3.4.1 The current systems for managing fatigue in aircrew are prescriptive, relatively inflexible and not based on scientific principles; rather they are largely based on industrial practices in existence at the time of development. Because the legislation cannot meet operator requirements in all situations, most systems have a provision to allow exemptions from compliance with the rules. However, because the exemptions, too, lacked a scientific basis, they were seen as a major factor in the increasing incidence of fatigue in aircrew.

3.4.2 CASA has recently adopted a policy whereby an operator seeking to renew an exemption may, with the increasing emphasis on a scientific approach to the management of fatigue in the workplace, develop a fatigue risk management system (FRMS) incorporating the concept of risk management to replace an existing exemption from compliance with CAO 48. A FRMS would be the cornerstone of an operator's fatigue management system.

3.4.3 Risk Management

3.4.3.1 Under the Australian concept, the principles of risk management outlined in Australia/New Zealand Standard (AS/NZS) 4360:1999 are adapted to fatigue management becoming a system for managing the risk of becoming fatigued and the consequences arising there from. A Risk Management System established under AS/NZS 4360:1999 has the following attributes:

- Policy - which includes the objectives of and the commitment for managing risk
- Commitment - Management commitment to the establishment, implementation and maintenance of a risk management system
- Responsibility and Authority - joint responsibility and authority for the identification and assessment of risk factors and their treatment, communication and consultation
- Resources - for education, training, verification and review
- Implementation - sponsorship and support of senior management, policy development and communication, management of risks at all levels within the organization

- Monitor and Review - Ongoing monitoring of risks and effectiveness of the risk management process.

3.4.3.2 A risk management system is a quality system in the same way as Safety Management Systems or a Quality Assurance Systems are quality systems.

3.4.4 Fatigue Risk Management

3.4.4.1 The fatigue risk management system proposed by CASA consists of a two element system of management where the likelihood of becoming fatigued while operating is determined and treated and the risk from operating in a fatigued state is determined and treated.

Fatigue - exhaustion of mind or body resulting from labour or exertion.

Research has confirmed that fatigue is also "an exhaustion" which is caused by lack of sleep. In fact the research has confirmed that, of all the factors which contribute to fatigue, lack of sleep is the most significant contributing factor.

Risk - The chance of *something happening* that will have an impact upon objectives measured in terms of consequences and likelihood. *AS/NZS 4360: 1999 Risk Management*

Risk Management - the culture, processes and structures directed towards effective management of *potential opportunities* and adverse effects. *AS/NZS 4360: 1999 Risk Management*

'potential opportunities' in the context of Fatigue Risk Management equates to *'something happening'.*

'something happening' may be termed a hazard.

Hazard - a source of potential harm or a situation with a potential to cause loss. *AS/NZS 4360: 1999 Risk Management.*

That hazard is the performance of tasks at fatigue levels in excess of those considered safe in the circumstance.

3.4.4.2 **Fatigue Risk Management** is thus a process of managing fatigue in aircrew and other workers in the aviation industry so that it does not become a source of potential harm. This description satisfies the requirements of ICAO Annex 6:

The State of the Operator shall establish regulations specifying the limitations applicable to the flight time and flight duty periods for flight crew members. These regulations shall also make provision for adequate rest periods and shall be such as to ensure that fatigue occurring either in a flight or successive flights or accumulated over a period of time due to these and other tasks, does not endanger the safety of a flight.

3.4.5 Commitment/Joint Ownership

3.4.5.1 The implementation of a fatigue risk management system involves a commitment by management to support the concept of fatigue risk management as a safety management tool which is routinely applied to the management of day to day company operations. Without such commitment, there is a risk that a FRMS will be seen simply as a tool for increasing rate of effort.

3.4.5.2 Ownership of a FRMS implies responsibility for its use. An FRMS is jointly owned by staff and management, accordingly each is jointly responsible and accountable for the effective implementation, operation and administration, maintenance and improvement of the system. All have a duty of care to ensure that information recorded is timely, accurate and honest. Management must ensure that the FRMS is applied fairly and within acceptable limits commensurate with OH&S legislation while staff must undertake to abide by the limits and take the opportunity for rest when it is offered.

3.4.3 In addition to their responsibilities under OH&S legislation to report for duty in a fit state, staff have an obligation to report circumstances relating to adverse performance of an FRMS such as fatigue excursions, adverse operational factors or physiological factors such as illness or sleep disorders which will have an adverse effect on fatigue levels.

