AIRSERVICES AUSTRALIA

MANAGEMENT INSTRUCTION

Instruction Topic	**FATIGUE RISK MANAGEMENT SYSTEM (FRMS) - PROCEDURES**		
Instruction Number	**MI- 3203 Version 2.0**	**Issue Date**	28 September 2007
Functional Area	Part 172 Operating Certificate – Air Traffic Services		
Background	Airservices has established a fatigue risk management system (FRMS) for shift working ATS staff in response to its legal and ethical responsibilities as they relate to its occupational health and safety and fitness for duty policies. This Instruction forms part of the FRMS. It contains procedures that shall be followed to manage workplace fatigue risks. It contains links to recommended practices that constitute guidelines for implementing these procedures.		
Corporate Policy Reference and Links	Fitness for Duty Policy Safety Management Policy		
Responsibility	General Manager, Safety Management		
Definitions and Explanations	Refer associated documents and this instruction		
Further Guidance and Key Links	See hyperlinks from this instruction		
Effective Date	15 October 2007		
Contacts	Manager, Safety Enhancement and Development		
Document Controller	National Documentation Manager		
Functional Authority/Approval	General Manager, Safety Management,		

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1. PURPOSE

The procedures contained in this instruction give effect to the strategies iterated in Section 4.2 of this Instruction. The procedures:

- Reinforce the concept that fatigue management is a shared responsibility between Airservices Australia in its capacity as an employer, and its staff;
- Specify how managers and staff shall enact the strategies in order to achieve an optimal fatigue outcome utilising a risk management approach; and
- Provides links to a suite of guideline documents that provide recommended practices to execute each procedure.

2. SCOPE

The document applies to ATS managers and all shift working ATS staff.

3. REFERENCES

A report to the National Consultative Council Occupational Health and Safety Sub Committee on Fatigue Management within Airservices Australia Air traffic Services.

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4. OVERVIEW

4.1 Air Traffic Services Fatigue Risk Management System

The Air Traffic Services Fatigue Risk Management System has been established to manage fatigue and fatigue risk. It consists of an integrated strategic and tactical approach to reduce the likelihood of fatigue while working with and controlling risks associated with fatigue particularly in the H24 delivery of air traffic services.

4.2 Fatigue Risk Management Strategies

The management of fatigue risk in ATS is being supported by strategies that:

- Ensure joint staff and management ownership of the organisations fatigue risk management system;
- Ensure staff and management understand the impact of fatigue and are aware of fatigue management requirements and strategies;
- Ensure rosters are designed and managed in a manner that provides adequate opportunity for rest and recovery sleep as assessed by the computerised FAID system;
- Ensure the workplace environment is conducive to fatigue mitigation and provides adequate facilities to rest and to prepare and consume food and drink;
- Ensure workload and rest breaks are adequately managed;
- Ensure FAID score targets for worked shifts are achieved by a system of routine auditing;
- Provide a simple process to assist shift workers and supervisors to assess fitness for duty in relation to recent sleep and wake periods;
- Provide a simple process to review risk factors when allocating extra duty, particularly when night shifts are involved;
- Provide a system of risk assessment and acceptance requirements that involve management accountability;
- Provide a system for recording and reporting fatigue risk events;

- Provide a system to support continuous improvement that includes routine auditing and review of system performance;
- Require implementation of fatigue and workload management to control increased fatigue risk; and
- Require avoidance of unacceptable risk levels.

5. GENERAL

5.1 Basis for fatigue risk management

Fatigue shall be managed as a workplace OH&S hazard that has the potential to impact on fitness for duty.

Where this Instruction specifies the use of published guidelines and/or recommended practices any variation from those guidelines shall be subjected to a risk assessment by the business unit concerned.

5.2 Observed Fatigue Symptoms

Where supervisors or staff detect signs of reduced alertness or impairment, it is important that the possibility of fatigue be considered. There are a number of causal factors that can present similar symptoms to fatigue. Self assessment of impairment due to fatigue can be unreliable, particularly if high levels of fatigue are being experienced.

5.3 Responsibilities

Management and staff are jointly responsible for managing workplace fatigue risk.

5.3.1 Managers are responsible for providing:

- Fatigue Management Awareness & System Training;
- Roster schedules that provide sufficient recuperative sleep opportunity between shifts as assessed by the FAID application; and
- Work and shift management strategies that moderates fatigue accumulation.

5.3.2 Staff are responsible for:

- Managing their lifestyle and recuperative sleep opportunities to enable them to present fit for duty on scheduled shifts; and
- Frank disclosure of impairment due to fatigue when it may pose a workplace hazard.

5.4 Fatigue prediction tool

The Interdyne FAID system shall be used as a predictive tool for the potential for fatigue associated with hours of work.

If the FAID score exceeds 80 then this shall be used as the initiating score for the FRMS processes.

NOTE: FAID scores to one decimal point will be rounded to the nearest whole number. For example a resultant score of 80.4 will be rounded to 80.

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6. FATIGUE RISK MANAGEMENT AND CONTROL

6.1 Risk management control and process

Shifts that exceed the initiating FAID score shall be subjected to the Fatigue Risk Assessment process and where assessed as necessary a Control Process

The process requires consideration of four factors:

- Peak FAID score prediction;
- Prior sleep/wake assessment;
- Task complexity/workload assessment; and
- Application of fatigue and/or operational risk controls.

Where the FAID prediction exceeds the initiating score the remaining three factors are placed in a matrix array which has four possible residual fatigue impact outcomes, three of which require acceptance of risk or a decision to withdraw a service from successively higher specified management levels. The four levels are depicted in the table below:

Residual Fatigue Risk Impact	Risk Acceptance Authority for the unit where the risk occurs
Acceptable	None required
D	ATC Line Manager (ALM)
C	Service Delivery Manager
B	General Manager, Air Traffic Control

The process for determining the residual fatigue risk impact is performed in the Fatigue Risk Calculator.

The following linked documents contain additional information about the background of, and using the Prior sleep/wake assessment model.

Risk management procedures must also be applied when it is known that fatigue risk is elevated, using the Risk Assessment Guidance document for this purpose.

Increased risk mitigation efforts are required to control increasingly higher FAID scores. This may require a combination of fatigue and operational risk control strategies. Follow the link for examples of fatigue and operational risk control strategies that may be commonly applicable.

Organisational and management responsibility for fatigue risk identified through this process cannot be accepted by the individual staff member concerned.

6.2 Operational Risk Profile

The propensity to make fatigue induced errors increases with increasing fatigue levels and the ability to recognise and correct errors reduces with increasing levels of fatigue. It is therefore necessary to manage fatigue risk as part of the operational Human Factors risk management strategy. The consequence of a fatigue induced error has been assessed for each air traffic services' function and, as a result, ATS functions have been divided into two groups.

Functions in which a fatigue induced error could escalate into an incident having an immediate impact on operational safety have been classified as "high consequence functions". The remaining functions, in which the number of available system defences means that the likelihood that a fatigue error will escalate into an incident with immediate operational safety consequences is very low, have been classified as "low consequence functions".

All shift working ATS functions are high consequence functions unless otherwise classified.

ATS shift working functions classified as low consequence are:

- AusFIC Briefing;
- Training staff, and staff who are training and are not involved in traffic separation; and
- Target Generation Officer (TGO).

6.3 Continuous improvement

Fatigue management shall be the subject of a continuous improvement program, including reassessing the FAID target and an overall review every six months.

7. Rosters

Rostered shifts shall not exceed the target initiating FAID score.

New rosters shall be based on FRMS Guidelines.

8. Staff Replacement

8.1 Rosters containing night shifts

Extra duty shall, as far as practical, be allocated in a manner that:

- Equitably shares extra duty between staff and avoids unnecessarily high FAID scores; and
- Does not result in a night shift longer than eight hours or another shift longer than ten hours.

When allocating extra duty, FAID assessments shall be conducted from seven days prior to the affected shift to the next two day break.

FAID assessments and Fatigue Risk Assessment (FRA) tasks will be prioritised on a risk management basis. The impact of this on fatigue management procedures is that when higher priority tasks present, such as In-Flight Emergency Response (IFER) management or system degradation, and there is inadequate spare resource to manage a fatigue process in relation to extra duty, then an appropriately qualified, available person will be sourced for the extra duty and the fatigue assessment process applied to that callout when the higher priority matters are resolved.

