Australian Government
Civil Aviation Safety Authority

Fatigue Risk Management System Handbook

March 2025

Acknowledgement of Country

The Civil Aviation Safety Authority (CASA) respectfully acknowledges the Traditional Custodians of the lands on which our offices are located and the places to which we travel for work. We also acknowledge the Traditional Custodians' continuing connection to land, water and community. We pay our respects to Elders, past and present.

Artwork: James Baban.

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This document contains guidance material intended to assist CASA officers, delegates and the aviation industry in understanding the operation of the aviation legislation. However, you should not rely on this document as a legal reference. Refer to the civil aviation legislation including the *Civil Aviation Act 1988* (Cth), its related regulations and any other legislative instruments—to ascertain the requirements of, and the obligations imposed by or under, the law.

Contents

Amendment record/revision history

Amendments/revisions of this sample manual/exposition are recorded below in order of most recent first.

Table 1 Revision history

Version no.	Date	Parts/sections	Details
3.0	March 2025	All	Administrative update for compliance - new template.
2.0	October 2020	All	Significant change to outcome based regulatory philosophy
1.0	April 2013	All	First issue

References

Acronyms

The acronyms and abbreviations used in this manual are listed in the table below.

Table 2 Acronyms

Acronym and abbreviation	Description
AOC	Air Operator's Certificate
ALARP	As Low As Reasonably Practicable
BMM	Biomathematical Model
CAAP	Civil Aviation Advisory Publication
CAO	Civil Aviation Order
CASA	Civil Aviation Safety Authority
CASR	*Civil Aviation Safety Regulations 1998*
CEO	Chief Executive Officer
FCM	Flight Crew Member
FDAP	Flight Data Analysis Programme
FDP	Flight Duty Period
FOQA	Flight Operational Quality Assurance
FRMS	Fatigue Risk Management System
FSAG	Fatigue Safety Action Group
FTL	Flight Time Limit
HF/NTS	Human Factors/Nontechnical Skills
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
LOSA	Line Operational Safety Audit
ODP	Off Duty Period
PSOE	Present, Suitable, Operating, Effective
PVT	Psychomotor Vigilance Task
SAG	Safety Action Group
SMS	Safety Management System
SPI	Safety Performance Indicator
SRB	Safety Review Board
SPS	Samn-Perelli Score

Acronym and abbreviation	Description
TOR	Terms of Reference
TOD	Top of Descent
TNA	Training Needs Analysis
WOCL	Window of Circadian Low

Definitions

Terms that have specific meaning within this manual are defined in the table below.

Table 3 Definitions

Term	Definition
fatigue	A physiological state of reduced alertness or capability to perform mental or physical tasks, which: • may impair the ability of the FCM to safely operate an aircraft • is caused by one or more of the following: – the FCM's lack of sleep – the FCM's extended wakefulness – the FCM's circadian phase at any relevant time – the FCM's workload of mental activities, and/or physical activities at any relevant time. **Note:** An individual's level of fatigue and state of alertness can also be influenced by their health, diet, fitness and overall well-being.
fatigue risk management system (FRMS)	A data-driven means of continuously monitoring and managing fatigue-related safety risks, based upon scientific principles and knowledge as well as operational experience, that aims to ensure relevant personnel are performing at adequate levels of alertness, and: a. includes all of the elements set out in Appendix 7 of CAO 48.1 b. is approved for implementation by CASA.
flight crew member (FCM)	A crew member who is a pilot or flight engineer assigned to carry out duties essential to the operation of an aircraft during flight time.
flight duty period (FDP)	A period of time that: • starts when a person is required, by an operator, to report for a duty period in which they undertake one or more flights as part of an operating crew • ends at the later of: – the person's completion of all duties associated with the flight, or the last of the flights, or – 15 minutes after the end of the person's flight, or the last of the flights. **Note:** FDP does not include positioning, administrative or simulator duties conducted after the last flight.

Term	Definition
flight time	The time when an FCM is acting in the capacity as a crew member on board an aircraft that includes: • in the case of a heavier-than-air aircraft, the total time from the moment at which the aircraft first moves under its own power for the purpose of taking-off until the moment at which it comes to rest after landing, and • in the case of a lighter-than-air aircraft, the total time from the moment at which the aircraft first becomes airborne until it comes to rest on the ground, excluding any time during which the aircraft is moored. **Note:** Recording flight time from 'push-back' or 'off blocks', rather than from the moment the aircraft first moves under its own power (as per the definition), is acceptable. Likewise, for rotorcraft, recording flight time from the moment the rotor blades start turning until they stop turning is also acceptable.
off-duty period (ODP)	A period of time during which an FCM is free of all duties and standby associated with their employment.
window of circadian low (WOCL)	Under Appendix 2 of CAO 48.1: • if the FCM is acclimatised — hours between 0200 and 0559 local time at the location where the FCM is acclimatised • if the FCM is in an unknown state of acclimatisation — hours between 0200 and 0559 local time at the location where the FCM was last acclimatised. Under an Appendix of CAO 48.1 other than Appendix 2, hours between 0200 and 0559 local time at the location where an FCM commences the FDP. **Note:** A duty infringes the WOCL if the duty is performed during all or any part of the WOCL.

Reference material

Table 4 Reference material

Document type	Title
Civil Aviation Order	*CAO 48.1 Instrument 2019*

1 Introduction for assessors

1.1 Regulatory decision making

Where the legislation provides for one, and only one decision – the 'correct' decision – is the only decision open to CASA. However, most of the decisions CASA makes involve the exercise of discretion. Accordingly, there may well be more than one acceptable or correct decision. In these cases, the law requires CASA to make the 'preferable' decision, that is, the most appropriate decision, having regard to the overriding interests of safety and the obligation to be fair.

In all such cases, CASA is bound to act in accordance with the applicable rules of administrative law. These rules govern how CASA arrives at the 'preferable' decision in any given case. Adherence to these rules is a requirement, not an option. Decisions and actions taken in contravention of these rules are unlawful, unenforceable and, in most cases, invalid. CASA is legally accountable for the decisions it makes, and CASA decision-makers are obliged to avoid the appearance, as much as the reality, of unlawful decision-making. Sound and lawful regulatory decision-making is generally governed by the 10 rules of administrative law summarised below. Adherence to these rules is essential to CASA's obligations of accountability and good governance.

Natural Justice (Procedural Fairness)

Hearing Rule – Persons affected by CASA's decisions have a right to be heard. To be meaningful, the hearing rule normally requires CASA to provide persons not only with notice (usually in advance) that a particular decision is going to be taken, but also the reasons for the decision CASA proposes to take. Without notice and a statement of reasons, there may be little point to providing a person with an opportunity to be heard.

Rule Against Bias – Decision-makers should not have a **personal** or **pecuniary interest** in the outcome of their decisions; neither may decision-makers prejudge (or **pre-determine**) matters in respect of which they are called upon to make a decision.

1. A decision-maker must not act for **improper purposes**. Even if the purposes for which a particular decision are lawful, the decision may only be taken for the purposes specifically authorised by the law under which the decision has been taken.
2. A decision-maker must not take any **irrelevant considerations** into account in coming to a decision.
3. A decision-maker must take all **relevant considerations** into account in coming to a decision.

> **Note:** Applicable Policy is Always a Relevant Consideration.

4. A decision-maker must act on the basis of evidence, not mere supposition or speculation.
5. A decision-maker must not formulate requirements in **vague** or **uncertain terms**.
6. A decision-maker must not inflexibly apply policy (although departures from policy will normally need to be justified).
7. A decision-maker must not act under dictation (although this does not preclude adherence to formal directions, compliance with lawful conditions in relation to the process by which a decision is taken or the obligation to consult in the process of considering a decision).
8. A decision-maker must decide the matter within a reasonable time.
9. A decision maker must not act in a way that is manifestly unreasonable. A decision must not be so unreasonable that no reasonable person would make such a decision.

Note: The meaning and application of these principals, and related considerations of administrative law, are covered more fully in the induction and orientation training undertaken by all CASA employees. Any questions in relation to these matters should be referred to the Legal Services Division.

1.2 Departure from authorised policy for assessors

Adherence to CASA's authorised policies will almost always produce an appropriate decision. As said, however, from time to time, there will be circumstances in which the strict application of policy may not result in the 'preferable' decision. In these cases, it may be appropriate (and possibly necessary) to depart from otherwise applicable policy.

Any departure from policy must be justified to ensure that it:

- is genuinely necessary in the interests of fairness
- does not inappropriately compromise the need for consistent decision-making, and
- is not in conflict with the interests of safety.

It is expected that appropriate consultation will occur before a decision is made, which is not the product of the policies and processes set out in this manual. The prescribed consultation process is described below.

1.3 Consultation process for assessors

1.3.1 Decision maker's responsibilities

When a decision-maker believes there is a need to depart from policy, they are expected to consult with their direct supervisor. This process should be initiated in writing:

- detailing the relevant facts and circumstances
- identifying the provisions of the policy normally applicable
- stating why the application of that policy would not result in the making of the 'preferable' decision in the circumstances to hand, and
- specifying the rationale, the decision-maker believes is more likely to result in a 'preferable' decision.

1.3.2 Supervisor's responsibilities

In considering a consultative referral, the decision-maker's supervisor should:

- advise the decision-maker as to whether their assessment of the relevant considerations appears to be complete and correct
- if, in the opinion of the supervisor, the circumstances do not warrant a departure from policy, provide the decision-maker with written advice and guidance as to how the decision might more properly be approached within the current policy framework, and

Note: Reliance on relevant precedent is a sound basis on which to ground such an opinion. It may also be helpful to seek advice from peers, superiors and/or CASA's Legal Services Division.

- If, in the opinion of the supervisor, a departure from policy is warranted, ensure the policy sponsor (normally the relevant Executive Manager) is advised of:
  - the alternative approach the decision-maker will be taking to the matter.
  - the intention to depart from the otherwise applicable policy.

The supervisor should ensure that a full written record of these actions is made and maintained.

Note 1: In no case may the terms of decision be dictated to a delegate authorised to exercise discretionary decision-making powers.

Note 2: If a decision-maker's supervisor or the policy sponsor is not satisfied that the decision the decision-maker intends to make is the correct or preferable decision in all the circumstances, responsibility for that decision should be assumed by, or assigned to, another authorised delegate in accordance with appropriate processes and procedures.

1.3.3 Policy sponsor's responsibilities

If the policy sponsor concurs in the proposed departure from policy, they should ensure the decision-maker is advised accordingly as soon as possible.

If the policy sponsor does not believe the proposed departure from policy is warranted, they should:

- advise the supervisor accordingly
- assume responsibility for the decision
- ensure that the decision-maker and any person affected by the decision (for which the policy sponsor has assumed responsibility) is advised accordingly, and
- make the decision in a manner consistent with the applicable policy.

The policy sponsor should ensure that a full, written record of these actions is made and maintained.

Nothing in these processes should be interpreted or applied so as to dictate the terms of the decision to be made by a decision-maker authorised to make discretionary decisions under the civil aviation legislation, or to delay unreasonably the making of such decisions.

2 Introduction for industry and assessors

Civil Aviation Order 48.1 Instrument 2019 (as amended, CAO 48.1) requires operators to transition to a new regime for the management of flight crew member fatigue and alertness. CAO 48.1 allows operators the option to develop and operate to a Fatigue Risk Management System (FRMS) once approved by CASA for implementation.

Any Australian AOC holder may apply for an FRMS trial or full approval. Operators may apply to CASA for approval to implement an FRMS for all or part of its operations.