3.4.6 Safety Case

3.4.6.1 Once management has committed to the concept of fatigue risk management, it must commit to frank and open dialogue with staff and put in place appropriate mechanisms for consultation. A safety case approach must be applied to establishment of the context in which fatigue is a factor. Staff must be involved in the identification, analysis, evaluation and treatment of fatigue. **AS/NZS 4360:1999** provides a generic framework for such risk assessment which would satisfy the regulator's requirements.

3.4.6.2 Such factors as the type of operation and the indicators and consequences of fatigue particular to each type of operation need to be identified and addressed. An acceptable level of risk in light of consequences needs to be determined for each type of operation together with justification and procedures which need to be developed to enable fatigue hazard identification. Strategies must be developed to mitigate such hazards. A number of measures may be available to the operator to either minimise the onset of fatigue or mitigate the effects of fatigue such as:

- the provision of suitable rest or sleep facilities;
- the provision of transport;
- the availability of catering;
- the provision of adequate support staff;
- upgrading of equipment essential to the task;
- the availability of operational support such as flight planning;
- reduction of duty periods; and
- augmenting of flight crews.

3.4.6.3 The list is not complete but the use of such measures should be considered during development of the safety case.

3.4.6.4 The operator cannot simply install a fatigue risk management system developed for another operator but must be able to demonstrate knowledge of fatigue risks unique to his or her organisation.

3.4.7 Rostering System

3.4.7.1 Fatigue models. A number of computer based or spreadsheet tools have been developed to enable the levels of fatigue in a standard individual to be modelled and determined or projected. Such tools enable preparation of rosters within established fatigue limits and enable estimation of peak levels of fatigue during and on completion of a roster period. However, these tools only take into account the 'body clock' factors affecting fatigue, such as hours of being awake and propensity to sleep correlating to time-of-day (circadian rhythm effects). These do NOT consider the range of activities and nature of each activity performed in a roster cycle or the fatigue effects of such activities. The fatigue risk assessment and relevant control measures must manage these activity and life-style issues.

3.4.7.2 It is important to remember that a person's previous work history must be considered when constructing a roster, as this will influence the fatigue state of the individual when entering the roster. This is particularly pertinent to casual or part-time staff.

3.4.7.3 **Fatigue level benchmark (or Peak Fatigue Limit).** A fatigue level benchmark or Peak Fatigue Limit is a rostering tool comprising a maximum predicted level of fatigue acceptable for planning purposes. Thus, a roster can be developed with a fatigue level benchmark beyond which a pilot must not be rostered. This benchmark will not be the same for all operations but will be lower where an operator determines that the risk to the operation from a pilot or crewmember with a particular level of fatigue is unacceptable or of greater consequence. Conversely, a higher fatigue risk level or fatigue level benchmark may be acceptable in a less demanding operation. Employee consultation and involvement is an essential element in the process of setting the benchmark.

3.4.7.4 The topic of benchmark setting must be addressed in the safety case.

3.4.7.5 **Excursions** (Where the Peak Fatigue Score exceeds the Peak Fatigue Limit). There will always be contingency situations requiring extension of work periods. Excursions of fatigue beyond the benchmark are acceptable provided that the operator has strategies in place to manage the consequent increased level of fatigue risk. Such strategies may involve:

- the establishment of excursion limits;
- limiting the number of times an excursion may be permitted in a roster period;
- prescribing the maximum level of excursion over which mandatory action would be necessary;
- prescribing duties and responsibilities of staff following occurrence of an excursion;
- limiting the availability of the crewmember for future rostering following an excursion.

3.4.7.6 **Lifestyle guarantee.** Dislocation of family and social life as a result of unsatisfactory rostering practices may result in pressures on relationships, domestic workloads and community activities. As with sleep and fatigue, this has implications for task performance, health, safety, morale, absenteeism, productivity and attrition rates. A lifestyle guarantee is a set of prescriptive limits or rules applied to a rostering system designed to provide a degree of predictability to a crewmember's time free of duty to allow a satisfactory social and family life.

3.4.7.7 At a minimum, a lifestyle guarantee should provide the following:

- minimum time constituting a rest period
- maximum time constituting a work period
- minimum number of days free of duty per roster period
- maximum number of consecutive work days in a roster period.

3.4.7.8 Some operators may prefer to adopt the limits detailed in prescriptive legislation or their current exemption as their lifestyle guarantee while others may prefer to negotiate an acceptable arrangement with staff. Together with the other rostering tools, lifestyle guarantees are the key elements in a fatigue risk management system.