The following documents shall be used as guidelines and recommended practices:

- Allocation of Extra Duty
- Fatigue Risk Calculator
- Fatigue Risk Assessment Guidance

8.2 Rosters not containing night shifts

Extra duty shall as far as practical, be allocated in a manner that equitably shares overtime between staff and avoids unnecessarily high FAID scores.

The following documents shall be used as guidelines and recommended practices:

- Allocation of Extra Duty
- Fatigue Risk Calculator

9. Mutual Change of Shift

Rostered shifts can be mutually changed between employees working on the same roster provided they do not result in either employee working a shift with a FAID score in excess of the initiating FAID score.

The following document shall be used as guidelines and recommended practices:

- FRMS - Change of Shift

10. Rest Breaks

Provision shall be made for rest breaks to mitigate the effects of work related fatigue and to attend to personal needs.

The following document shall be used as guidelines and recommended practices:

- Rest Breaks During Shift

11. Napping and Sleep Inertia

Business units may authorise napping in a designated room or location within reasonable proximity to operational positions in accordance with the following provisions. Additional provisions or process may be specified in business unit documentation.

11.1 Manager and supervisor responsibilities

Prior to authorising a staff member to leave a workstation for the purpose of a nap, managers and supervisors shall assure themselves of the following:

- There is no reasonable expectation that operational safety could be compromised by the absence of the staff member;
- The proposed nap is a fatigue risk control measure implemented as part of a fatigue risk management strategy or the staff member is temporarily not required;
- Procedures are in place to manage sleep inertia recovery. To reduce the risk associated with sleep inertia operational tasks should not be undertaken immediately after awakening. As a general guide it is recommended that individuals be awake and undertaking activity for the following period prior to performing operational tasks:
  - Between twenty and thirty minutes during the period 3:00AM to 7:00AM; and
  - Between ten and fifteen minutes at other times.
- Appropriate arrangements are in place to ensure the staff member will be awakened at the agreed time.

11.2 Staff Responsibility

While on duty, staff shall not intentionally nap without authorisation. If authorised to nap, the staff member shall ensure that they have in place an appropriate mechanism to wake in sufficient time to recover from the effect of sleep inertia before they are required to resume an operational function.

Staff will ensure that they spend this recovery period in activity that is conducive to increasing alertness levels and, where possible, in a brightly lit environment.

11.3 Sleeping at Workstations or Consoles

For safety reasons staff are not permitted to nap at operational workstations.

11.4 Unintentional Napping

Staff who experience signs of drowsiness or micro sleeps whilst responsible for an operational function must inform their supervisor, where available, and take reasonable action to reduce the likelihood of falling asleep.

Staff who inadvertently fall asleep for more than a few minutes whilst responsible for an operational function need to be aware of sleep inertia risk.

Additional Information on sleep risk

12. RESPONSIBILITIES

The General Manager, Safety Management shall be responsible for:

- Oversight of the FRMS;
- National FRMS standards and procedures; and
- Coordinating the review and continuous improvement process.

Business Units shall be responsible for:

- Day to day operation of the FRMS;
- Establishing and maintaining processes to ensure compliance with the FRMS; and
- Retention of FAID assessment records.

Reports shall be generated in relation to these responsibilities on:

- Data and outcomes of the fatigue risk assessment process;
- Fatigue identified as a causal factor in air safety incidents (ESIR);
- Fatigue identified as a causal factor in OH&S events (OH&S incident reports); and
- Staff reports of unfitness for duty associated with fatigue (SAP leave records).

13. RELATED DOCUMENTS

Document number	Document Name
AA-GUIDE-SAF-0002	Allocation of Extra Duty
AA-GUIDE-SAF-0003	Approval for Mutual Change of Shift
AA-GUIDE-SAF-0004	Recommended Roster Strategies
AA-GUIDE-SAF-0005	Using the Prior Sleep Wake Model
AA-GUIDE-SAF-0006	Fatigue Risk Management Guidance
AA-GUIDE-SAF-0007	Examples of Fatigue and Operational Risk Control Strategies
AA-GUIDE-SAF-0008	Roster Design Issues
AA-GUIDE-SAF-0009	Sleep Inertia Risk Associated with Sleeping or Napping on Duty
AA-GUIDE-SAF-0010	Prior Sleep Wake Model Background Information Paper
AA-GUIDE-SAF-0011	Extra Duty and Mutual Change of Shift – Background Information
AA-GUIDE-SAF-0012	FRMS Description and Overview
AA-GUIDE-SAF-0013	The ATS Fatigue Risk Assessment Calculator
AA-GUIDE-SAF-0014	Rest Breaks

14. GLOSSARY

Acronym/Abbreviation	Description
FAID	Fatigue Audit InterDyne system
FRA	Fatigue Risk Assessment
FRMS	Fatigue Risk Management System

Amendment Record

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Version 2	Changes marked, included ML TLI 06_0501 and related document table	Vanessa Pasapera	28/09/2007

Airservices Australia

Fatigue Risk Management System
Safety Standards & Practices

FRMS Description and Overview	
Document Number: **AA-GUIDE-SAF-0012**	
Endorsed by: **Brian Joiner** Signed: Designation: Manager, National ATC Service Support Air Traffic Control	Prepared by: **Vanessa Pasapera** Signed: Designation: Operational Risk System Specialist Safety Management
Approved by: **Claire Marrison** Signed: Designation: Acting General Manager, Safety Management	
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Recommended Practice	▪ Provides recommended practices on how a standard may be met. Business units may develop alternative practices provided that they meet the requirements of the standard. Business units must ensure that such alternative practices provide a due diligence defence for Airservices Australia. ▪ *Printed in italics with the prefix (P).*
Note	▪ Presents relevant factual information or references, but does not constitute part of the Standard or Recommended Practice. ▪ Prefixed with "Note".

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Key words

Fatigue, FRMS, Roster Design, Allocation of Extra Duty, Prior Sleep Wake Model, Fatigue Risk Assessment Calculator, Fitness for Duty.

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1. Fatigue

Fatigue has the potential to adversely impact on individual, industry and community safety, on family and social harmony, on health and on workplace efficiency. Fatigue in the Airservices Australia workplace will be managed as an OH&S workplace hazard using standard risk management methodology.

2. Fatigue Risk Management System (FRMS)

The key to a successful FRMS is the integration of strategies to identify, assess and manage risks associated with fatigue. Effective fatigue risk management can only be achieved if all shift workers and their mangers understand the causes of fatigue and accept the joint responsibility of working together to identify, mitigate and control fatigue risk.

3. The FRMS for ATS Shift Workers

The FRMS for ATS shift workers is based on AS/NZS 4360 Risk Management Principles and is consistent with the Airservices Australia's Safety Management System and Enterprise Risk Management Framework. The FRMS manages fatigue risk through application of the following strategies:

- Allocation of responsibility to individual's managers;
- Fatigue management awareness education to enable staff and management to identify organisational and individual behaviour that may create a fatigue hazard;
- Scheduling of shifts to provide sufficient recuperative sleep opportunity between shifts and between shift cycles;
- Provision of rest breaks to mitigate fatigue accumulation during shifts;
- Risk management of extra duty allocation;
- Tools, procedures and training to support FRMS objectives;
- Provision of facilities to support FRMS objectives;
- Procedures and systems for reporting and monitoring fatigue hazards;
- Procedures and systems for reviewing and auditing FRMS activity; and
- Evaluation and modification of FRMS benchmarks and thresholds.

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4. Principal ATS FRMS Components

4.1. Strategic Components

(to minimise the likelihood of hazardous fatigue levels)

- FRMS Procedures and Documentation.
- Fatigue Management Awareness Education.
- Roster Design.
- Review and Audit Processes.

4.2. Tactical Components

(to identify and manage fatigue when it may be hazardous)

- Risk Management of Extra Duty Allocation.
- Management of Fatigue Risk During Shifts.
- PSWM and FRAC Fatigue Risk Assessment Tools.
- Management of Fitness for Duty (Fatigue Related).
- Reporting and Recording FRMS Data.

5. FRMS Procedures, Guidelines and Recommended Practices

ATS FRMS procedures, guidelines and recommended practices are published to enable the operation of the FRMS.

6. Fatigue Management Awareness (FMA) Education

Fatigue Management awareness education for staff is provided in FMA CBT.

Deleted

This education is delivered upon initial entry to Airservices Australia and as part of the refresher training program.