CASA has adopted ICAO's Standards and Recommended Practices (SARPs) in developing CAO 48.1. CASA's FRMS policy and processes align with ICAO guidance available from the ICAO website as found in:

- Fatigue Management Guide for Airline Operators. Second Edition, 2015
- Fatigue Management Guide for General Aviation Operators of Large and Turbojet Aeroplanes. First edition, 2016
- Fatigue Management Guide for Helicopter Operators. First Edition, 2020
- Manual for the Oversight of Fatigue Management Approaches (Doc 9966), Second Edition, Version 2 (Revised) 2020.

The implementation of an FRMS allows an operator to adjust their policies, procedures and practices to address specific conditions where fatigue risk is present in their operations. An AOC's FRMS is customised to their operational environments.

While each operator develops their FRMS relevant to their organisational and operational requirements and accompanying fatigue risk, establishing an FRMS requires all operators to be committed to a fatigue risk management culture.

2.1 Purpose of the Handbook

The CASA FRMS Handbook (the Handbook) provides AOC operators or applicants with information on how to proceed to seek an approval of their FRMS. It should be noted that the responsibility for the development and implementation of an FRMS rests entirely with the applicant. The Handbook also provides structured guidance to staff assigned by CASA to assess an FRMS application.

The Handbook is subject to a continuous improvement program involving periodic review. Suggestions for change can be submitted to fatigue.management@casa.gov.au.

It should be noted the FRMS Handbook is intended to facilitate the transitional processes from the existing rules to the new rules. A version of the FRMS Handbook will have a limited period of currency and will be amended and/or replaced as required.

2.2 Using the FRMS Handbook

CASA staff assessing an FRMS are required to follow the procedures and policies with respect to CAO 48.1 within the Handbook.

An applicant may use these policies and procedures as guidance when preparing their FRMS applications.

Utilising the Handbook's policies and procedures allows for all parties to be consistent with regulatory requirements.

While Appendix 7 can be considered primarily as 'outcome-based' legislation, compliance is required with the provisions of the legislation. In the Handbook, the word 'must' is used to indicate that CASA requires the policy or procedure to be adhered to in accordance with a legislative provision.

The word should, indicates there are numerous options that may be exercised to meet the intent of the legislation. The word should does not mean that the policy/procedure can be dismissed as unnecessary.

CASA assessor(s) will use their experience, training and consultation with the CASA Fatigue Panel in their assessment of whether the intention of the legislation has been achieved.

2.3 CAO 48.1 (2019) Parts 1, 2 and 3

While an applicant for an FRMS will focus primarily on Appendix 7 of CAO 48.1, the applicant will need to consider all relevant aspects of the Instrument to ensure compliance is achieved.

The introductory clauses of CAO 48.1, Parts 1, 2 and 3, subsections 6-16 include aspects that may need to be considered in the FRMS Manual. The potential relevance of these subsections is summarised below.

2.3.1 Subsection 6 'Definitions'

Civil Aviation Order 48.1 Instrument 2019 (as amended) subsection 6

Subsection 6 'Definitions' defines all terms relevant to CAO 48.1.

All relevant activities/operations conducted by the operator must be defined in the FRMS Manual in accordance with the definition in subsection 6. There is no provision in Appendix 7 to allow for any amendment to the definition of any term defined in subsection 6. Refer to section 3.4 of the Handbook for further information and guidance.

2.3.2 Subsection 7 'Determination of acclimatisation'

Civil Aviation Order 48.1 Instrument 2019 (as amended), subsection 7

Subsection 7 'Determination of acclimatisation' will be relevant to all operators with FCMs who may cross two or more time zones. Should an AOC have such operations, they need to ensure their FRMS Manual includes procedures for meeting the requirements of this subsection to allow for such operations to be undertaken.

2.3.3 Subsection 8 'General condition on Air Operators' Certificates'

Civil Aviation Order 48.1 Instrument 2019 (as amended), subsection 8

Subsection 8 in Part 2 'Conditions' relates to conditions on AOC holders.

An applicant will need not only to review this subsection, but also document the requirements to comply with each requirement for the AOC holder as set out in the CAO, and comply with the limits and requirements for an FCM as provided for by each Appendix under which the AOC holder applies to the FCM.

Furthermore, the applicant must document the requirements to ensure that each of the AOC holder's FCMs, when acting as such, complies with each requirement imposed by the CAO on flight crew licences.

2.3.4 Subsection 9 'General conditions on flight crew licences'

Civil Aviation Order 48.1 Instrument 2019 (as amended), subsection 9

Subsection 9 in Part 2 'Conditions' relates to conditions on the licences of FCMs.

An applicant will need to review this subsection and document that the flight crew licence of an FCM is subject to the condition that the FCM must comply with each limit and requirement imposed on the FCM by the CAO.

2.3.5 Subsection 10 'Limits and requirements for operations'

Civil Aviation Order 48.1 Instrument 2019 (as amended), subsection 10

Subsection 10 in Part 3 'Limits and Requirements' relates to the requirement to operate to an Appendix or Appendices of CAO 48.1.

While, in applying for an FRMS, an applicant must advise CASA of the intention to operate to Appendix 7, the operator must document this in the FRMS Manual.

Should an operator intend to conduct only part of its operations under an FRMS, the applicant must identify what operations are conducted under the FRMS and what operations are conducted under other specified Appendix or Appendices. In doing so, the operator must ensure full compliance is achieved for whichever Appendices are used for those operations (see subsection 13).

2.3.6 Subsection 11 'Part 137 Operations'

Civil Aviation Order 48.1 Instrument 2019 (as amended), subsection 11

Subsection 11 relates to CASR Part 137 operations and will not generally be relevant for FRMS applicants.

2.3.7 Subsection 12 'Private operations'

Civil Aviation Order 48.1 Instrument 2019 (as amended), subsection 12

Subsection 12, clause 12.4 details when 'Private Operations' must be considered by an applicant so the FRMS adequately deals with and achieves compliance in relation to private flights in so far as they may impact on any FDP for commercial flights under the AOC.

2.3.8 Subsection 13 'Operations under multiple Appendices'

Civil Aviation Order 48.1 Instrument 2019 (as amended), subsection 13

Subsection 13 'Operations under multiple Appendices' will only be relevant to applicants who are conducting some of their operation under an FRMS and another part of their operation under another appendix in circumstances where the FCMs may be working under both appendices in a single FDP.

It is not anticipated that these circumstances will be regular occurrences under an FRMS; however, if an applicant were to propose such an arrangement, the FRMS must manage these arrangements in accordance with these provisions.

2.3.9 Subsection 13A 'Transitioning from Appendix 4B, 5 or 5A or Subpart 137.Q of CASR'

Civil Aviation Order 48.1 Instrument 2019 (as amended), subsection 13A

Subsection 13A 'Transitioning from Appendix 4B, 5 or 5A, or Subpart 137.Q of CASR' will only be relevant to applicants who are conducting some of their operation under Appendix 4B, 5 or 5A or subpart 137.Q of the CASR, and some of their operation under an FRMS.

It is not anticipated that these circumstances will be regular occurrences under an FRMS; however, if an applicant were to propose such an arrangement, the FRMS must manage these arrangements in accordance with these provisions.

2.3.10 Subsection 14 'AOC holder obligations'

Civil Aviation Order 48.1 Instrument 2019 (as amended), subsection 14.

Subsection 14 'AOC holder obligations' relates to matters that will be relevant to applicants and, as such, the FRMS Manual must document how the applicant manages these matters.

Applicants should note that subsection 14.5 refers to the provision of meals for FCMs, but is prefaced with the words 'Except for operations under Appendix 7…' At first glance, an applicant may consider they do not need to address the provision of meals in the FRMS. However, the note under subsection 14.5 states in part '…it is expected that the FRMS would provide the opportunity for FCMs to have access to adequate sustenance at appropriate intervals.' As such, the FRMS should deal with the provision of sustenance to FCMs.

The applicant must also ensure compliance with the requirements detailed for 'Records and Reports' and 'Rosters'.

2.3.11 Subsection 15 ‘Enhanced fatigue management obligations’

Civil Aviation Order 48.1 Instrument 2019 (as amended), subsection 15

Subsection 15 ‘Enhanced fatigue management obligations’ does not apply to an operator conducting operations under Appendix 7, as all matters described in this subsection would be dealt with under an FRMS in a more advanced manner.

2.3.12 Subsection 16 ‘Flight crew member obligations’

Civil Aviation Order 48.1 Instrument 2019 (as amended), subsection 16.

Subsection 16 ‘Flight crew member obligations’ relates to the requirement for FCMs to be fit for duty with respect to fatigue and, as such, the applicant must address this matter in the FRMS documentation.

2.4 Definition of Terms

Civil Aviation Order 48.1 Instrument 2019 (as amended), subsection 6

The ‘Definitions’ in Part 1, subsection 6 of the Civil Aviation Order 48.1 Instrument 2019 define the relevant terms. All terms used in this Handbook and all terms in an applicant’s proposed FRMS Manual are defined in accordance with the ‘Definitions’.

For simplicity and clarity, an applicant need only include, in their FRMS Manual, the definitions of terms that are or may be relevant to their operation or proposed operation. For example:

- If an Applicant conducts or may conduct operations that may involve reassignment of FCMs, then the Applicant must include in the FRMS Manual the definition of reassignment as it appears in subsection 6.
- If an Applicant does not intend to employ a medical transport tasker, there is no need for the Applicant to include, in the FRMS Manual, the definition of a medical service tasker.

Please also note the following with respect to Definitions and terms in this handbook:

- The term Fatigue Risk Management System Handbook has been, at times, abbreviated to the FRMS Handbook or the Handbook.
- The term Trial FRMS Implementation has been, at times, abbreviated in this Handbook as FRMS trial or the trial.
- The terms organisation, operator, applicant have been used in this document to mean an AOC holder, or an applicant for a new AOC, and are also taken to include the holder of a Part 141 certificate to whom CAO 48.1 applies.
- Any reference to CAO 48.1 in this document refers to Civil Aviation Order 48.1 Instrument 2019 (as amended) and/or any subsequent amendment.

2.5 Roles and responsibilities

2.5.1 CASA

It is the responsibility of the oversighting Regional Office to lead discussions of an application for an FRMS approval with the relevant operator and assign an assessor(s) to project manage the application process. The CASA Fatigue Panel will support the Regional Offices throughout the process.

CASA assesses applications for trial or full FRMS implementation approvals according to the requirements of CAO 48.1. It is not the purpose of the Handbook to comprehensively detail the legal requirements associated with the order, as it is a guide to presenting an FRMS application.

CASA assessors will use the guidance in the Handbook and record the assessment on the FRMS Technical Assessor Worksheet (Form 817)

Note: While the application process is a consultative activity, CASA's role is to assist in the approval of the operator's FRMS, rather than acting as a content developer.

2.5.2 Applicant

The applicant is responsible for the development and implementation of their FRMS including all associated procedures and practices.

The Fatigue Risk Management Systems: a Step by Step Guide provides an overview of fatigue risk management systems, including how to develop and implement an FRMS. The Fatigue Risk Management System Gap Analysis Tool provides a detailed checklist to assess current policies and procedures to identify areas requiring further development. The review and completion of these documents will assist an applicant in understanding the requirements of an FRMS and, as such, represent a pivotal aspect of the preparation of the applicant.