3.4.8 Education and Training

3.4.8.1 An operator is responsible for educating staff on the nature of an FRMS. The training program must provide for induction of new employees and regular refresher training for existing employees covering such topics as:

- the nature and cause of fatigue in individuals;
- fatigue in the workplace, and its possible adverse effects;
- duties and responsibilities of employers and employees;
- recording and reporting;
- contingencies;
- circadian rhythms and their relationship to work scheduling;
- flexible work schedules and design principles;
- hazards associated with flexible work and extended hours;
- the impact of flexible work and extended hours on health and safety;
- including lifestyle issues.
- individual strategies for managing disrupted rest periods;
- education material for family members.

3.4.9 Monitoring and Review

3.4.9.1 The performance of an FRMS must be monitored to ensure compliance with the approved criteria and that limits and levels are reasonable and do not lead to excessive fatigue levels in aircrew. A fatigue incident reporting and acquittal procedure is thus an essential element of a FRMS.

3.4.9.2 There should be a mechanism within the FRMS for review of benchmark levels and acceptable excursion limits. In conjunction with the reporting procedure, regular review will enable the operator to detect trends in FRMS performance.

3.4.10 Audit and Reporting

3.4.10.1 Audit, involving both internal and external audit, is an essential element of a safety system. The performance of an operator's FRMS will be subject to audit by CASA. The FRMS must therefore have the capacity for retrospective analysis. Furthermore, CASA will require reports of action in the event of major excursion so each FRMS must have a mechanism for both internal and external reporting.

3.4.10.2 Internal audit by appropriately qualified personnel will assist the operator to achieve the goals of the FRMS and will also make the process of external audit easier.

3.4.11 Record Keeping

3.4.11.1 Adequate record keeping is essential to ensure that the performance of the FRMS can be monitored and to provide evidence of measures implemented to improve performance. Record keeping will also show whether or not the reporting obligations of an FRMS have been met. Further, the success of an audit relies to a great extent on accurate and faithful record keeping.

3.4.11.2 Trends in performance of an FRMS and in compliance history can only be detected over time and records required in 3.4.11.1 must be kept for the life of the FRMS or a minimum period of three years.

3.4.12 Contingency Planning

3.4.12.1 An FRMS must include instructions to employees regarding action in the event of contingency circumstances. Such circumstances may include such events as:

- action in the event that an employee considers him/herself fatigued and therefore unfit to work;
- action in event of excursions from agreed levels;
- inadequate or unavailable sleeping or resting accommodation;
- unavailability of transport to accommodation;
- remote location operations;
- rostering computer failure;
- communications problems; etc.

3.4.12.2 Where adverse trends become evident, the FRMS must have strategies in place to address not only the trends but also excursions above benchmark and limit levels. Such strategies may involve the use of reduced work periods or additional time free of duty, increased staffing levels, or amended route profiles or work practices and would be accompanied by appropriate reporting procedures.

Appendix Six

Example of a Napping Protocol

Background

The following example of a napping protocol has been provided to the FRMS.

Example Only

Napping

The benefits of napping as a fatigue counter-measure, particularly on night shifts, are well known. Staff who feel fatigued are encouraged to nap where opportunities exist. Staff however should never assume a napping opportunity will be available or that they will be able to successfully nap if given the opportunity. For these reasons it is important that staff adequately prepare for completing their shift without a nap.

Also well known is the 'sleep inertia' effect. Sleep inertia occurs whenever we awake from sleep and has been scientifically demonstrated to result in a significant, temporary impairment of cognitive functions. Performance is generally low immediately upon awakening, but recovers usually after 15 to 30 minutes.

The effect of sleep inertia is more pronounced the longer the sleep and at night. Exposure to bright light, appropriate nutrition, exercise and conversation, coupled with the time of day, all influence recovery from sleepiness. Importantly, however, there is no validated means of speeding up the process of recovery from sleep inertia.

Staff are also reminded of the effects of sleep inertia on the drive to and from work if sleeping prior to, or on completion of duty.

Instruction

Staff are not to perform any operational function or undertake any operational task until a minimum 15 minutes has elapsed after waking from sleep. Consideration should be given to planning a longer sleep inertia recovery period on the night shift.

References

Our primary reference source has been the review of research literature undertaken for Airservices Australia by EDU.Au PTY LTD. That document contains the details of references used throughout the FMWG reports.