7. Roster Design

The most effective fatigue risk management strategy available within the ATS environment is to ensure that ATS rosters provide sufficient recuperative sleep opportunity between shifts and between shift cycles. Adherence to a few simple roster design strategies will provide the recuperative sleep necessary to significantly reduce fatigue risk. Roster design guidance is provided in the attached documents.

8. Review and Audit Processes

To measure progress in the systematic management of fatigue and to identify issues requiring additional attention, the Manager, Safety Enhancement and Development will collate and review FRMS data annually.

FAID data for worked shifts is regularly calculated and the results are available to staff via the ATS FRMS Avnet site. In addition to a table that summarises important data from all ATS rosters, specific data is available for each roster. This data includes the peak FAID score each roster line and detailed shift information and commentary on roster lines with high FAID scores.

9. Risk Management of Extra Duty Allocation

FAID system reviews have identified that peak FAID scores occur on a night shift that is either an extra duty shift or has been preceded by an extra duty shift. Historically extra duty has been allocated without consideration of any additional fatigue risk. A risk assessment will now be undertaken prior to the allocation of extra duty. The risk assessment process involves:

- Identification of available staff;
- Calculation of the FAID score associated with the extra duty shift (may initially be optional for extra duty not directly or indirectly involving a night shift);
- Allocation of the extra duty to a shift worker with a FAID score of not greater than 80 if possible;

  NOTE: FAID scores to one decimal point are rounded to the nearest whole number. For example a resultant score of 80.4 will be rounded to 80.

- If no-one with a FAID score of 80 or less is available, a risk assessment calculation must be completed. If increased risk is identified, approval from the appropriate level of management must be obtained prior to the shift being undertaken and
- Details of the process is provided in the FRMS documentation.

10. Enhanced Management of Fatigue Risk During Shift

The guidance provided in the FRMS documentation, combined with increased awareness of fatigue issues resulting from FMA and FRMS training modules, is expected to result in:

- an increased awareness of fatigue accumulation factors associated with shift activity and time of day;
- an improvement in organisational and personal management of fatigue; and
- a more uniform approach to the effective management of fatigue in the workplace.

11. PSWM and ATS FRAC Fatigue Risk Assessment Tools

The Prior Sleep Wake Model (PSWM) calculates a "Fatigue Likelihood Score" based on sleep obtained in the previous 24 and 48 hour period and the time continuously awake. This model provides a simple and objective methodology for assessing fatigue levels unlike the predictive methodology used in the FAID system. The thresholds and risk profile used in this model need to be assessed on an industry by industry basis and this will occur as data becomes available from ATS responses.

The ATS Fatigue Risk Assessment Calculator (FRAC) is provided to ensure a consistent process is used when assessing fatigue risk associated with the allocation of extra duty. A FAID score greater than 80 will trigger a requirement for a risk assessment to be completed. The FRAC computes a risk level based on three inputs:

- Personal Fatigue Likelihood Score as assessed by the PSWM;
- the Task Risk of the shift to be performed; and
- the availability of controls (mitigation strategies) to reduce the risk level.

The FRAC calculates a residual risk level and identifies the level of management approval required to accept the risk. The manager may decide not to accept this level of risk and initiate alternative action. The FRAC data is automatically stored for later use if necessary.

12. Management of Fitness for Duty (Fatigue Related)

It is expected that shift workers and managers will have sufficient understanding of fatigue management issues to be able to identify personal fatigue management requirements and circumstances where there may be increased risk associated with excessive fatigue. Fitness for duty and reporting of possible increased fatigue risk will be managed under OH&S procedures.

13. Reporting and Recording FRMS Data

FRAC and FAID report data provides the core of the FRMS database. Additional fatigue data will be collected from other sources such as reports of fatigue risk submitted by email, leave requests and operational and OH&S incident reports. This data will enable issues that require additional attention to be identified.

14. Benefits of the ATS FRMS

Improved management of fatigue will benefit:

- Shift Workers:
    - reduced risk of personal injury.
    - improved health and well being.
    - reduced involvement in operational errors.
- Airservices Australia:
    - actively managed risk.
    - reduced OH&S costs.
    - reduced number of operational errors.
    - enhanced reputation and increased efficiency.
- The aviation industry and general public:
    - increased safety and efficiency.

Airservices Australia

Fatigue Risk Management System
Safety Standards & Practices

Allocation of Extra Duty	
Document Number: **AA-GUIDE-SAF-0002**	
Endorsed by: **Brian Joiner** Signed: Designation: Manager, National ATC Service Support Air Traffic Control	Prepared by: **Vanessa Pasapera** Signed: Designation: Operational Risk System Specialist Safety Management
Approved by: **Claire Marrison** Signed: Designation: Acting General Manager, Safety Management	
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2	Document renumbered, changes marked and included ML TLI 06_0501	V. Pasapera	28/09/2007

Key words

FAID, Allocation of extra duty, Prior sleep wake model.

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1. Allocation of Extra Duty – H24 Rosters

1.1. Identify Likely Replacement Staff

1.2. Check FAID Score if Necessary

1.2.1. Check the peak FAID score if the extra duty shift:

- Is a night shift or is contiguous with a shift cycle containing a night shift; or
- Results in only a single day off before a shift cycle containing a night shift; or
- Results in more than six consecutive shifts.

Consider all shifts from seven days prior to the next two-day break.

1.3. Complete Fatigue Risk Assessment Calculation if Necessary

1.3.1. Shifts where the FAID score exceeds 80 shall be subjected to a Fatigue Risk Assessment using the Fatigue Risk Assessment Calculator.

NOTE: FAID scores to one decimal point are rounded to the nearest whole number. For example a resultant score of 80.4 will be rounded to 80.

This requires the following steps:

- Ascertain sleep and wake information from likely replacement staff;
  - if PSWM Fatigue Likelihood Score is "Acceptable", no further risk assessment is required; and
  - if PSWM Fatigue Likelihood Score identifies a Fatigue Likelihood Score risk, complete the Fatigue Risk Assessment Calculator inputs.
- Enter Task Risk;
- Enter Risk Control Level; and
- Obtain approval from nominated manager.

1.3.2. If FAID score of a subsequent shift exceeds 80 follow local procedures to identify and manage increased risk (Refer to note in Section1.3.1).

1.3.3. See FRAC document for additional information.

1.4. FRMS Objectives

1.4.1. Avoid the following if possible:

(I) A FAID score exceeding 80 (Refer to note in Section 1.3.1).
(II) A night shift longer than eight (8) hours.
(III) More than two consecutive night shifts.
(IV) Less than 10 hours between shifts.
(V) More than six (6) consecutive shifts.
(VI) Consecutive extra duty shifts.
(VII) A night shift without a full recuperative sleep opportunity the previous night.

1.4.2. Best practice fatigue management includes the following strategies:

(I) Allocate the minimum extra duty hours necessary to maintain services and share these hours between staff if this gives a lower fatigue outcome.
(II) Not more than one night shift in any shift cycle.
(III) Minimise the length of night shifts.

(IV) Provide a minimum time off period between shifts of at least 10 hours (plus commuter travel time); where this minimum period is used it should include as much of the period between 10:00PM and 7:00 AM as possible.

(V) A period awake of not more than 14 hours by the end of the shift.

(VI) Allocate not more than 3 consecutive early morning shifts.

(VII) Allocate extra duty so as to provide lowest FAID score outcome, consider current and future shifts.

(VIII) Increase supervision and the frequency and length of rest breaks on extra duty shifts.

For further information refer to AA-GUIDE-SAF-0011 Extra Duty and Mutual Change of Shift – Background Information.

2. Allocation of Extra Duty – Non H24 Rosters

2.1. Consider FAID score

2.1.1. The FAID score will not exceed 80 (Refer to note in Section 1.3.1) for rosters that do not contain night shifts unless a significant number of consecutive very early morning starts are worked.

2.1.2. Unless a number of consecutive very early morning shifts have been worked it is not necessary to obtain a FAID score or to complete a Fatigue Risk Assessment.

2.2. FRMS Objectives

2.2.1. Avoid the following if possible:

(I) A FAID score exceeding 80 (Refer to note in Section 1.3.1).

(II) Less than 10 hours between shifts.

(III) More than 6 consecutive shifts.

(IV) Consecutive extra duty shifts.

2.2.2. Best practice fatigue management includes the following strategies:

(I) Allocate the minimum extra duty hours necessary to maintain services and share these hours between staff if this gives a lower fatigue outcome.