The application process is described on the Application for a Fatigue Risk Management System implementation approval (Form 824). In summary, the applicant is required to:

- consider, in detail, whether the operation can be conducted under CAO 48.1 Appendix 1-6, with or without a Minor Variation, and identify all areas where this is not possible or practicable
- notify the oversighting CASA office they are considering applying for an FRMS approval in order CASA can arrange a pre-application meeting
- complete the FRMS Gap Analysis
- attend the pre-application meeting
- complete and submit the formal application (Form 824) with the supporting documents required by CASA, including:
  - a thorough Gap Analysis identifying supporting systems, individuals and processes already in place, and what components will need to be added to meet the requirements for an FRMS
  - a safety case that clearly articulates how the FRMS will manage the fatigue risks of the operation
  - an FRMS Implementation Plan informed by the Gap Analysis showing how and when the organisation will put into place or enhance any components requiring development
  - a manual that details all required aspects of the FRMS
  - it is strongly encouraged that the Form 817 (showing where in the manual or in any supporting document compliance is achieved with the legislation provisions and requirements) be completed to facilitate the process
  - relevant evidence to support any claims made in the application documents.
- Facilitate the assessment processes; there is a mutual expectation of:
  - making requested documents and records available
  - ensuring relevant personnel are available to respond to questions and be interviewed if necessary
  - attending meetings as requested
  - responding to questions in a timely and complete manner.
- Pay the required CASA fee (if applicable).

The success of the application is highly dependent on the cooperation of all parties to ensure that the proposed operation and supporting documents are completed to provide a comprehensive submission.

2.6 Assessment concepts – overview

CASA's assessment of an applicant's FRMS aligns with CASA regulations and the regulatory philosophy of 'outcome-based legislation' with due consideration to the concept of scalability. An FRMS is scalable to the

size and complexity of an organisation, and with reference to the fatigue hazards of the operation. CASA will consider all relevant factors and circumstances when assessing an FRMS application and the supporting evidence.

CASA must be satisfied with the entire application prior to an approval being issued for an FRMS trial. FRMS Technical Assessor Worksheet (Form 817) has been developed by CASA as the tool for CASA and applicants to manage and facilitate the assessment process. The form also ensures a consistent evaluation of FRMS applications.

Using the form, the applicant will record where, in the FRMS Manual, they achieve compliance with all required aspects of CAO 48.1, and particularly Appendix 7 of the CAO. This process ensures the AOC implements a system that may be assessed through performance based oversight.

The CASA assessor's review of the FRMS application will determine whether the relevant elements of the FRMS are in place before recommending the approval to conduct an FRMS trial. CASA uses the 'Present, Suitable, Operating, and Effective' (PSOE) concept originally developed by ICAO Safety Management International Collaboration Group (SMI CG), which integrates human factor oversight together with safety management oversight. Many operators will be familiar with these terms as they are used in other CASA assessments (e.g. SMS, Part 142) and which are defined as follows:

Present

There is evidence that the 'indicator' is clearly visible and is documented within the organisation's documentation.

Suitable

The indicator is suitable based on the size, nature, complexity of the organisation and the inherent risk in the activity, including consideration of the industry sector.

Operating

There is evidence that the indicator is in use and an output is being produced.

Effective

There is evidence that the indicator is effective and achieving the desired outcome.

The FRMS evaluation method employed by CASA consists of considering Appendix 7 of CAO

48.1 and whether all elements are present, suitable, operating and effective (PSOE) within the AOC's operations manual. In respect to the PSOE method, the operator needs to be clear as to how their FRMS will manage crew fatigue and alertness across all elements.

The use of Form 817 enables the applicant to indicate to CASA where compliance is achieved with the wording and intent of the legislation so CASA can be satisfied as to the extent to which FCMs perform at levels of alertness sufficient to ensure the safety of operations.

2.7 Assessment process – overview

The formal assessment process commences with a review of the FRMS Manual, along with sampling of evidence of the processes described in the manual. For example, verification of the operator's systems may involve review of records of hazard identification and risk assessment processes to establish limits, sampling of training courses, records and course materials, and so on.

Using Form 817 to record the evaluation, the CASA assessor(s) will consider each line item and determine the status of the indicator.

CASA will record and report any deficiency or anomaly on Form 817, which will be provided back to the applicant.

The applicant will need to respond to CASA resolving any deficiencies with a manual or system amendment or providing further explanation as to processes, system and intentions.

Experience has shown the FRMS application to be an iterative process with Form 817 being exchanged between the parties on a number of occasions as the various sections are completed.

Once the CASA assessor(s) are finished with their assessment, a recommendation may be made to issue the operator with an instrument that approves a trial FRMS implementation in accordance with clause 8 in Appendix 7 of CAO 48.1.

3 Entry control

3.1 Initial steps

Preparation

Prior to making any decision in relation to an FRMS application, CASA expects the operator to:

- review the CASA fatigue website and familiarise themselves with CASA's guidance material, especially the Fatigue Risk Management Systems: Step by Step Guide
- evaluate whether their operation can be conducted under Appendices 1 - 6 of CAO 48.1 and to identify the most applicable Appendix (or Appendices) to their operations and the areas within that Appendix (or Appendices) where they consider compliance with the requirement(s) not possible or practicable
- evaluate whether their operation may be able to be conducted under CAO 48.1 and Appendix 1 - 6 supported by a Minor Variation to the Appendix they have identified as most appropriate for their operations
- fully inform themselves about the requirements of an FRMS by completing the 'Fatigue Risk Management System Gap Analysis Tool.'

While any AOC holder can opt to operate under Appendix 7, many operators may find it challenging to meet the ongoing requirements of an FRMS. Similar to a Safety Management System (SMS), an FRMS is an active cultural aspect of an AOC. As such, any prospective applicant needs to give careful consideration to the continuous resourcing and systemic and operational implications of maintaining the FRMS.

Applicants with more than one AOC or organisation in a commercial group may consider using the processes of a consolidated FRMS across some or all its AOCs or organisations. However, the commercial group cannot apply for an FRMS, as only an AOC holder can apply for an FRMS.

The relevant AOC holders within the group may apply for FRMSs that share common processes documented in the group FRMS Manual. For example, a commercial group that has two AOCs – one conducting long range international operations and the other conducting shorter domestic operations – could apply for an FRMS for each AOC. These AOC holders could use common elements described in a group FRMS Manual where the operations overlapped; these may include a common governance framework, FSAG, FRMS Manager, reporting system, biomathematical modelling tool, training structures etc.

CASA will assess the relevant aspects of the FRMS applications independently to ensure the fatigue risks of each operation are appropriately identified, risk assessed and mitigated.

A group FRMS Manual must identify the common and unique elements of the AOC's FRMS. CASA would expect documentation of the specific differences in rules, processes, procedures and limits for the different operations to mitigate the different risks present in the operations.

Applicants need to be aware that each AOC holder within the group will be regarded as an individual applicant for an FRMS, and each AOC holder will remain responsible for satisfying CASA as to the suitability of its processes, procedures and systems.

3.2 Pre-application meeting

Pre-application meeting requirements for an operator

Having completed the preparation stages note above, the applicant will need to notify the oversighting Regional Office of the possible intention to submit an FRMS application. CASA will subsequently contact the operator to arrange for the pre-application meeting.

The pre-application meeting agenda will cover the following items:

- entry control requirements
- application process
- estimate cost and the payment process (if applicable)

- overview of assessment processes – trial FRMS implementation and full FRMS implementation approvals
- review the FRMS Gap Analysis
- arrangements for the interview of the nominated FRMS manager
- overview of the operator's resources for system development, implementation and on- going management.

Following the pre-application meeting, the operator should be better able to make a more informed decision whether to proceed with an FRMS application. Should an operator decide not to proceed with an FRMS application, CASA would appreciate written advice of this decision.

3.3 Application

Should the operator decide to formally apply for an FRMS approval, the operator will need to complete and provide Form 824 Application for Approval of a Fatigue Risk Management System and the supporting documents to CASA.

The supporting documents to be submitted at this time are:

- a completed FRMS Gap Analysis Form
- a safety case establishing how the operator will identify and manage all relevant fatigue risks
- an FRMS Implementation Plan
- draft FRMS Manual
- Form 817 detailing where in their manual the operator achieves compliance with all applicable criteria/requirements.

These documents are discussed in more detail below.

3.3.1 FRMS gap analysis

The FRMS Gap Analysis Form is available from the CASA fatigue resources web page.

By conducting a thorough FRMS Gap Analysis, the applicant will identify:

- elements of the FRMS that are already available in existing systems and processes
- existing systems and processes which need to be modified to meet the basics of FRMS (to minimise 're-inventing the wheel')
- where new systems and processes need to be developed for the FRMS.

For example, an operator may already have a confidential safety reporting system as part of its SMS or organisational processes. However, the existing report forms may need to be modified to include the specific information needed to record fatigue related evidence and information. Additional training (or staff) may also be needed to ensure the appropriate analysis of fatigue reports to understand the contributing factors of fatigue within the operations. Also, procedures may need to be added for reports on fatigue-related events to be communicated on a regular basis to the FSAG or equivalent safety group.

3.3.2 FRMS safety case

The FRMS Safety Case is a document in which the AOC holder details how their proposed FRMS and its supporting processes are effective in meeting all Appendix 7 requirements. Accordingly, the AOC's FRMS Safety Case provides CASA with evidence of the operator's understanding of the scientific basis underlying their system which maintains the FCM(s) alertness at a level that ensures the safety of the operations.

In preparing the FRMS Safety Case, the applicant should include appropriate information about existing and proposed processes and its planned activities. This shows the applicant understands and will attempt to mitigate any fatigue related risks inherent in operating outside the relevant prescriptive limits. A thorough Safety Case should include, at least:

- what operations will be conducted under the FRMS. For example, an airline type operation may seek to operate domestically and limited international services under a prescriptive Appendix and with long haul international under an FRMS
- the proposed limits under the FRMS that clearly identify each prescriptive limit of the relevant Appendix which the operator is seeking to exceed, by how much, and in what circumstances
- the processes used to identify fatigue hazards for each exceedance
- the risk assessments for all identified fatigue hazards of each exceedance
- the scientific principles supporting the proposed mitigations for each fatigue risk
- how the identified mitigations are deployed and assessed for effectiveness
- the mechanisms for escalating and resolving fatigue risk issues
- the system for collecting relevant evidence and data to support the proposed processes.

CASA considers the ability of an organisation to develop and substantiate an appropriate FRMS Safety Case to be indicative of their ability to establish and maintain an effective FRMS.

3.3.3 FRMS implementation plan

The results of the FRMS Gap Analysis and Safety Case referenced above are used as the basis for the development of the operator's FRMS implementation plan.

Essentially, this plan provides the AOC with a means to address/resource the 'gaps' in their current policies and procedures, the FRMS processes to address these gaps within the operations and organisation, and how to safely proceed with realistic timelines for implementation of the mechanisms to address the gaps.

The implementation plan should reflect the requirements of the CAO and Appendix 7 such that all required processes and procedures are in place, with evidence they are capable of managing fatigue risk prior to the trial.

The FRMS Implementation Plan must outline the anticipated project dates for the implementation of FRMS processes. CASA needs to be advised of the proposed dates for the submission of required documentation and supporting evidence so that CASA can assign the required resources to review and respond in a timely fashion.

It is anticipated that systems and processes may be adjusted in the lead up to, and during, the trial from the gathering and analysis of fatigue data. Accordingly, CASA must be convinced that the FRMS is capable of continuously and effectively monitoring and managing fatigue-related safety risks before the trial approval.

3.3.4 FRMS manual

The applicant may elect to provide a standalone FRMS Manual or an Operations Manual with the FRMS described and documented within the manual; or a Safety Management System Manual with the FRMS described and documented within this manual. Whichever method of documentation the applicant chooses, the FRMS Manual (however named) must contain all elements as prescribed in paragraph 1.2(a) to (f) of Appendix 7 in the CAO 48.1.

Furthermore, if an operator has a CASA-approved SMS, the FRMS must be integrated within the SMS as set out in paragraph 1.3 of Appendix 7 in the CAO 48.1. If the operator's SMS is not an approved SMS, but is a part of the company's operations manual, the FRMS should be integrated with the operations manual.

If the SMS is not a part of the company's operations manual, that is, it is not subject to regulation 215 of the Civil Aviation Regulations 1988 (CAR), the FRMS must be part of the operations manual.