Van den Heuvel C, Fletcher A, Paradowski M & Dawson D (reviewed by Gander P & Cruz C) (2003), *A review of Fatigue Management Research Literature and Current Air Traffic Control Practices for Airservices Australia.* Airservices Australia, Canberra.

Additional material has been sourced from the following reports and papers:

- Beyond the Midnight Oil Report House of Representatives Committee (October 2000)
- Response from the Government to the above report
- Response from Airservices Australia to the above report
- Fatigue Management in ATC; the New Zealand Approach - paper by Philippa Gander from the Wellington School of Medicine Sleep/Wake Research Centre; 2000
- Practical Living for Shiftworkers; Baker A, Fletcher A, Dawson D. 2002
- Documents on proposed CASA rule making and standards for fatigue management
- Employers' duty of care to their employees in relation to fatigue - paper by Steven Penning & Megan Cameron from Turner Freeman Solicitors (August 2003)
- Special Commission of Enquiry; Waterfall Rail Accident; Commissioner The Hon P A McInerney QC; 2003
- Interaction of Age with Time of Day and Mental Load in Different Cognitive Tasks; The Journal of Perceptual Motor Skills; paper by Bonnefond A, Rohmer O, Hoeft A, Muzet A, Tassi P. 2003; p96 & p1223-36
- Cognition and aging in a complex work environment: relationships with performance among air traffic control specialists; The Journal of Aviation, Space and Environmental Medicine; paper by Becker, J.T. and Milke, R.M. 1998 Vol 69 pp944-51.

Attachment One

Final Comments from Members of the Working Group

Comment by Mr Alf Duczek

Any new procedures, processes, changes or variations to current practice have to be subject to the Airservices Australia Safety Management System (SMS) and risk assessment processes for assessment prior to implementation.

Accordingly we must not compromise our requirement to use the SMS and risk assessment processes.

The question will always be as to what is considered reasonable and safe? The answers are more difficult and need to be validated with evidence and balanced by current practice and delivery of service requirements.

Current practices and precedents may not have been based on evidence validated by a Fatigue Management System (FMS), however, they are what can frequently be termed at an accepted level. They have been formed through the experience in the delivery of a safety orientated service while ensuring positive employee welfare.

These practices are the starting point for the basis of a low as reasonably possible (ALARP) approach to a phased introduction of a FMS that can be supported by evidence and due process.

While each recommendation in the report must be assessed and reviewed to determine an ALARP outcome, it does not necessary mean that all recommendations would need to be implemented (partially or in total) to achieve an acceptable FMS. They are a set of guidelines to facilitate the introduction of a FMS and to allow the project activity to begin in what could be termed pioneering work.

Airservices Australia must also be cognisant of recommendations providing limited fatigue benefit that will compromise the flexibility currently enjoyed by staff.

I have some concerns that attention may focus specifically on recommendations with defined outcomes in isolation, such as those listed under rest breaks, which would be adequately addressed by recommendations 42, 47 and 49.

However, I am confident that the maturity exists to see that these are a set of guidelines that will allow Airservices Australia to move towards a validated FMS.

Given that all of the above is clearly understood, I am happy to endorse the provision of this Report to the National Consultative Council, Occupational Health and Safety Sub Committee for their review.

Comment by Mr Peter Gregg

To enable the implementation process to continue I endorse this Report.

I have one major concern that I wish to have recorded; my concern relates to the Section on Rest Breaks.

The Working Group found several examples of rest break arrangements in single person tower operations, whether this qualifies as validated evidence is questionable. From my own experiences during many years of shift work there is a lot more to rest and recovery than a mandatory rest break every two hours. This period could be extended in certain cases subject to a formal risk management process - workload, traffic patterns, working environment, shift cycles, time away from work and personal chemistry all have a part to play.

As submitted previously, I would prefer the Rest Break Recommendations to be restricted to Recommendations 42; 47 & 49. I know that the successful application of these three recommendations will rely heavily on trust between Employer and Employee which is sadly lacking today. Maybe this could be a turning point in the "trust" stakes.

Comment by Mr Phil Vabre & Mr Peter Holmes

One significant issue that has not been addressed [in finalising this report] is the insertion of the words "Implementation of" at the start of the proposed Recommendation 2. As you know, we have highlighted the matter of this un-agreed insertion in the past and it has also been addressed by Dr Fletcher.

Furthermore, as we earlier advised, Civil Air is not prepared to sign off on a report which contains comment by FMWG members that is merely personal opinion and neither agreed, nor based on science and/or the weight of expert opinion [this attachment].