(II) Provide a minimum time off period between shifts of at least 10 hours (plus commuter travel time); where this minimum period is used it should include as much of the period between 10:00PM and 7:00 AM as possible.

(III) A period awake of not more than 14 hours by the end of the shift.

(IV) Allocate extra duty so as to provide lowest FAID score outcome.

(V) Increase supervision and the frequency and length of rest breaks on extra duty shifts.

For further information refer to AA-GUIDE-SAF-0011 Extra Duty and Mutual Change of Shift – Background Information.

Airservices Australia

Fatigue Risk Management System
Safety Standards & Practices

Recommended Roster Strategies			
Document Number: **AA-GUIDE-SAF-0004**			
Endorsed by:	**Brian Joiner**	Prepared by:	**Vanessa Pasapera**
Signed:		Signed:	
Designation:	Manager, National ATC Service Support Air Traffic Control	Designation:	Operational Risk System Specialist Safety Management
Approved by:	**Claire Marrison**		
Signed:			
Designation:	Acting General Manager, Safety Management		
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Key words

FAID, shift, roster.

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1. Recommended Roster Strategies

The following strategies will assist in the development of a balanced roster which structures work and non work time in a manner that supports control of fatigue risk in the workplace whilst providing time for social and family requirements.

1.1. Limit the Number of Sleep Debt Shifts

- Roster only one night shift or two very early morning shifts in any shift cycle.
- Do not roster additional early morning starts in any shift cycle containing a morning to night shift quick change.

1.2. Shift Length

- Shift length should generally be eight hours or less.
- Night shifts should be as short as possible and not longer than eight hours.
- Ten hour day shifts may be rostered provided they involve periods of low workload operations, provide appropriate rest breaks and are subjected to a risk assessment process that includes an assessment of fatigue risk.

1.3. Time Off

- The minimum period between any two shifts should be ten hours.
- The use of quick change shifts that do not include an overnight sleep period is not recommended and individual exposure should be minimised.
- Roster a minimum of two days off between all shift cycles if possible.
- If rostering a single day off between two shift cycles finish the last shift by 10:00pm and do not commence the first shift prior to 8:00am.

1.4. Shift and Roster Cycles

- A shift cycle should not contain more than five shifts.
- A shift cycle containing a night shift should not contain more than four shifts.
- Always roster two days off prior to a shift cycle containing a night shift.
- As far as is practical, roster cycles should be a predictable pattern of similar shift cycles with an equal number of days off after each shift cycle.

1.5. Equity and Lifestyle Factors

- When rostering a block of similar shifts, use the same start time for consecutive shifts whenever practical (not appropriate for night or very early morning shifts).
- Days off over traditional weekends should be shared equitably between all eligible staff on the roster.
- Night shifts, and other shifts that impact on normal family and social activity time, should be equitably distributed between all eligible staff (the pool of eligible staff should include all staff on the roster if possible).

1.6. FAID System Assessment

- All rosters should be assessed by the FAID system. A peak FAID score not exceeding 80 is required (preferably significantly lower) and, where practical, new rosters should deliver a reduction in the peak FAID score relative to the replaced roster.

NOTE: FAID scores to one decimal point are rounded to the nearest whole number. For example a resultant score of 80.4 will be rounded to 80.

For further information refer to AA-GUIDE-SAF-0008 Roster Design Issues.

Airservices Australia

Fatigue Risk Management System
Safety Standards & Practices

Fatigue Risk Management Guidance	
Document Number: **AA-GUIDE-SAF-0006**	
Endorsed by: **Brian Joiner** Signed: Designation: Manager, National ATC Service Support Air Traffic Control	Prepared by: **Vanessa Pasapera** Signed: Designation: Operational Risk System Specialist Safety Management
Approved by: **Claire Marrison** Signed: Designation: Acting General Manager, Safety Management	
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Fatigue, predicted scores, causes, colour bands.

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1. Impact of Fatigue

The potential impact of fatigue includes:

An increase in:
- Level of anxiety;
- Reaction time;
- Time taken to complete tasks;
- Variability in work performance;
- Errors of omission;
- Errors of commission when time pressure is applied;
- Lapses in performance (both quality and time); and/or
- Attention narrowing.

And a decrease in:
- Level of alertness;
- Level of vigilance;
- Accuracy of the short term memory;
- Accuracy of the audio-visual scan;
- Quality of communication skills; and/or
- Motivational drive.

Primary Causes of Elevated Fatigue:
- Insufficient restorative sleep;
- Excessive time awake;
- Insufficient rest breaks and/or high intensity activity during a shift;
- Excessive work hours and/or workload and/or second job and/or private; business and/or other significant responsibilities;
- Excessive or intensive non work related activity between shifts (eg. high intensity sport, labouring, etc); and/or
- Excessive levels of heat, cold, glare, light, noise, dust, etc.

2. Primary Causes of Elevated Fatigue

Where a manager, team leader, supervisor or staff detect signs of reduced alertness or impairment, it is important that the possibility of fatigue be considered. There are a number of causal factors that can present similar symptoms to fatigue. Self assessment of impairment due to fatigue can be unreliable, particularly if high levels of fatigue are being experienced.

3. FAID Predictive System Scores

- FAID scores of up to 40 are typically reached working a standard working week.
- FAID scores between 40 and 80 are regarded as moderate fatigue scores.
- FAID scores between 80 and 100 are regarded as high fatigue scores.

NOTE: FAID scores to one decimal point are rounded to the nearest whole number. For example a resultant score of 80.4 will be rounded to 80.

- FAID scores in excess of 100 are regarded as very high fatigue scores.
- The FAID system sets a nominal score of 80 for "high risk functions" and this setting is currently being used for all ATS FAID calculations.

4. FAID System Colour Bands

To assist users to quickly identify high FAID scores, the FAID system colour codes scores above 72.5 on the “high risk function” setting.

The FAID system assesses “average fatigue” on the basis of work and rest periods. It cannot account for personal deviations from the “normal behaviour” pattern. As such there cannot be a general FAID score at which a specified level of fatigue risk is individually reached. For this reason a band of FAID scores are used identify risk levels.

The colour bands are:

- Black background – FAID score of 87.5 and above.
- Red background – FAID score between 82.5 and 87.5.
- Yellow background – FAID score between 77.5 and 82.5.
- Green background – FAID score between 72.5 and 77.5.

5. Examples of Fatigue and Operational Risk Control Strategies

Deleted

For further information refer to AA-GUIDE-SAF-0007 Examples of Fatigue and Operational Risk Control Strategies.

6. Fatigue Risk Management Guidance Notes

These notes are provided to assist supervisors and staff in the risk assessment and mitigation of various fatigue risk issues. The objective of risk assessment is to identify any increase in the likelihood that an increased level of fatigue will result in an operational error, personal injury or damage to property. The level of risk mitigation should be increased to counter an increasing level of fatigue and operational risk (i.e. higher levels of mitigation are required for operational safety functions).

Fatigue Risk	Possible Cause	Risk Threshold	Risk Measurement	Comments
Elevated fatigue level at commencement of shift	Insufficient recuperative sleep	Varies between individuals however, on average, less than 5 hours sleep in previous 24 hours is insufficient to maintain alertness levels	Significant increase in risk for each hour less than personal requirement for sleep	
		Varies between individuals however, on average, less than 13 hours sleep in previous 48 hours is insufficient to maintain alertness levels	Moderate to significant increase in risk for each hour less than personal requirement for sleep	
	Significant personal activity prior to shift	A period of intense physical or acute mental activity, or activity in adverse conditions eg. high temperature, between recuperative sleep and commencement of duty	Risk increases with length and intensity of activity	
	Significant prior work or personal activity	More than 6 consecutive shifts Second job and/or other significant responsibilities High level of personal activity during time off duty	Varies with: - intensity of prior activity - number of nights since a full recuperative sleep - high FAID score	
	Insufficient opportunity for recovery between shift	Less than 10 hours between shifts	Depends on amount and quality of recuperative sleep obtained, higher level of fatigue if time off not during period 10:00PM and 8:00 AM	Higher level of fatigue likely if insufficient notice of work requirement given to enable proper rest and preparation for work period