3.3.5 FRMS technical assessor worksheet (Form 817)

The FRMS Technical Assessor Worksheet (Form 817) has been developed by CASA as the tool to assist the facilitation of the assessment process to ensure clear communication with FRMS applications.

The use of Form 817 in support of the application helps the operator identify the relevant regulatory provisions and where, in their FRMS Manual, they achieve compliance with the various aspects of CAO 48.1 and Appendix 7.

As stated previously, CASA assessor(s) use Form 817 to record the progress of an applicant towards implementation of the FRMS with the 'Present', 'Suitable', 'Operating' and 'Effective' method to evaluate the application.

CASA's periodic updates to Form 817 keep the applicant well informed during the FRMS trial. The use of Form 817 assists CASA in ensuring that any deficiencies or the need to provide further explanation on processes, system and intentions are clearly and succinctly conveyed to the applicant in a timely fashion. The applicant can then respond to and resolve any these matters by noting on Form 817 where changes have been made or information provided.

During the FRMS implementation, changes will likely occur on an iterative basis. As the planned processes and policies are implemented, the organisation may need to adjust some initial parameters, amend documents and provide supporting information. Such changes and advice can easily be documented on Form 817. CASA anticipates the form will be exchanged between the parties on a number of occasions as the various sections are completed or revised to meet the requirements of CAO 48.1 and Appendix 7.

The use of Form 817 for formal communications allows both the AOC and CASA to communicate quickly, effectively and concisely throughout the FRMS application process, which will assist in consistency and cost control.

3.4 Assessment standards

Civil Aviation Order 48.1 Instrument 2019 (as amended) Appendix 7 subclauses 1.2 and 1.4; clauses 2 and 8.

Before a trial FRMS approval is issued to an applicant, CASA must be satisfied that the operator's FRMS meets the requirements of CAO 48.1, including the applicable subsections 6 to 16 (excluding subsection 11) in CAO 48.1, and, in particular, the requirements set out in subclauses 1.2 and 1.4, clause 2 and 8 in Appendix 7 of CAO 48.1.

As noted previously, CASA Assessors will use Form 817 to provide feedback on the operator's progress in completing their application using the PSOE method.

The following example provides an example of how an item from Form 817 is assessed by CASA. In this case, the requirements of subsection 2.3(a) of Appendix 7:

Table 5 Example of how an item from Form 817 is assessed

Civil Aviation Order 48.1 Instrument 2019 including Appendix 7	FRMS handbook reference	Applicant's manual reference	Present	Suitable	Operating	Effective
The FRMS policy makes it clear that, while primary responsibility for the FRMS lies with the AOC holder, its effective implementation requires shared responsibility by management, FCMs, and other relevant personnel.						

The FRMS policy of an operator needs to clearly state the responsibilities of each of the parties involved. The focus of this requirement is that all parties recognise they have responsibilities for ensuring the overall management of fatigue risk, and they must act in accordance with these responsibilities.

In this example, CASA assesses compliance with the wording and intent of the legislation by considering the following:

Table 6 Example of how CASA assesses compliance

Present	Suitable	Operating	Effective
The FRMS responsibilities are clearly identified with all roles sharing the responsibility for effective implementation, however, with management remaining ultimately responsible.	Given the size and complexity of the AOC, the responsibilities of the roles adequately address the requirements of the FRMS through resourcing and training commensurate with the activities.	The organisation has evidence to demonstrate that managers, FCMS and other personnel are operating in accordance with the requirements of the 'Suitable' category.	The organisation can demonstrate that the relevant responsibilities for each role are performed in a manner that achieves effective implementation.

3.5 FRMS manual – expectations for content and standards

3.5.1 FRMS policy

Civil Aviation Order 48.1 Instrument 2019 (as amended) Part 3, paragraph 14; Appendix 7, clause 2.

The applicant's FRMS policy is a required high-level statement that links many of the FRMS elements together. The policy must cover the overarching components required of an FRMS, identify the lines of accountability, and include a statement of the company's commitment to FRMS.

The CASA assessor(s) will confirm that all aspects of an applicant's FRMS policy have met the requirements as detailed in CAO 48.1, which include that the Policy must:

- be integrated with the SMS where applicable
- require the identification of all operations to which the FRMS applies
- make it clear that, while primary responsibility for the FRMS lies with the AOC holder, its effective implementation requires shared responsibility by management, FCMs, and other relevant personnel
- clearly indicate the safety objectives of the FRMS
- be approved in writing by the Chief Executive Officer
- be accessible to all relevant areas and levels of the organisation in a way that indicates the AOC holder's specific endorsement of the policy
- declare management commitment to the ongoing provision of adequate resources for the FRMS
- declare management commitment to the continuous improvement processes of the FRMS
- require identification of clear lines of accountability for management, FCMs and all other involved personnel
- include all elements of the FRMS – the objectives, documentation, practical operating procedures, procedures for hazard identification, risk assessment and mitigation, safety assurance, safety promotion procedures and change management
- require periodic reviews of the FRMS to ensure it is relevant.

The FRMS policy must also declare management commitment to effective safety reporting. This may be achieved with the inclusion of the FRMS policy containing a commitment from management to an operational

environment that promotes a healthy safety culture. This would be a specific discussion of reporting fatigue that is based on an open and fair safety reporting culture through which staff are encouraged to report all safety-related observations, errors and near misses.

As an AOC holder must not assign a duty on a flight to an FCM if the AOC holder reasonably believes that the FCM is unfit to perform the duty because of fatigue, this must be stated in the FRMS Manual and should appear in the FRMS Policy. Similarly, the FRMS Policy should specifically commit the organisation to openly accepting the displacement of crew from duty if, considering the circumstances of the flight to be undertaken, the crew member reasonably believes they are or may become unfit to perform the duty because of fatigue.

3.5.2 FRMS safety objectives

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclause 2.3(b).

The safety objectives must be specified in the FRMS policy, identifying what the operator wants the FRMS to achieve. The FRMS objectives should clearly indicate safety as the priority.

To foster success in achieving FRMS objectives (goals) stated in the FRMS Policy, research indicates that SMART principles should be employed:

- Specific
- Measurable
- Achievable
- Realistic
- Time-bound, have a set time frame for the objectives to be achieved.

FRMS objectives may include:

- proactive management of operational risk of reduced alertness to maintain a safe operation
- adequate flight crew member resourcing
- adequate flight crew member training to avoid, detect and mitigate fatigue impairment
- reporting and acting upon fatigue hazards and incidents within a specified timeframe to minimise the chance of recurrence
- maintaining active awareness of, and applying, contemporary fatigue research as part of the continuous improvement reviews of the FRMS
- promoting participation by all relevant areas of the organisation to ensure representation in the processes and decision-making that occurs in the FRMS.

To track whether the FRMS is meeting these objectives, its performance needs to be monitored. The CASA assessor(s) will verify whether the operator has supported their objectives with specific SPIs and associated safety targets that effectively measure progress towards achieving the FRMS objectives. Examples of safety performance indicators and targets that can be used to measure how well the FRMS is meeting the safety objectives are detailed subsequently in this manual.

3.5.3 Management commitment and responsibility

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclause 1.3 and 2.3(c) and (e).

The CEO must approve the FRMS Policy in writing and, in doing so, demonstrates a genuine commitment to the management of fatigue as a safety risk.

The CASA assessor(s) will confirm the following aspects are visibly endorsed by the AOC management throughout the applicant's documentation:

- Sufficient resources are allocated to develop, establish, train for, implement and maintain the FRMS. These resources need to be clearly identified with evidence showing that the applicant has allowed for associated capital or human resource expense.

- Resource allocation is linked into the FRMS development in accordance with the FRMS implementation plan.
- An appropriate organisational structure is documented and operating to ensure the effective functioning of the FRMS. The structure will need to show all the FRMS linkages in the company from the CEO through the FSAG (or equivalent safety group) to the training department, rostering staff and crew, and with appropriate linkages to the SMS or relevant safety processes.
- Stakeholder identification and a consultation process relative to the scope of the FRMS. The Stakeholder group should include where applicable and appropriate:
  - management
  - FCMs
  - flight crew representatives
  - rostering staff
  - FRMS training staff
  - other crew/staff/contractors working under the FRMS.

Stakeholders may include other relevant personnel; for example, procurement officers, FRMS and/or safety specialists, accommodation providers, and other external parties.

- Where an AOC has an SMS, the FRMS must be integrated with the SMS. The CASA assessor(s) will assess the processes by which the FRMS is integrated into the SMS in such instances.
- Clear FRMS decision making processes covering areas such as:
  - roles and responsibilities and assigned levels for decision making
  - closed-loop escalation processes
  - defined time periods for responses/decisions to be actioned or addressed by each responsible party.

3.5.3.1 Chief executive officer (CEO)

Civil Aviation Order 48.1 Instrument 2019 (as amended) Part 1 ‘Definitions’, and Appendix 7, subclause 2.3(c) and (e)(ii).

The CEO as the AOC holder is accountable for:

- approval of FRMS policy
- provision of adequate resources and authority to support the FRMS
- appointment of the FRMS Manager.

While the CEO is not expected to comprehensively understand all aspects of the FRMS, the commitment of the CEO to the safety principles of the FRMS is intrinsic to the success of the FRMS.

3.5.4 Continuous improvement

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclause 2.3(e)(iii) and (g) and 5.4.

The FRMS must include a continuous improvement process. Through ongoing evaluation and review of the FRMS, the applicant will ensure:

- the AOC is compliant with regulatory requirements
- safety performance targets are regularly considered and modified as appropriate
- the defined tolerances of SPIs maintain currency with the input from FCMs (i.e. FSAG membership, survey responses, fatigue reporting, open communication)
- the FRMS is kept current with operational changes and/or input
- the review processes and potential changes of the organisation’s learning culture are consistent with developments in human factors

- regardless of specific modification, the change process improves the organisation's overall safety experience.

CASA requires routine evaluations to be conducted as part of the continuous improvement of the FRMS. For example, examining fatigue reports of routes and rostering on an ongoing basis provides feedback on the potential contribution of fatigue. Additional measures, such as fatigue surveys, are beneficial sources of information about the system.

The FRMS must include a routine evaluation of the FRMS and all associated processes to determine the adequacy of facilities, equipment, documentation and procedures (i.e. an internal FRMS audit). CASA anticipates the operator will take an outcome-based approach to determine the frequency of their self-assessments of the FRMS. Importantly, continuous improvement of the FRMS is reliant on monitoring and evaluation.

FRMS audits, where possible, should be conducted by an individual or committee with independent oversight as no particular individual or group (e.g. the FSAG) should assess their performance.

The FRMS continuous improvement processes should include:

- any findings, outcomes and actions identified through safety assurance processes that may enhance the FRMS
- review of the fatigue risk management processes to ensure the ongoing adequacy and requirements for risk controls and mitigators
- review of the FRMS practices and principles against applicable scientific advances in fatigue management
- consideration of new scientific knowledge and processes to enhance the management of operational alertness
- review of the communication process for its effectiveness in conveying information to all stakeholders
- data analysis of fatigue metrics gathered during operations.

In addition, the inputs into an FRMS review may include appropriately detailed reports from the FSAG highlighting fatigue related issues, such as:

- trends identified from fatigue reports or surveys
- emerging fatigue risks that have been identified and the mitigation strategies employed
- any fatigue investigations conducted and relevant findings
- reports of the audit of the FRMS
- relevant findings from FDAP, LOSA etc. (as applicable)
- potential implications from relevant scientific developments
- resourcing issues
- recommendations and rationale for change to any FRMS process or structure.

The outputs from the review process include formal acknowledgement that the FRMS is achieving objectives, areas that were recommended for changes and those that were actioned or not, and areas that have been targeted for change.