Fatigue Risk Management System (FRMS) Guidance Notes

Fatigue Risk	Possible Cause	Risk Threshold	Risk Measurement	Comments
Elevated fatigue level during shift	Total time awake	Varies between individuals however, on average, fatigue is apparent after more time awake than sleep obtained in previous 48 hours	Varies between individuals however, on average, fatigue risk becomes increasingly apparent after 13 or 14 hours awake	
		More than 18 hours awake	Varies between individuals however, on average, fatigue risk becomes significant after this period awake	Control strategies necessary
		More than 23 hours awake	Very high level of fatigue risk	Working and driving with this level of fatigue should be avoided.
	Insufficient rest breaks during shift	More than 2 hours since last rest break	Increasing level of risk after 2 hours of continuous work Risk increases with workload	
		More than 4 hours since last rest break	Significant increase in level of risk after 4 hours of continuous work Risk increases with high or very low workload and poor environmental conditions	Provide rest break (preferably away from working environment)

Fatigue Risk	Possible Cause	Risk Threshold	Risk Measurement	Comments
Elevated fatigue level during shift	Excessive work hours	Continuous working for more than 8 hours (especially when the hours prior to 7:00 AM or after midnight are involved)	Increasing level of fatigue risk after 8 hours of moderate to high workload. The level of fatigue on afternoon and night shifts is likely to increase significantly after eight hours, irrespective of workload	A risk assessment is required prior to the rostering of shifts longer than eight hours Mitigation strategies should be considered when extending shifts beyond 8 hours, especially late afternoon and night shifts
	Excessive work load	Continuous high workload or intensive activity	Increasing level of risk after 60 to 90 minutes of very high workload or activity	
	Circadian "danger zone"	Generally between 2:00 AM and 5:00 AM	Increased level of fatigue during these periods	Fatigue risk controls may be less effective during these hours
	Adverse environmental conditions	Very hot or cold; high levels of noise, glare or dust		Increase number and length of rest breaks away from adverse environment Increase availability of hot/cold drinks & meals

Airservices Australia

Fatigue Risk Management System
Safety Standards & Practices

Examples of Fatigue and Operational Risk Control Strategies	
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Fatigue, risk, control, strategies.

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1. Fatigue Risk Control Strategies

The following list contains examples of fatigue risk control strategies that may be commonly applicable. This list is not exhaustive and other strategies may be more appropriate under certain circumstances.

1.1. High Impact Strategies

The following strategies have the potential to very effectively reduce the level of individual fatigue. The actual impact of any strategy will vary depending on a number of factors:

- Delay start of shift to allow more sleep (applicable to morning and night shifts);
- Reduce length of shift (late start and/or early finish); and/or
- Provide napping opportunity (note that a nap may not be achieved; include adequate time to recover from sleep inertia)

1.2. Moderate Impact Strategies

The following strategies have the potential to either reduce the level of fatigue or reduce the likelihood of fatigue impacting adversely. The actual impact of any strategy will vary depending on a number of factors:

- Increase number and/or length of rest breaks (refrain from using breaks to undertake administrative duties or using screen based equipment);
- Monitoring of performance;
- Work in company to enable support & monitoring; and/or
- Provide meal break opportunity

1.3. Low Impact Strategies

The following strategies have the potential to either reduce the rate of fatigue accumulation or to provide a short term stimulus to assist alertness levels. The actual impact of any strategy will vary depending on a number of factors:

- Undertake light exercise during rest breaks;
- Appropriate use of caffeine based drink;
- Rotate positions;
- Increase brightness of lighting in rest and reaction areas; and/or
- If working in a screen based environment avoid using screen based equipment during rest breaks.

2. Additional Risk Management Strategies

2.1. Supportive Operational Strategies

More extensive risk management is required whenever an employee is working with a high level of fatigue. For high consequence functions it may be appropriate to support fatigue risk mitigation by implementing additional operational risk control strategies.

Whenever practical, employees with a very high level of fatigue should be replaced by other staff or placed on a low consequence function.

If an employee with a high level of fatigue is required to perform a high consequence function, the implementation of operational risk control strategies such as one or more of the following should be considered:

- Avoid complex and high workload functions;
- Arrange Planner (or Coordinator in Tower) support;
- Increased supervision;
- Reduce workload;
- Meter traffic flow;
- Increased separation standards;
- Increased alerting parameters;
- Direct supervision; and
- Reduce service level.

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Roster design, sleep, shift cycle.

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1. Roster Design Issues

Consideration of the following issues will assist in the production of a balanced roster that structures work and non work time in the manner that supports control of fatigue risk in the workplace whilst providing time for social and family requirements.

1.1. Sleep Debt

Working and commuting during the normal sleep period (generally accepted as between 10:00 pm and 8:00 am), can result in a build up of sleep debt between episodes of full recovery sleep.

Significant sleep debt can be avoided by minimising the number of sleep debt shifts in a shift cycle and avoiding consecutive night shift cycles.

1.2. Workplace Fatigue Factors

Workplace related fatigue generally increases with:

- The length of shift;
- The number of consecutive shifts;
- Workload and complexity;
- Time awake; and/or
- Working during the normal sleep period.

1.2.1. Controlling and Mitigating Workplace Fatigue

The only "cure" for mental fatigue is sleep.

Workplace fatigue can be controlled or mitigated by obtaining adequate sleep between shifts and between shift cycles and adequate rest breaks during a shift.

- A full recuperative sleep period for most people is a period of uninterrupted sleep of approximately seven to eight hours occurring between the hours of 10:00pm and 8:00am and from which awakening occurs naturally (eg without an alarm).
- One recuperative sleep period is usually sufficient to recover from fatigue; however it may take two recuperative sleep periods to fully recover from a shift cycle containing a night shift.
- The minimum time off duty between two shifts necessary to achieve a full recuperative sleep is normally an overnight period of approximately ten hours.
- Significantly more time off duty between consecutive shifts is normally required to achieve a full recovery if the period is outside the hours of 10:00pm and 8:00am.

1.3. Equity and Lifestyle Factors

- Social and family requirements are likely to impact on individual fatigue management strategies if more than six consecutive shifts are worked.
- Rostering a minimum of two days off between shift cycles provides social and family benefits.
- A roster containing predictable and regular shift cycles is less fatiguing than a roster containing irregular shift cycles.
- The number of different start and finish times should be kept to a minimum to assist sleep patterns and the planning of family and social activity.
- Days off over traditional weekends often have greater family and social value than other days off.

For further information refer to AA-GUIDE-SAF-0004 Recommended Roster Strategies.

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Fatigue Risk Management System
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Sleep Inertia Risk Associated with Sleeping or Napping on Duty	
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Sleep Inertia, sleeping, napping.

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1. Sleep Inertia Risk Associated with Sleeping or Napping on Duty

1.1. Background

Scientific evidence suggests that a fairly high percentage of shift workers fall asleep spontaneously during night shift (unintended napping) or suffer alertness deficits associated with micro sleeps. The peak occurrence period for both of these is associated with the human circadian trough period between 3:00 am and 5:00 pm. There is also evidence to suggest that the incidence of these events increase with increased levels of fatigue.

The primary defence against fatigue induced error is regular, good quality, night time sleep. Where this is not possible it is important to minimise the number of hours of continuous wakefulness. Organisations can minimise the occurrence of work related fatigue by implementing good rostering practice that involves limiting the number of consecutive sleep debt contributing shifts and providing ample opportunity for recovery sleep between shifts. Individuals can take measures to manage sleep periods away from work appropriately and to ensure that they maintain a healthy lifestyle.

Despite good rostering practice and good personal fatigue management, the interaction of normal family and social activity with night and early morning working hours will, occasionally, result in levels of fatigue that can result in spontaneous sleep (unintended napping) or alertness deficits associated with micro sleeps.

1.2. Sleep Inertia

Sleep inertia describes a transitory period of lethargy, drowsiness and performance impairment observed immediately after awakening, especially after a sudden awakening.

The intensity and period of sleep inertia is variable however the following factors appear to have an impact:

- The time of day of the sleep or nap (relative to the circadian rhythm);
- The duration of the sleep or nap;
- The sleep stage occurring immediately preceding awakening from the sleep or nap;
- The level of fatigue (sleep debt) preceding the sleep or nap; and
- The length of time awake preceding the sleep or nap.