3.5.5 Appointment of key FRMS personnel

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclause 2.3(a) and (f) and 2.5(a) and (b).

The FRMS Manual must include the personnel accountabilities, responsibilities and authorities for effective implementation of the FRMS. CASA will review the organisation's structure diagram, position criteria and training programs in the company's manual, as well as other supporting documents. This is done to verify that the organisation has sufficient and appropriately skilled trained and/or experienced personnel to perform the responsibilities to implement and administer the FRMS.

The FRMS Manual needs to describe the mechanisms for ongoing involvement for all personnel through a functional group and responsible individual who coordinates the FRMS activities. The processes supporting these activities are to be defined and documented.

It is anticipated that these processes will be refined through the continuous improvement of the FRMS. While changes to the names or details of individuals with roles and responsibilities under the FRMS are not significant changes and so do not require prior CASA approval, they need to be reported to CASA within seven days.

3.5.6 FRMS Manager

Civil Aviation Order 48.1 Instrument 2019 (as amended), Part 1 'Definitions'; Appendix 7, subclause 2.5(a) and 6.2(a).

The FRMS Manager (however named) is appointed by the CEO to be responsible for the day- to-day implementation, management and continuing effectiveness of the FRMS.

The appointment of an appropriate FRMS Manager is critical to the success of the organisation's FRMS. The FRMS Manager will need to have a level of authority to ensure they are appropriately informed and consulted on all decisions that may have fatigue or alertness implications for FCMs.

For example, an organisation considering a contract for hotel accommodation for FCMs should include the FRMS Manager in the decision making to ensure an appropriate evaluation is made of the sleep environment, food quality and transfer times to the airport.

If the operator has a SMS in place, whether the SMS has been approved under CAO 82.3, CAO 82.5, CASR 142, or is a SMS the operator has opted to establish, it should be made clear whether the FRMS Manager reports directly to the Safety Manager or directly to the CEO.

3.5.6.1 FRMS Manager roles and responsibilities

Civil Aviation Order 48.1 Instrument 2019 (as amended), Part 1 'Definitions'; Appendix 7 subclause 2.5(a) and 6.2(a).

The FRMS Manager is the responsible individual and focal point for the effective implementation of the FRMS. The personnel accountabilities, responsibilities and authorities of the FRMS Manager for effective implementation of the FRMS must be clearly described in the FRMS Manual.

As the chair of the FSAG, the FRMS Manager will need to have accountabilities, responsibilities and authorities to facilitate the appropriate functioning of the FRMS by ensuring the:

- processes for the FRMS are established, implemented and maintained
- FRMS documents and records are maintained
- FRMS hazard identification and risk management processes are coordinated
- performance of the FRMS is monitored
- FRMS is continuously improved
- reports are provided to the Safety Manager/CEO on the performance of the FRMS
- appropriate FRMS training is developed and delivered
- promotion of the FRMS is carried out.

3.5.6.2 FRMS Manager – training

Civil Aviation Order 48.1 Instrument 2019 (as amended), Part 1 'Definitions'; Appendix 7 subclause 2.5(a) and 6.2(a).

As noted above, CAO 48.1 requires the FRMS Manager to be appointed by the CEO to be responsible for the day-to-day implementation, management, and continuing effectiveness of the FRMS.

The FRMS Manager needs to have a sound understanding of FRMS principles and practices acquired through formal training and experience. This may include attending training courses and meetings covering

the latest developments in fatigue science. If the FRMS Manager has not developed the company's internal FRMS training, the FRMS Manager should be familiar with the content (e.g. undertake the training).

Depending on the size and complexity of the organisation, the FRMS Manager's overall knowledge, skills and experience should include:

- a sound knowledge of FRMS principles and practices
- a sound knowledge of Fatigue Science
- experience in fatigue or safety systems within an aviation organisation
- data collection and analysis techniques
- hazard identification and risk management
- knowledge and understanding of biomathematical fatigue modelling
- investigative, auditing, and analytical skills/experience
- interpersonal and communication skills
- leadership ability.

Note: The knowledge and skill requirements are scalable dependent upon the type of AOC, nature of operations and scope of the FRMS. A more complex operation may require a more extensive and diverse skill set.

While the FRMS Manager should bring training and industry based FRMS experience to the role, the organisation should ensure currency through a professional development plan for the role. CASA will consider all these matters as part of the assessment of the FRMS.

CASA will review the background of an FRMS Manager in relation to the responsibilities of the role. Specifically, the CASA assessor(s) will consider all aspects of the FRMS manager (i.e. the CV and any supporting documents, training certificates etc.) and conduct an interview with the nominee to foster an efficacious completion of the FRMS submission.

More information about the topics that may be covered in the interview can be found in the FRMS Manager Assessment Guidance at Appendix A.

If there are any areas in need of development, the identified FRMS Manager should address these within the professional development plan.

To avoid potential disruption to the FRMS in the absence of the FRMS Manager or other FRMS key personnel, the organisation should have policies and procedures to cover short and extended period of absences, and/or enable the completion of duties and responsibilities remotely. These contingency processes will also need to cover the communication and handover processes to ensure personnel and CASA are notified of the changes as required.

3.5.7 Fatigue safety action group (FSAG)

To address the requirements to provide the mechanisms for ongoing involvement of relevant personnel, an operator should create a functional group that is responsible for coordinating the FRMS activities. In larger organisations, this group or committee may be referred to as the Fatigue Safety Action Group (FSAG).

The fatigue safety group/committee/FSAG should be chaired by the FRMS Manager and provide for effective representation for all relevant stakeholders.

All members of any fatigue safety committee/group/FSAG should complete fatigue training programs to ensure competency levels commensurate with their roles and responsibilities on the FSAG.

3.5.7.1 Composition of the FSAG

In deciding the composition of the FSAG, the operator will need to consider its operational and organisation profile, its activities, the interactions of the FSAG with other parts of the organisation, and the need to promote active and ongoing participation from all stakeholder groups within the organisation.

For example, in an air transport type of operation, the relevant stakeholders in the FRMS would generally include a representative (or representatives) from:

- flight crew members
- staff responsible for crew scheduling
- management of the relevant work groups
- any other work group included within the FRMS (e.g. cabin crew, engineering)
- appropriate subject matter experts (e.g. Aviation Medical Officers, Human Factors or fatigue specialists)
- other relevant representatives (e.g. SMS personnel).

Where the organisation is small but with a functioning SMS, it may not be practical to have a separate FSAG. Having fatigue as a standing agenda item on the Safety Action Group (SAG) meetings would be an acceptable alternative, given that the FRMS Manager and representatives of FRMS stakeholders are included in the SAG.

Note: It is not unusual for the members of safety committees, such as FSAG, to hold other positions within the company. There is no provision that prohibits them for doing so other than those associated with being able to meet the stand-alone requirements of each role.

3.5.7.2 FSAG Terms of Reference

The ‘Terms of Reference’ (TOR) set out the parameters within which the FSAG will function and specify how the group is accountable.

ICAO considers the following aspects of the FSAG as core FRMS accountabilities:

- assist in FRMS implementation
- oversee the ongoing operation of the fatigue risk assessment processes
- contribute as appropriate to the FRMS assurance processes
- maintain the FRMS documentation
- be responsible for ongoing FRMS training and promotion
- provide necessary input on all aspects of fatigue risk to the SMS.

Accordingly, the TOR for the FSAG should include:

- the stated objectives and recognition of the FSAG within the company structure
- the lines of communication for decision-making processes
- the frequency of meetings
- the expectations of the FSAGs scope and deliverables
- the delineation of FSAGs members roles and responsibilities.

In larger organisations, the FSAG may report through a higher-level safety governance structure to a Safety Review Board (SRB) or similar. In less complex organisations, a Safety Committee may have oversight of the FRMS activities and carry out the responsibilities of the FSAG.

Provided an organisation has established the mechanisms for the ongoing involvement of relevant personnel in the FRMS, CASA is open to a variety of ways of achieving this outcome.

The TOR may cover the following:

- schedule of FSAG Meetings with formal agendas and minutes circulated to all relevant parties in a timely manner
- meetings will include review of all fatigue data including reports required by the FRMS
- the FRMS Manager chairs the FSAG meetings
- attendees of FSAG Meetings with representation from all FRMS stakeholder groups
- FRMS manager oversees the FSAG members fulfilling the requirements of the FRMS.

An example of a TOR for a FSAG has been adapted from the ICAO Manual for the Oversight of Fatigue Management Approaches (Doc 9966) – this can be found at Appendix B.

3.5.8 FRMS documentation and records

Civil Aviation Order 48.1 Instrument 2019 (as amended), paragraphs 14.3, 14.4 and 14.9; Appendix 7, clauses 1 and 2; subclauses 2.5(d) and (e).

Before issuing an approval for either the trial FRMS or the full FRMS, CASA assessor(s) must confirm that the FRMS Manual meets all requirements of CAO 48.1.

Apart from the FRMS Manual, there will be a number of other documents that fall under the heading of FRMS Documentation, including but not limited to:

- rosters and flight time as scheduled and as flown
- flight duty records
- duty periods and off-duty periods
- fatigue and incident reports, and documents associated with the investigation of fatigue related incidents
- agendas and minutes of the FSAG meeting and associated bodies
- fatigue surveys, submissions, or other FCM input
- training and competency related records (i.e. syllabi, instructor feedback, course feedback)
- hazard identification and risk assessment records
- operations notices, bulletins, newsletters etc. that reference fatigue related matters
- reports of extensions, diversions and the like
- audit reports and records of the FRMS
- details and records of BMM activities, including thresholds, assumptions, operational procedures and outputs
- fatigue or safety related data collection and analysis.

All documents and records relating to the FRMS are to be retained by the operator for at least five years from the date of the record and must be made available to CASA upon request.

The amendment and distribution of the FRMS documentation, such as the FRMS Manual, will need to be documented and conducted under a formal document control process.

3.5.9 Practical operating procedures

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, clause 3.

The FRMS must have practical operating procedures to identify fatigue related safety hazards and the risks that result from these hazards. The FRMS must have procedures to ensure that remedial actions necessary to effectively mitigate the risks associated with the hazards are implemented properly.

With respect to the identification, mitigation, recording, assessment and monitoring of fatigue related safety hazards, CASAs expects the FRMS to document the ‘who, what, when, where and how’ in the procedures. A communication feedback loop within the risk management process will facilitate the effectiveness of the fatigue risk management and contribute to the continuous improvement of the FRMS.

For organisations with an SMS, the procedures for hazard identification and risk assessment will be pre-existing. As FRMS procedures are based on the same scientific principles and knowledge of SMS, CASA does not anticipate difficulties for organisations to develop fatigue related risk procedures.

Organisations can modify their established SMS processes and procedures to meet their obligations with respect to their operating procedures for the specific management of fatigue risks, provided the procedures operate in a manner and deliver outcomes commensurate with those required by CAO 48.1. The procedures in the FRMS Manual must be adequately detailed to ensure the recording of all relevant actions and processes including the recording of the deployment of remedial actions and the extent to which these actions mitigated the fatigue risk.

Further details on hazard identification and risk assessment processes are described below with other information provided in the CAAP.

Operators who do not have a pre-existing SMS, or who have had limited exposure to SMS concepts, may find risk management methodology and implementation challenging. This Handbook does not provide material and guidance on generic hazard identification and risk assessment processes. Operators who are applying for an FRMS without an SMS and/or who are unacquainted with risk assessment and hazard identification methods would benefit from developing the requisite skill set to prior to their application.

3.5.9.1 FRMS limits

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, clause 3, subclause 2.5.

The FRMS Manual must concisely document the operational limits, with the limits based on scientific principles and knowledge and subject to safety assurance processes. The limits must include the maximum values for flight times, flight duty periods and duty periods; the minimum values for off-duty periods (ODPs); and all other relevant limits.

To determine these values, an AOC must establish what Appendix or combination of Appendices between 1-6 would best suit their operations should they not require an FRMS. The gap(s) between the limits in the proposed FRMS and those limits under the relevant Appendix or Appendices are areas of increased risk to be addressed.

Functionally, this means the operator will be required to specifically:

- identify every maximum limit proposed that is greater than the corresponding maximum limit in the relevant Appendix
- identify the potential fatigue hazards and risks of exceeding the corresponding maximum limit in the relevant Appendix
- implement specific mitigation strategies to manage these hazards and risks
- monitor the outcomes of the mitigation (through data collection) to ensure the mitigations are effective in managing the risks.

Similarly, the operator is required to specifically:

- identify every minimum limit proposed that is less than the corresponding minimum limit in the relevant Appendix
- identify the potential fatigue hazards and risks of this reduction from the corresponding minimum limit in the relevant Appendix
- implement specific mitigation strategies to manage these hazards and risks
- monitor the outcomes of the mitigation (through data collection) to ensure the mitigations are effective in managing the risks.

In identifying the values of the various maximum and minimum limits, the operator must determine and stipulate the relevant limits with respect to the following matters where these are applicable to their operation:

- flight times, FDPs and duty periods
- ODPs (at home base and away)

- sleep opportunities
- duty periods which infringe on a window of circadian low
- displacement time
- acclimatisation
- number of sectors
- augmented/unaugmented crew numbers (and complement)
- the class(es) of crew rest facility
- inflight rest opportunities
- delayed reporting time
- reassignment and extensions
- standby and positioning
- split duties and split duty rest periods
- cumulative flight and cumulative duty time
- training – in aircraft and in simulators.

The applicant will need to provide the CASA assessor(s) with relevant evidence to demonstrate the appropriate deployment of the FRMS processes and systems to establishing all limits in the form of a FRMS safety case to justify each of the divergence.

In reviewing the proposed limits in the FRMS, the CASA assessor(s) will consult the relevant Appendices 1-6 in CAO 48.1 based on the type of operation and use the limits detailed in that Appendix as benchmark limits. Applicants need to be cognisant that the limits in the Appendices 1-6 represent the maximums and minimums as determined by CASA and industry following extensive consultation.

Any divergence from the limits in the Appendices being sought in an FRMS application requires support with demonstrable evidence of fatigue risk mitigation. The supporting evidence provided must be relevant to the divergence between the limits as in the relevant Appendix and the limits under the proposed FRMS.

CASA must be satisfied that the proposed limits do not introduce fatigue risks that are not adequately mitigated. The greater the extent of divergence from the limits in the relevant Appendix, the more substantive and compelling the evidence will need to be.

As noted elsewhere, operators may apply for an FRMS for reasons other than altering the maximum or minimum limits. In such circumstances where an applicant is operating to an FRMS with limits that are within the maximum and minimum limits of the relevant appendix, the burden of substantiation with respect to the limits is effectively removed, and the applicant can focus on providing evidence that relates to the actual divergence from the rules.

The obligation rests with the applicant to provide evidence to satisfy CASA that any proposed divergences from the maximum and minimum limits of the relevant appendix do not result in fatigue risk that cannot be safely mitigated.

The CASA assessor(s) will consider the safety case advanced by the operator for the divergence from each of these limits and evaluate whether the proposed mitigations adequately resolve any elevated fatigue risk that may result from the divergences.

Should data from the FRMS indicate that the maximum and minimum limits are too high or too low (respectively), the applicant should adjust their mitigation strategy (which may be done by amending the FRMS limits) to ensure that these limits are within an acceptable level of safety.

As an example, an operator may find that flight duty periods that appeared appropriate and reasonable during the benign winter weather in a tropical operation are the subject of multiple fatigue reports during the summer when flown in challenging weather. On review, the only mitigation found to effectively reduce the fatigue levels was a reduction in the FDP during summer. In this example, the FRMS was able to track and respond meaningfully to variations in fatigue levels arising during operations.

The FRMS Manual must detail the operating procedures describing this process which should include examples of potential thresholds, alerts or indicators that would trigger the re- evaluation of the suitability of the limit. The establishment of meaningful SPIs will assist the applicant with the process of continually assessing the suitability of the limits.

3.5.10 Hazard identification, risk assessment and mitigation procedures

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, clause 4.

The FRMS Manual must include FRMS hazard identification, risk assessment and risk mitigation procedures.

The hazard and risk activities required as part of an FRMS follow internationally accepted risk management processes with an ongoing cycle of hazard identification, analysis, risk assessment, evaluation, treatment/mitigation and monitoring (refer to Figure 1 below).

Figure 1 Sample hazard identification/risk assessment cycle

While the processes are described in more detail below, to achieve the outcomes, the operator should have procedures to ensure that:

- all fatigue hazards are identified
- the risks associated with each hazard are identified and classified
- appropriate remedial action/mitigation strategies are implemented to reduce the level of risk to as low as reasonably practicable (ALARP)
- all levels of residual or remnant risk (however named) that fall into the tolerable range are formally accepted by designated level of management
- any residual or remnant risk that remains after mitigation is subject to further mitigation as part of the ongoing risk management and continuous improvement processes
- formal records of all hazard identification and risk management processes are maintained
- risk management processes involve relevant SMEs and stakeholders
- all persons involved in any risk management processes have successfully completed the relevant training to enable this activity to be appropriately conducted.

3.5.11 Hazard identification

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclause 4.1 - 4.4.

The operator's hazard identification procedures must include predictive, proactive and reactive processes. The operator must develop and maintain these processes for fatigue hazard identification, risk assessment and mitigation.

As can be seen from Figure 2 below, there is some degree of overlap among the processes. This is particularly seen in the data that may be used for predictive and proactive hazard identification processes.

The operator will need to identify their fatigue hazards using these methods to ensure availability of the various kinds of information and data needed by an FRMS to continuously monitor the levels of fatigue risk. This information helps to enable data-driven decisions based on scientifically valid principles and measurements.

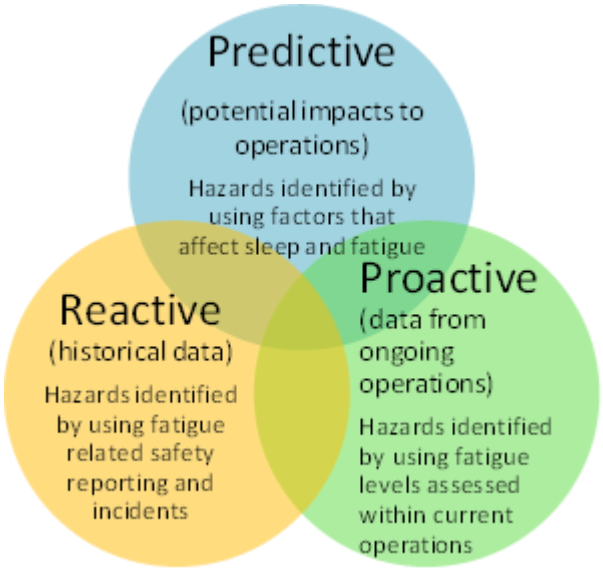

Figure 2 Summary of predictive, proactive & reactive hazards

The types of data that can be monitored within the three forms of hazard identification are summarised in Figure 3 below.

The following sections describe each of these types of data.

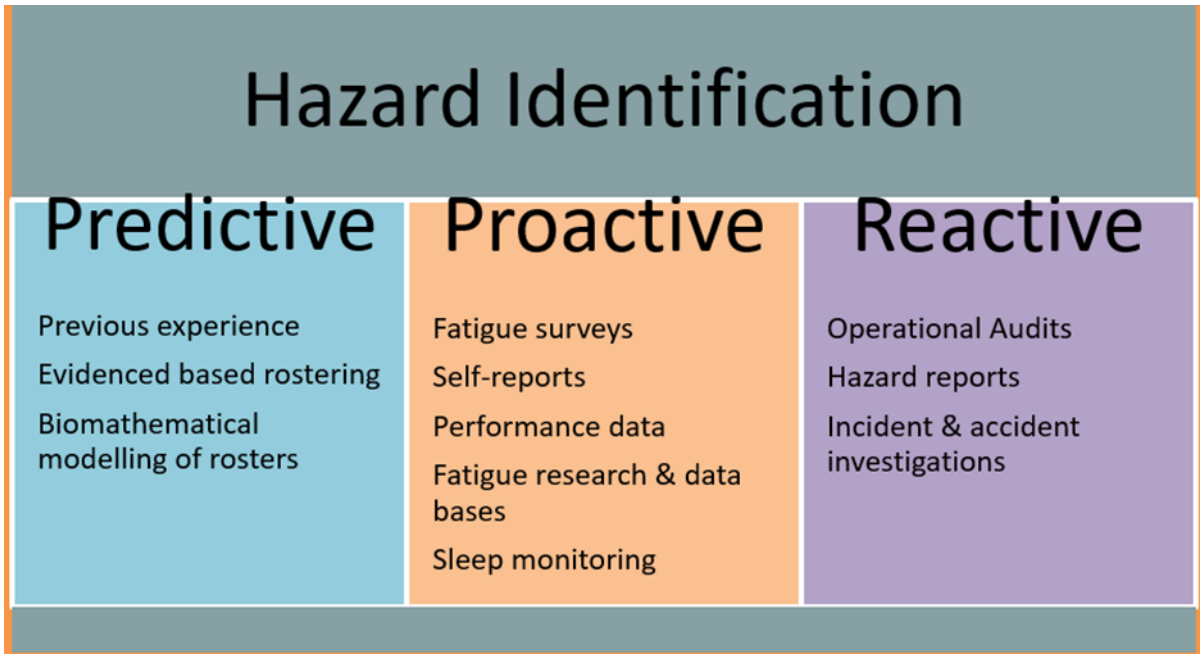

Figure 3 Predictive, proactive & reactive hazard identification

3.5.11.1 Predictive processes

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclauses 4.1(a) and 4.2(a) – (c).

The operator's hazard identification procedures must include predictive processes. Predictive processes are designed to identify likely fatigue hazards before they occur in a similar fashion to trend analysis within a SMS, which evaluates an organisation's existing safety data to predict potential hazards. Outlined below are

the three possible methods of data or information collection and analysis which could inform the development of predictive fatigue hazard identification processes.

Previous experience

The collective experience of managers, schedulers, and FCMs is an important source of information for identifying fatigue hazards relating to scheduling. Some examples include:

- FCM input from their experience of particular types of operation
- review of safety reports citing fatigue from existing operations
- review of reports and crew fatigue reports on similar routes.

In sum, organisational experience in safety or fatigue management may allow for development of safety cases, trend identification, and assessment of 'hypothetical' or 'what-if scenario' analysis to predict potential fatigue hazards associated with proposed operations

Evidence-based scheduling practices

Fatigue hazards relating to scheduling can also be predicted when fatigue science is applied while building schedules. Some examples and considerations include:

- Appropriate consideration is given to the impact of time awake, circadian rhythms, sleep loss and recovery on FCM performance during planned FDPs.
- Appropriate consideration is given to the impact of environmental stressors and workload on FCM performance during planned FDPs.
- Appropriate consideration is given to the choice of accommodation to facilitate appropriate sleep quality and duration to be achieved.

Using known scientific facts, schedulers can assume the fatigue risk of operations that contain similar factors (i.e. length of FDP, WOCL infringement) within their scheduling pattern and consider appropriate counter measures (i.e. limiting consecutive WOCL FDPs, increasing ODP).