Depending on the above factors, sleep inertia may last from a few minutes to at least thirty minutes. A laboratory study by Bruck & Pisani (1999) shows clearly that sleep inertia negatively affected decision making performance and subjective sleepiness for at least thirty minutes after arousal from sleep, with the most impairment in the first three minutes when decision making fell to almost 50% of baseline levels. The ability to make decisions was still impaired by up to 20% after thirty minutes. A further study by Balkin & P. Badia (1988) concludes "it is apparent that prior sleep loss exacerbates the performance and alertness deficits which are evident immediately upon awakening. The implications of this finding are obvious for fire fighters, ambulance drivers, fighter pilots, physicians, or any others, who are allowed to sleep while "on call" with the expectation that they can quickly awaken and perform their tasks with reasonable efficiency and skill, especially after prior sleep loss."

The recovery from sleep inertia is of significant relevance to Airservices Australia staff who are authorised to sleep or nap on duty, who nap during a rest break, or who may inadvertently fall asleep on duty, especially if they awake in response to a call or alarm requiring immediate decision making. If they have commenced the shift with a significant sleep debt, the impact of sleep inertia may be greater (more intense and longer), especially if it is associated with a sleep or nap during the night circadian low period.

To reduce the risk associated with sleep inertia operational tasks should not be undertaken immediately after awakening. As a general guide it is recommended that individuals be awake and undertaking activity for the following period prior to performing operational tasks:

- Between twenty and thirty minutes during the period 3:00am to 7:00am; and
- Between ten and fifteen minutes at other times.

1.2.1. Short Naps During Rest Breaks

Whilst it is recognised that naps as short as ten minutes can be beneficial in managing fatigue, staff who elect to nap during an assigned rest break, or immediately prior to commencing duty, need to ensure that appropriate measures are taken to counter the effect of sleep inertia risk. Short naps during the day or early evening are unlikely to produce sleep inertia risk for more than five to ten minutes; however ten to fifteen minutes may be required to recover from longer naps. It is the responsibility of staff who undertake a nap under these circumstances to ensure that they do not resume operational responsibility within the required recovery period.

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Prior Sleep Wake Model Background Information Paper	
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Prior Sleep Wake Model.

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1. Prior Sleep Wake Model – Background Paper

The Prior Sleep Wake Model has been selected as the most appropriate methodology for assessing the personal fatigue risk component when undertaking a risk assessment of fatigue issues in our Fatigue Risk Management System (FRMS). It is probable that the parameters on which the risk calculations are based will be refined as experience with the model enhances our knowledge of the actual impact of each parameter within our work environment.

The Prior Sleep Wake Model has been developed by the Centre for Sleep Research under the leadership of Dr Drew Dawson (Ph.D). The research and evidence associated with the development of this model is provided in a research paper 'Managing Fatigue: It's about sleep – stupid'; written by Dr Dawson and Kirsty McCulloch. The paper has been reproduced in Sleep Medicine Reviews in the press.

Dr Dawson heads the Centre for Sleep Research (CFSR) at the University of South Australia. Kristy McCulloch is undertaking research at the CFSR.

The information provided below is intended to assist staff and management to understand the role of prior sleep and time awake in the fatigue risk calculation. This model is of particular relevance when considering fitness for duty to undertake extra duty for which only limited notice has been provided, however employees may also find it to be useful when considering sleep requirements necessary to prepare for rostered shifts.

2. Managing Fatigue "It's about sleep – stupid"

The following text is a general summary of parts of the research paper "Managing Fatigue: It's about sleep – stupid": (D. Dawson; K. McCulloch; 2004).

2.1. Background

At best we can suggest that based on the published literature:

- Error rates increase exponentially with linear increases in psychometric measures of fatigue
- Errors are broadly comparable in nature and frequency with other forms of impairment and
- We can make only general predictions about the susceptibility of certain types of tasks to fatigue-related error.

In view of our lack of a detailed understanding of workplace or task specific risk associated with fatigue, any set of guidelines should be considered provisional, tentative and subject to ongoing refinement on the basis of post implementation evaluation.

With this caveat in mind, we would suggest that knowledge of the frequency distribution of prior sleep and wake could form a rational basis for determining the level of fatigue an individual is likely to experience within a given shift. Furthermore, there is potential for both individuals and organisations to use this information as the basis for rational decision making with respect to fatigue-related risk. Within this framework, there are two main questions to be asked. First, is the individual fit-for-duty and acceptably alert to commence work? The second question is predicated on the answer to the first. That is, if an individual is acceptably alert to commence work, for what period of time can they be reasonably expected to work before fatigue subsequently creates an unacceptable level of risk?

As a starting point for this decision, we suggest that a rational FRMS should be based on prior sleep and wake rules, linked to an evaluation of the adequacy of prior sleep and wake. The reasons for this are straightforward:

- Unlike subjective estimates of fatigue, prior sleep and wake are observable and potentially verifiable determinants of fatigue
- Prior sleep and wake provide a way of integrating individual and organisational measures of fatigue since systems-based approaches can deal with probabilistic estimates of sleep and wakefulness, and individual employees can make clear determinations of individual amounts of actual prior sleep and wakefulness; and
- Prior sleep and wake measures can be set or modified according to the risk profile associated with specific tasks or workgroups.

In order to determine whether an employee is likely to be fatigued and the required degree of hazard control, we propose a simple algorithm based on the amount of sleep and wake experienced in the 48 hour period prior to commencing work.

2.2. Prior Sleep Wake Model

The adequacy of personal fatigue management in relation to workplace fatigue risk management can be determined by an algorithm that is comprised of three simple calculations: prior sleep in the last 24 and 48 hours; and length of wakefulness from awakening to the end of the work shift.

Prior Sleep Threshold – Prior to commencing work, an employee should determine whether they have obtained:

(a) X hours sleep in the prior 24 hours; and
(b) Y hours sleep I the prior 48 hours.

Prior Wake Threshold – Prior to commencing work an employee should determine whether the period from wake-up to the end of shift exceeds the amount of sleep obtained in the 48 hours prior to commencing the shift.

Hazard Control Principle – Where obtained sleep or wake does not meet the criteria above, then there is significant increase in the likelihood of a fatigue-related error and the organisation should implement appropriate hazard control procedures for the individual.

A critical aspect of the rules defined above is to create appropriate threshold values for the minimum sleep values for the 24 and 48 hours prior to commencing work and the amount of wakefulness that would be considered acceptable. For example, if a given task has either a greater susceptibility of fatigue-related error, or there are significantly greater consequences of a fatigue-related error, the threshold values may be adjusted to a more conservative level.

To our knowledge, there is currently no published data that would enable us to determine appropriate thresholds for specific task or industries. However, there is significant literature addressing the consequences of various levels of sleep restriction and the subsequent effects on standardized measures of sleepiness, neurobehavioral performance, and to a lesser extent, error rates.

2.3. Setting the Prior Sleep Thresholds

Following a single night of sleep loss, it would appear that there is little evidence of a clinically significant reduction in any measure of sleepiness/alertness until a Time in Bed (TIB) is reduced below 6 hours. Most measures show significant clinical levels of sleepiness once TIB is reduced to 4 hours. Between 6 and 4 hours there is some debate based on the measure used and the degree to which the task is engaging or boring.

Given the distinction between TIB, sleep obtained and the need to not be carrying an accumulated sleep debt, it is unlikely that individuals would be significantly impaired at most common work tasks until obtained sleep fell below 5 hours in the preceding 24.

The studies cited indicate that there is not a clear or definitive answer to the question of how much sleep is sufficient. It would appear that clinically significant declines in neurobehavioral performance and increases in sleepiness appear once the TIB for a single night decreases below 5 to 6 hours. If TIB is restricted over multiple nights (up to 7), we see clinical impairment once the longer-term average declines below approximately 6 hours.

2.4. Extended Wakefulness

The section above supports the idea of a minimum sleep threshold consistent with the requirement for a safe system of work. In this section we address the methodology for limiting prior wake to ensure fatigue levels are not above a given threshold. As a starting point for this discussion we would put forward the following argument.

First, that the fatigue 'clock' starts 'ticking' from the moment of wake and continues 'ticking' until the next sleep period. It does not start 'ticking' at the point that an individual employee starts work.

As a consequence, the point at which fatigue is likely to become problematic is more directly related to the duration of wakefulness and only indirectly to the length of the work period. Relative to shift occurring late in the (normal) wake period (e.g. afternoon and night), shifts starting early in the (normal) wake period (morning) can go for longer before fatigue will become a problem. Hence our view that assessing the likelihood of fatigue should focus on prior wake rather than work hours.