Biomathematical Modelling

Biomathematical models (BMM), made available mostly as computer software, provide predictions of the level of fatigue associated with certain schedules. While not mandatory, BMMs for fatigue can incorporate aspects of fatigue science into rostering practices by providing predictions of potential fatigue risk levels, performance levels, and/or optimum sleep times/opportunities. Fatigue BMMs have limitations that must be considered, including:

- predicting risk probabilities for a population average rather than fatigue levels of a specific individual
- not accounting for the impact of workload or personal and work-related stressors that may affect fatigue levels
- possible misrepresentation of the predicted fatigue risk, when using expected versus actual sleep data
- models do not currently consider the influence of all components of environmental stress or workload on predicted alertness
- some models do not generate fatigue estimates for trans meridian travel.

It is essential that all staff working within the FRMS have a general understanding of the limitations of the fatigue predictions generated by the BMM engaged by their organisation. Staff who are responsible for inputting data into the model and generating/interpreting the fatigue predictions need to have undertaken specific training that should address the following:

- how to accurately collect and analyse fatigue related data
- the use of appropriate default and/or adjusted parameter settings and procedures for the input of data into the BMM
- how using predicted vs. actual sleep data can influence the BMM predictions of fatigue within an FDP
- how to interpret the BMM fatigue risk outputs
- the limitations of the predictions of fatigue within the scheduled operations.

To assist with understanding the various BMMs available to organisations, CASA has published a paper Biomathematical fatigue models guidance and a recent update that compares attributes and limitations of various fatigue modelling tools. CASA does not endorse any fatigue modelling tool BMM, and operators need to be mindful to select a BMM suited to the potential fatigue risks of their operation.

> **Note:** The output of the biomathematical modelling tool is not used for 'go/no go' decision making. Any score derived from a BMM does not 'mean' a schedule is free from fatigue or that fatigue mitigations would not benefit FCM performance.

3.5.11.2 Proactive processes

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclause 4.3.

The operator's hazard identification procedures must include proactive processes. Proactive processes are designed to identify fatigue hazards by measuring fatigue levels in current operations. Data could be collected from a variety of sources including subjective and objective measures of alertness, performance and sleep. Continuous collection and analysis of data identifies specific aspects of work schedules or other factors that may contribute to fatigue over specific time periods or due to changes in operational environments. The quality of the data will reflect the maturity of the culture, the familiarity with surveys, and past feedback from participation.

Data should only be collected from FCMs who have volunteered to participate. FCMs should not be coerced into participation through financial or other means. The willingness of FCMs to participate may be contingent upon their experiences in previous survey activities and their trust in the processes.

The collected data should be stored by AOC holders in an individual's personal file (electronic or hard copy). Where third parties are used to collect data, or recording devices are used, the data is also stored on electronic files pertaining to that individual FCM. Both AOC holders and those third parties must observe the requirements of the Privacy Act 1988.

Outlined below are possible methods of data or information collection and analysis which could inform the development of proactive fatigue hazard identification processes. A culture or training regime that has promoted underlying causes of fatigue (root cause) would help the understanding and identifying potential threats:

- fatigue surveys
- self-reports
- relevant human performance data
- safety databases and scientific studies
- sleep monitoring.

Fatigue surveys

Surveys are an effective method for collecting a large quantity of information regarding operational fatigue risk. They are often used to identify not only the duties that FCMs find the most fatiguing, but also specific scheduling elements associated with increased fatigue, or other operational variables that may be contributing to fatigue. Where possible, surveys should also collect information regarding general health, wellbeing, recent sleep and duty history.

Surveys can be administered as a paper and pencil questionnaire, a web-based survey, or via a mobile device. Surveys can also be collected retrospectively or prospectively.

Retrospective surveys ask FCMs to recall their fatigue levels and the contributors to fatigue over a specific time period. These surveys are often web-based and can be relatively detailed, so they are usually completed annually or biannually.

Prospective surveys ask FCMs to monitor and record their current alertness, fatigue levels and sleep time. These are typically short and completed multiple times across a duty period or roster.

An example of a retrospective fatigue survey is presented in Appendix E.

Self-reports

A fatigue report form, either paper-based or electronic, should include information on:

- recent sleep
- duty history (the minimum should be the last three days)
- time of day of the fatigue-related event
- measurement of different aspects of fatigue-related impairment (example alertness or sleepiness scales).

The report should also provide space for written commentary so that the person reporting can explain the context of the event and give their view of why it happened. An example of a fatigue occurrence report form can be found in Appendix D.

Fatigue reports should be analysed regularly by the FSAG, and feedback provided as appropriate to individuals and groups about any actions taken, or why no action was considered necessary. A series of fatigue reports on a particular route, or series of shifts, should trigger further investigation by the FSAG.

Relevant human performance data

Performance measurements provide objective data that can be used to compliment the subjective fatigue data collected in fatigue reports and surveys. Currently, there are three main approaches to monitoring performance which include:

- tests of cognitive performance and alertness
- automated data collection
- observational reports.

Tests of cognitive performance and alertness

There are several alertness tools that could be used to measure a range of performance metrics, for example: reaction time, vigilance and short-term memory. Things to consider when choosing a performance test for measuring an individual's fatigue include:

- the length of the test and whether it can be easily performed during an FDP
- whether the test been shown to be sensitive to the effects of sleep loss under laboratory conditions
- whether the test is predictive of more complex tasks e.g. performance in a simulator
- whether it has been used in other similar aviation operations, and whether the data are available to compare fatigue levels between operations.

Automated data collection

There is now considerable interest in finding ways to link individual fatigue levels to data collected systematically through an automated system, such as flight data analysis (FDA). Such data has the advantages that it is routinely collected; it does not interrupt the normal flow of work; and it is relevant to operational safety. The difficulty is that a multitude of factors contribute to deviations from planned parameters. Therefore, linking consequences of the deviations to fatigue is difficult and requires further research.

Observational reports

Trained observers can be used to rate the performance of operational personnel undertaking their duties (e.g. Line-Oriented Safety Audit (LOSA) for pilots). However, this can be labour- intensive and expensive. Having the observer present may also have an alerting effect and place additional demands on the individual. These factors currently limit the usefulness of this approach for proactive fatigue hazard identification in an FRMS.

Safety databases and scientific studies

Additional information about fatigue hazards may be available from external safety databases, such as reports generated by the Australian Transport Safety Bureau. Analyses of safety event databases complement direct measurement of fatigue levels in the operations covered by the FRMS.

Operationally based fatigue research is expanding. These types of studies may have value to an FRMS due to their applied scientific approach.

Operators should ensure they have processes to review and learn from these sources.

Sleep monitoring

The simplest method of monitoring sleep is to have FCMs complete a daily sleep diary before, during, and after the pattern of work or part of the roster being studied. FCMs are typically asked to record sleep time and quality. This can be done using a paper diary or electronic devices.

Sleep and wake behaviours can be measured more objectively via the use of actigraphy devices. These devices are generally worn continuously on the wrist and detect sleep time and quality based on body movements and/or physiological measures. The accuracy of the sleep prediction can vary depending on the device type and software platform.

Further information on sleep monitoring can be found in Appendix G of the CAAP and on the CASA fatigue website.

3.5.11.3 Reactive processes

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclauses 4.4.

The operator's hazard identification procedures must include reactive processes. FRMS reactive processes are designed to identify the contribution of FCM fatigue to safety reports and events that have occurred. The aim is to identify how fatigue could have been mitigated and to reduce the likelihood of similar occurrences in the future.

The reactive hazard identification processes are closely aligned with the fatigue investigation processes (refer to the Fatigue Investigation section). The findings of any fatigue investigation should be recorded as part of the FRMS documentation.

Some potential triggers for the reactive process include:

- operational audits
- fatigue/safety reports
- incidents and accidents.

In analysing whether a flight crew member was in a fatigued state, the operator should consider as part of the fatigue report:

- how much sleep FCM needs to feel fully rested
- how much sleep the FCM achieved in the previous 24 hours
- how much sleep the FCM achieved in the previous 72 hours
- how long the FCM had been awake at the time of the event
- the position in the circadian cycle of the FCM at the time of the event
- the FCM's workload at the time of the event
- the FCM's physical and mental health, medication, nutrition, physical exertion, and environmental stress.

3.5.11.4 Fatigue investigation

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclause 4.4.

Operators should develop a fatigue investigation process to identify causal and contributing factors to fatigue related incidents. The outcomes of this process may contribute to the reactive hazard identification processes. An appropriate investigation process ensures:

- All fatigue events/incident reports and any other reports in which fatigue may be identified are formally reviewed, based on predetermined thresholds. The thresholds should be determined through the risk assessment process to enable identification of fatigue events/incidents for investigation along with the level of the investigation.
- The fatigue incident reporting and investigation process is clearly documented, and the investigation is conducted with appropriately trained individuals. The reporting and investigation process should include:
  - a standardised fatigue report form. An example of a fatigue report form from ICAO is included at Appendix D. Any report and subsequent investigation should consider the factors noted on this form, and as identified in the section outlining Reactive Hazard Identification
  - specialist assistance when required, e.g. a subject matter expert in flight data analysis, may be required to assist with an investigation which involves consideration of traces depicting a FDAP event
  - a timeframe for the completion of the investigation and the provision of the report to the FSAG (if present)
  - formal review of the investigation report and recording of all action items and decisions made in relation to the investigation report
  - staff awareness of their responsibilities for assisting with the investigation and providing any records, documents or information
  - reinforcing the principles of open and fair culture in evaluating any findings or recommendations
  - a focus that is directed to understanding the contributing factors that led to the reported fatigue and whether the reported fatigue is indicative of a unique set of circumstances or a systemic issue.
- All causal and contributing factors, findings and recommendations are presented in a format which facilitates formal analysis.

3.5.11.5 FRMS audits

The FRMS of an operation is not a static system. That is, once implemented there is an expectation with experience and evaluation the system will change over time. Accordingly, the fatigue risk management manual is a ‘living document’, undergoing continuous improvement and evolution as new hazards are identified, technology changes, knowledge increases, and new methods for measuring and mitigating fatigue become available. An annual process for auditing the document (through evaluation of essential components of the FRMS) will provide the pathway to changes or identifying areas at unacceptable levels of risk. Evaluation of the FRMS through subjective and objective data, FCM input, and comparisons with industry practices will foster the continuous improvement of the AOC (refer to section 4.6.1.2 for further information).

3.5.11.6 Fatigue risk assessment

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclauses 4.5 and 4.6.

The FRMS risk assessment procedures must ensure fatigue-related hazards are examined in relation to their context determining the probability, and the possible consequences of the hazards with the consideration of the effectiveness of existing controls. The procedures must ensure the organisation’s capability for determining the probability of events or circumstances leading to fatigue-related hazards, the potential severity of these hazards, and the mitigations required to resolve the safety risk.

The risk assessment process will be familiar to operators with an SMS. Operators who do not have an SMS may find developing FRMS risk assessment processes easier by completing formal risk assessment training and gaining operational experience.

The operator’s fatigue risk assessment procedures must ensure that the fatigue related hazards presented in the previous section are embedded within their procedures (refer to Appendix 7, section 4.6).

This examination must include considering the fatigue hazard in the relevant operational context with the existing procedures. The operator must determine the probability of the hazard arising, and the possible

consequences of the hazard in those circumstances. The operator must also examine the effectiveness of existing controls and procedures, and determine when the safety risks require mitigation (refer to Appendix 7 sections 4.5 and 4.6).

The operator must select appropriate mitigation strategies for each fatigue hazard, implement the mitigation strategies, and monitor the effectiveness of the implemented mitigations (refer to Appendix 7, section 4.7).

Figure 4 below displays an example of the decision-making steps that an organisation may take in the risk assessment process.