Second, sleep is a 'recovery process' for wake. That is, during sleep we recover fro fatigue and, as a corollary, sleep enables us to 'buy' a certain amount of subsequent wakefulness above a given threshold. This implies a linear relationship between sleep and alertness; that alertness increases as a function of prior sleep. Based on the theoretical modelling work of Van Dongen and colleagues (2003), it would appear that under normal entrained circumstances a nominal eight hours of sleep will typically 'buy' about sixteen hours of wakefulness. That is, each hour of sleep 'buys' about two hours of wakefulness.

The theory of 'sleep buys wakefulness' is further supported by an earlier study by Bonnet (1991), which examined the usefulness of prophylactic naps in operational settings. Nap lengths of 0, 2, 4, and 8 hours were tested to determine subsequent effects on alertness and performance. The results indicated that, on average, the benefits of a given nap period had a positive impact on alertness and performance for approximately double the length of the nap taken. Furthermore, such benefits continued to accumulate in a linear fashion for naps as long as 8 hours.

It is important to note that this is an average value and that this may vary according to (a) elapsed time (i.e. it may not be strictly linear) and (b) the time of day at which the wake period occurs. For example, a period of extended wakefulness occurring in the mid afternoon may be associated with less sleepiness than the same period of wakefulness occurring in the early hours of the morning.

However, if an individual has less than the normal six hours of sleep then the previous section indicates that their average subsequent fatigue (inferred from neurobehavioral performance and sleepiness) will be increased. With a reduction in sleep, an individual will start the next work period with a residual sleep debt and, on average, be more tired. In addition, we would suggest, that relative to a given threshold, they would be able to sustain alertness for less time compared to the individual who had their nominal eight hours of sleep.

Using the general (and admittedly simplistic) principle that each hour of sleep 'buys' two hours of subsequent wakefulness we would suggest that the ability to 'sustain alertness' is decreased by two hours for each hour of sleep loss. Thus, the individual who has reduced their sleep by two hours could maintain alertness above a given threshold for a period of only 12 hours [i.e. 16 – (2x2) = 12]. In view of the potential to carry a residual sleep debt into a subsequent work period, we have suggested that there be a one-to-one relationship relative to sleep in the preceding 48 hours. That is we set the wake threshold relative to the total hours of sleep in the 48 hours prior to commencing work rather than a two-to-one relationship for the prior night.

It is acknowledged that scientific evidence to support, or refute, our parameterisation of this rule is limited. We would, nevertheless, suggest that the general principle is probably sound (i.e. that sleep loss reduced the duration that one can sustain alertness) and is unlikely to be controversial. That is, less sleep will reduce the time that one can sustain alertness.

Discussion of the wake threshold is more likely to focus on the parameterisation of the rule rather than the rule *per se*. Thus, it may be the case we need an additional offset value for wake, based on factors related to the individual risk profile of the work task.

For example:

Wake threshold = sleep in prior 48 hours +/- C hours.

Therefore, we would suggest that the principles underlying the rule are sound and that appropriate experimental studies could provide data that would enable the rule to be parameterised in detail.

In its current formate the rule suggests that fatigue is likely to be a problem from the time that prior wake exceeds the amount of sleep in the 48 hours prior to the commencement of work. Thus, in an individual who has obtained 16 hours of sleep in the 48 hours prior to commencing work, fatigue would be considered a potential hazard after 16 hours of wakefulness. In practice, this would suggest that fatigue is likely to become a problem after up to 12 to 14 hours for shifts commencing very close to the time of wakeup. However, for shifts finishing close to the normal sleep onset time, the rule would indicate that fatigue is a potential problem after eight hours. In the case of a night shift with (possibly) 14 to 16 hours of prior wakefulness the rule would suggest that fatigue is a potential problem across the entire shift.

Finally, initial PSWM thresholds should be viewed as a starting point and be subject to revision in the light of actual workplace experience.

3. Impact of Short Naps

A short nap is not considered sufficient to "reset" the "Hours Awake Clock". A sleep period of less than two hours should not be used to "reset" the "Hours Awake Clock" to zero, however, the significant benefit of one or more short naps should be included in the PSWM X and Y calculations.

4. Additional Issues

The following additional issues should be considered when using this model:

- The Prior Sleep Wake Model (PSWM) and the sleep and wake thresholds presented are the subject of ongoing research.
- Time in bed does not equal obtained sleep, the period of sleep obtained will normally be less than the time in bed.
- The recovery value of sleep may show circadian variation i.e. sleep obtained during the normal night sleep period may be of a different recovery value than sleep obtained at other times. Additionally, the first few hours of sleep may have a higher recovery value than that of later hours of sleep.
- It is not suggested that laboratory results can be simplistically translated into a linear comparison between the PSWM and workplace performance or risk.
- The performance decrement level after a specific time awake will be influenced by the circadian rhythm of the individual (time of day), i.e. different parameters may be applicable to different shifts.
- It is probable that there is a degree of individual variation in the performance decrements associated with a generalised PSWM.

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Fatigue Risk Management System
Safety Standards & Practices

Extra Duty and Mutual Change of Shift – Background Information

Document Number:**AA-GUIDE-SAF-0011**

Endorsed by: **Brian Joiner** Signed: Designation: Manager, National ATC Service Support Air Traffic Control	Prepared by: **Vanessa Pasapera** Signed: Designation: Operational Risk System Specialist Safety Management
Approved by: **Claire Marrison** Signed: Designation: Acting General Manager, Safety Management	
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Key words

FAID, shift cycle.

Table of Contents

1. Extra Duty and Mutual Change of Shift

Prior to allocating extra duty or approving a mutual change of shift, it is essential that the fatigue impact of the preceding shifts be considered. If the extra duty may prevent the opportunity for sufficient rest and recuperative sleep prior to the following shift, then the impact on future shifts also needs to be considered.

A single day off duty that includes a normal sleep period, (i.e. the period 10:00PM and 8:00AM) will usually provide sufficient rest opportunity to overcome fatigue associated with previous workplace activity (i.e. “reset” the FAID score) unless the previous shift cycle included a night shift.

Two consecutive days off duty (including two normal sleep periods) are usually required to overcome fatigue associated with previous workplace activity (i.e. “reset” the FAID score) after a shift cycle containing one or more night shifts.

It is the amount of recuperative sleep obtained prior to the extra duty (or mutually changed) shift, and the amount of recuperative sleep available between the extra duty (or mutually changed) shift and the following shift that is most important in managing the potential fatigue associated with the extra duty (or mutually changed) shift.

Other important considerations for the allocation of unplanned extra duty (i.e. short notice extra duty) is the total time awake prior to the end of the extra duty shift, commuting time and the nature of activity undertaken prior to the extra duty or extended shift.

Time away from the workplace provides the opportunity to undertake family and social activities as well as supporting personal fatigue management requirements. Extra duty may impinge on these requirements and it is therefore important to ensure that, as far as is reasonable, extra duty is shared between all eligible staff.

1.1. Shift Cycles That Produce High FAID Scores:

- More than one night shift.
- A quick change from a very early morning (0500) start time to a night shift.
- Multiple early morning shifts (shift start times prior to 0700).

Shift cycles that contain a combination of the above are likely to produce FAID scores approaching 80, exclusive of the allocation of extra duty.

Mutual change of shifts provide more notice of time to prepare for work, however, this time needs to be managed appropriately.

On H24 rosters consider all shifts from seven days prior to the next two-day break when allocating extra duty or considering a request for mutual change of shift.

1.2. FAID Scores Above 80

FAID scores above 80 can be expected if extra duty results in a shift cycle that:

- Contains two or more night shifts;
- Contains a night shift and more than four preceding shifts; and/or
- Contains a combination of multiple very early morning start times and a night shift.

NOTE: FAID scores to one decimal point are rounded to the nearest whole number. For example a resultant score of 80.4 will be rounded to 80.

1.3. FAID Scores Around 80

FAID scores around 80 may be expected if extra duty results in a shift cycle that:

- Contains a night shift; or
- Provides only one day off before a shift cycle containing a night shift; or
- Contains more than six consecutive shifts involving multiple early morning start.

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The ATS Fatigue Risk Assessment Calculator	
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Endorsed by: **Brian Joiner** Signed: Designation: Manager, National ATC Service Support Air Traffic Control	Prepared by: **Vanessa Pasapera** Signed: Designation: Operational Risk System Specialist Safety Management
Approved by: **Claire Marrison** Signed: Designation: Acting General Manager, Safety Management	
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Key words

Fatigue Risk Assessment Calculator, Prior Sleep Wake Model

Table of Contents

1. Background

The ATS Fatigue Risk Assessment Calculator (FRAC) has been developed to provide a quick and consistent process to assess fatigue risk associated with the allocation of extra duty.

The FRAC requires the following inputs:

- Prior Sleep Wake Model (PSWM) data.
- An assessment of Task Risk.
- An assessment of the level of Risk Mitigation & Control strategies planned to be applied.

The FRAC calculates a residual risk from the above data and identifies the level of risk and the manager responsible for that level of risk.

The FRAC provides residual risk data for both high and low consequence functions and dispatched emails to the responsible managers and file.

2. Prior Sleep Wake Model

2.1. PSWM Thresholds

Initially the ATS FRMS will use the following thresholds in the PSWM to calculate Fatigue Likelihood Scores:

- X threshold will be five hours.
- Y threshold will be 13 hours.
- Z threshold will be the actual level of Y.

2.2. PSWM Fatigue Likelihood Score Calculation

Fatigue Likelihood Scores will be calculated using the following table:

- 4 Points for every hour of sleep less than the X threshold (5).
- 2 Points for every hour of sleep less than the Y threshold (13).
- 1 Point for every hour of wakefulness greater than the Z threshold (Y).

2.3. PSWM Risk Profile

Initially the following risk profile has been allocated to the Fatigue Likelihood Scores:

Fatigue Likelihood Score	Fatigue Risk
Zero (0)	Acceptable
Greater than 0 and less than five (5)	Low
Equal to or greater than five (5) and less than 10	Moderate
Equal to or greater than 10 and less than 15	High
Equal to or greater than 15	Very High

2.4. PSWM Points Allocated to Residual Risk

Points are allocated from the PSWM to the Residual Risk Calculator in the following manner:

HIGH Consequence Functions:

Residual Risk	Points transferred to the Residual Risk Calculation:
Acceptable	0
Low	2
Moderate	4
High	7
Very High	9

LOW Consequence Functions:

Residual Risk	Points transferred to the Residual Risk Calculation:
Acceptable	0
Low	1
Moderate	3
High	5
Very High	7

3. Task Risk

The Task Risk level is assessed relative to the complexity and workload considered normal for the allocated task (function). For example a shift involving workload and complexity below the normal level for that specific function would be assessed as "Low" (most night shifts) whereas an extra duty shift on a Friday night would probably assessed as "High". The default value is "Low".

3.1. Task Risk Profile

Task Risk	Points transferred to the Residual Calculation:
Low (1)	2
Moderate (2)	4
High (3)	6

4. Fatigue and/or Operational Risk Mitigation & Controls

The Fatigue and/or Operational Risk Mitigation & Control level is an assessment of the value of **additional** mitigation and control strategies implemented for this shift. If no additional mitigation and control strategies are employed for this shift the Impact of Risk Controls in Place is NIL. The default value is "NIL".

4.1. Fatigue Risk Controls

One or more Fatigue Risk Controls can often be implemented. The impact of each control on reducing fatigue risk needs to be assessed in a general manner. Some strategies such as reducing the length of the shift or providing a two hour nap during a night shift can be very effective. Working in a team or providing regular rest breaks can effectively reduce the level of risk. Light exercise during routine rest breaks and strategic use of a caffeine drink can be effective in maintaining alertness levels for one or two hours.

4.2. Additional Risk Management Strategies

If fatigue risk is assessed as high and only limited Fatigue Risk Control strategies are available, consideration should be given to also implementing operational and traffic management strategies to increase the level of risk mitigation.

4.3. Risk Control Profile

Risk Control	Points transferred to the Residual Risk Calculation
Nil (0)	0
Low (1)	Minus one (1)
Moderate (2)	Minus two (2)
High (3)	Minus three (3)

5. Residual Risk Calculations

The Residual Risk is calculated separately for High Consequence and Low Consequence functions. The minimum level of manager able to accept the level of risk is automatically generated.

5.1. High Consequence Functions

Points	Management level
Greater than 10 points	**B** Risk (General Manager, Air Traffic Control)
Between eight (8) and 10 points	**C** Risk (Service Delivery Manager)
Less than eight (8) points	**D** Risk (ATC Line Manager- ALM)

5.2. Low Consequence Functions

Points	Management level
Greater than 11 points	**B** Risk (General Manager, Air Traffic Control)
Between nine (9) and 10 points	**C** Risk (Service Delivery Manager)
Less than nine (9) points	**D** Risk (ATC Line Manager- ALM)

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Fatigue Risk Management System
Safety Standards & Practices

Rest Breaks		
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Endorsed by: **Brian Joiner** Signed: Designation: Manager, National ATC Service Support Air Traffic Control	Prepared by: **Vanessa Pasapera** Signed: Designation: Operational Risk System Specialist Safety Management	
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Rest breaks.

Table of Contents

1. Purpose

This document provides recommended practice to ensure the appropriate provision of rest breaks during shift.

2. Background

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.

Irrespective of the workload, time of day or staffing level, the allocation of rest breaks during a period of duty is essential to maintain an appropriate level of alertness and performance.

- The need for rest breaks to recover from mental fatigue is greater with work requiring acute mental attention (Sharmin and Rahman, 1997)
- Low levels of alertness and boredom, common during extended periods of low workload, can be improved by position rotation, social interaction, physical activity (standing, stretching and movement in general) and caffeine.

In ATC operations the frequency of break allocation should be balanced against the known increase in operational error rates that occur:

- During a period of low activity that has been preceded by a period of high activity; and
- During handover and within the first thirty minutes of control responsibility.

3. Frequency of Rest Breaks

As a general practice rest breaks should be provided approximately every two hours. Operational managers and supervisors who have the responsibility for managing rest breaks will need to consider a range of factors which would impact upon any particular situation.

Risk assessment processes will be used to identify periods where this should be varied. For example, during instances of very intensive work, rest breaks may need to be provided more frequently. In some instances the period between rest breaks may be longer (for example, during periods of low traffic, particularly in towers, and for non traffic separating functions). The period between rest breaks should not be more than four hours.

Where possible, an ATC who has worked during a period of exceptionally busy or complex activity should be provided with a rest break, or otherwise rotated to another position, if the level of activity drops significantly.

4. Length of Rest Breaks

Generally a short rest break should be at least fifteen minutes and a long rest break at least thirty minutes. Rest breaks provided after two hours of work should be long enough to enable staff to prepare and consume a quick snack and hot or cold drink, go to the toilet and attend to any urgent personal matters (eg. make a short telephone call). Rest breaks provided after three or four hours of work, or after the second two hour work period, should be long enough to enable staff to prepare and consume a meal and to undertake a period of other activity or attend to personal matters.

5. Activities on Rest Breaks

- Rest breaks should be taken away from the workstation and outside of the operational area when possible.
- If working involves significant use of screen based equipment staff should avoid unnecessary use of screen based equipment during rest breaks.
- Eating healthy and balanced meals and snacks and drinking adequate quantities of water are essential elements of healthy living in a shift working environment. Advice on this issue is available in shift work and fatigue training material.
- Light exercise during a rest break will increase levels of alertness and well being. Where possible a short walk outside of the building is recommended, particularly for staff normally working in an environment without natural light.
- Work related activity should not be undertaken during short rest breaks. It is important to maximise the opportunity provided by short rest breaks to refresh the mind and body.
- If a nap is planned during a rest break it is essential that arrangements are made to be awoken in sufficient time to recover from any sleep inertia prior to resuming safety critical duties (see napping and sleep inertia guidelines for important information).

6. Rest Breaks During Periods of Single Staffing

The work and activity level on operational shifts should be reviewed regularly to ensure staff have adequate access to rest break opportunities. This is particularly important for periods when staff are working on their own.

Staff undertaking a rest break during a period of single staffing may need to maintain operational responsibility for their function, this may restrict the range of activities available to them during their rest break. It is essential that arrangements are in place for the staff to leave the immediate operational area for short periods and that they are provided with sufficient time to prepare and consume meals and to regularly attend to personal needs during their shift.

Procedures should be developed and published to ensure that the staff are able to be temporarily absent from their workstation, during periods of single staffing, without adversely impacting on safety. If necessary, additional communication facilities and/or an alerting device should be provided to ensure safety critical functions are maintained whenever staff are temporarily absent from the workstation.