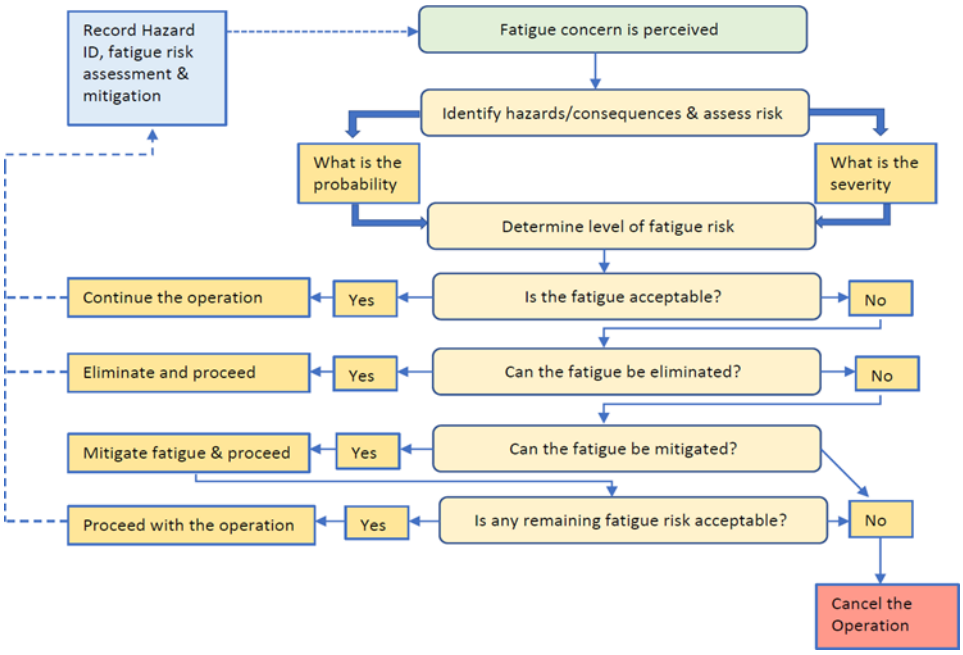

Figure 4 Sample risk assessment decision making steps

CASA acknowledges evaluating the risks associated with the hazard of fatigue can be challenging as many of the factors which contribute to the degree of impairment of an FMC are somewhat unpredictable. There is also considerable variability in the assessment and mitigation phases, as the level of risk that a fatigue hazard presents is dependent on the task and the context in which the task is being performed.

Despite these challenges, CASA considers the formal assessment of risk an essential component in the management of fatigue. Risk assessment is a scalable process that is individualised to an AOC's operational condition, but at a minimum an operator would require a risk matrix and associated records detailing the fatigue hazards and risk assessment processes which also record the:

- hazards identified
- operational context of the hazard/s
- risk levels associated with each hazard
- thresholds at which mitigation is required
- mitigation strategies/treatment measures employed
- management of remnant/residual risk
- names and roles or all persons involved in all aspects of the processes
- relevant dates for actions and reviews
- monitoring requirements.

Figure 5 below provides an example of a simple standard risk matrix that an organisation may use in the risk assessment process. Refer to Appendix F for an example of how the fatigue risk processes may be conducted.

Risk probablility		Risk severity				
		A	B	C	D	E
		Catastrophic	Hazardous	Moderate	Minor	Negligible
5	Frequent	5A	5B	5C	5D	5E
4	Occasional	4A	4B	4C	4D	4E
3	Remote	3A	3B	3C	3D	3E
2	Improbable	2A	2B	2C	2D	2E
1	Extremely improbable	1A	1B	1C	1D	1E

Figure 5 Sample risk matrix

International standards of risk management require the operator not to continue with an operation in which the level of risk is at an 'intolerable' level – CASA's expectation is no different. The designation of what constitutes 'intolerable' level of risk should be set out in the safety risk management sections of the operator's FRMS documentation.

3.5.11.7 Risk mitigation procedures

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclause 4.7.

Irrespective of the method by which a risk has been identified, the FRMS must document the processes by which the hazards and risks are mitigated. As part of this, the FRMS must contain procedures to ensure the identification, implementation and monitoring of the effectiveness of appropriate mitigation strategies.

Risk mitigation should attempt to eliminate the risk, or focus on introducing controls to reduce the potential for fatigue.

Given the need to select effective and appropriate mitigations, the decisions about fatigue risk mitigations should be made by the FSAG or safety committee, as such a body will have the appropriately skilled, trained and experienced staff to make such decisions.

The FSAG/safety committee may determine that the fatigue risk of a particular operation is ALARP, and that no further mitigation is required. In such circumstances, the record and rationale for this decision will become part of the FRMS documentation.

Whether risk mitigation is taken or not, the FSAG will need to monitor the operation to determine whether fatigue risks are tolerable. A core determinant of the FSAG's consideration is whether the relevant safety performance indicators have reached their pre-defined acceptable values or targets.

If the risk level for a fatigue hazard does not reach the 'acceptable' or 'tolerable' level, it will be necessary to re-visit the FRMS processes which may require gathering of additional information and data, re-evaluation of the safety risks associated with the hazard, and/or implementing and evaluating new controls and mitigations.

As with other risk control activity, the process is cyclical in nature with continuous monitoring and evaluation to ensure the ongoing efficacy of the mitigations deployed.

Appendix F provides an example of a fictitious fatigue risk assessment process. The example may prove helpful as a starting point for smaller less complex organisations that have limited familiarity with formal risk assessment processes.

3.6 FRMS safety assurance processes

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, clause 5.

As with the hazard identification processes, there may be overlap between various safety assurance processes and activities. In summary, the safety assurance procedures for the FRMS must:

- provide for continuous FRMS performance monitoring, analysis of trends, and measurement to evaluate/measure the effectiveness of the fatigue safety risk controls
- identify the impact of changes in the operational environment and within the AOC and determine which, if any, amendments or changes must be made to the FRMS to ensure the FRMS continues to perform effectively
- provide for continuous improvement of the FRMS itself by removal or modification of controls which are no longer relevant or required; routine evaluation of facilities, equipment, documentation and procedures; and identification of emerging risks resulting in the introduction of new procedures for risk mitigation.

The information below should be considered in conjunction with the relevant information relating to continuous improvement and management of change.

3.6.1 FRMS performance monitoring analysis and measurement

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, clause 5.1(a)-(c).

The FRMS Manual must include the safety assurance procedures to provide continuous monitoring of the performance of FRMS; analysis of fatigue-related trends; and measurements to evaluate the effectiveness of mitigation strategies.

Due to the interconnected nature of the monitoring, analysis and measurement processes, an applicant should develop and document procedures for the following FRMS safety assurance activities to address these requirements:

- safety performance Indicators (SPIs)
- a reporting and investigation system
- an audit program
- fatigue surveys
- the use of fatigue studies.

Each of these topics is covered in more detail below. While the FRMS must also include safety assurance processes related to the management of change, to avoid repetition, these matters have been included in section 4.6.2 ‘Management of Change’.

Applicants should note no approval is needed to commence monitoring, analysis and measurement with respect to fatigue in current operations. The collection and analysis of information on the current operations may provide the operator an overview of the effectiveness of the fatigue risk in the existing operation, and the effectiveness of the controls being applied. This information may then assist the operator in the subsequent development of the FRMS.

3.6.1.1 Safety performance indicators (SPIs)

FRMS safety performance indicators (SPIs) are a fundamental tool in the processes of continual monitoring, especially with respect to the effectiveness of the fatigue-related risk controls and mitigation strategies employed by the AOC holder. The operator will need to develop and set acceptable levels for SPIs specific to its operation.

SPIs should be developed to measure a range of key FRMS activities and be appropriate for measuring the effectiveness of the FRMS and the level of fatigue safety risk in operations.

SPIs are developed from risk management and monitoring in an effort to maintain continuous improvement of the system.

The operator should:

- develop and document SPIs to assess the functionality of the FRMS and the associated processes
- provide acceptable reasons to justify their selection of SPIs
- establish the basis on which they selected the thresholds for SPIs. SPIs can include:
- schedule-related indicators – dependent on the type of operation conducted
- targeted proactive/reactive fatigue indicators
- specific measures or tolerances which must be achieved to demonstrate the associated risks within an acceptable range
- identified critical SPI measures and/or tolerances which, if reached, require notification be sent to CASA
- a clear understanding of which personnel are responsible for monitoring risk and when they are to report if the risk is not being effectively managed within pre-determined parameters.

Note: It is not possible for CASA to document a set of SPIs to cover every type of operation. For example, the values for the SPIs identified by a simple operation are not likely to be relevant indicators for a complex operation. Each operator will need to determine SPIs relevant to their operation.

Several regulatory bodies and aviation organisations, such as IATA, have produced guidance for developing SPIs. Combinations and extracts from this guidance have been documented in Appendix C to provide examples of range of operational and FRMS governance activities from meaningful SPIs may be developed. The following are samples from Appendix C:

1. SPIs specific to an FRMS may include measures obtained through the FRMS processes:
   a. number of exceeded maximum duty days in operations covered by the FRMS
   b. number of fatigue reports per month
   c. number of fatigue ‘call-offs’ by FCMs for a specific pairing (or program of sectors)
2. Reports from operations contributing to the FRMS processes:
   a. attendance at non-compulsory FRMS training/information sessions
   b. results on FRMS training assessments
   c. FCM participation in fatigue-related data collection
   d. number of times fatigue is identified as an organisational factor contributing to an event.

Note: Investigation reports are included in records and reports to be retained by an operator under paragraphs 14.6 and 14.7 of CAO 48.1, and are to be made available to CASA upon request or during surveillance activity.

3.6.1.2 FRMS audit

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclauses 5.4(b).

CASA considers that continuous improvement within an FRMS is occurring when the operator conducts routine evaluations of facilities, equipment, documentation and procedures (i.e. an audit). It is highly recommended that audits be conducted annually or, should SPIs or risk assessment processes indicate, more frequently.

An FRMS audit will need to cover all relevant processes and outcomes impacting FCM fatigue. The program should include formal checklists relevant to the relevant areas. Ideally, the process should be conducted by persons or organisations external to FSAG.

The CASA assessor(s) will verify the internal audit processes:

- comprehensively cover all the FRMS elements
- include procedures to manage audit findings that include entry of findings into the relevant database; provision of the reports – to whom and in what time frame; and assigning of responsible persons to address findings.

3.6.1.3 Fatigue and FRMS surveys

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclauses 5.1(a) and (b) and 5.4.

For CASA to be satisfied the FRMS is subject to continuous monitoring and improvement, the operator should conduct fatigue surveys. Fatigue surveys have roles in the hazard identification processes, as well as in the safety assurance processes of the FRMS and can be conducted retrospectively and prospectively.

A sample sleep survey is available at Appendix E. More information is available about surveys in the section of proactive hazard identification.

Survey methods and purposes need to be tailored to meet the needs of the FRMS providing insights into the processes and mitigations that are employed. The potential to highlight areas of deficit within the system, should they exist, is the core of such activities.

Data and results of analysis from these surveys is fed through the governance framework via the FSAG to assist with tracking the performance of the FRMS and identifying areas of improvement.

3.6.1.4 Fatigue science

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclause 5.4.

A positive safety culture applied to the causes of fatigue and operational impact on reduced alertness embodies the concept of continuous improvement. That is, the body of knowledge in fatigue science is continually growing, as well as the organisation's understanding of the impact of fatigue within their operations. Over time, the advances in aircraft capability and technological development in fatigue monitoring will result in some mitigations becoming redundant, or found to be less effective in controlling fatigue risks.

CASA believes that an FRMS demonstrates continuous improvement, through the organisation's continued use of developments in fatigue science, current fatigue management tools or processes, and applying these changes to operational knowledge and processes.

When such changes are applied, the FRMS version should highlight the rationale for modification or elimination of mitigation strategies.

These processes should include, where possible:

- the attendance of relevant stakeholders (e.g. the FRMS Manager) at relevant forums, workshops or other educational activities to remain current with developments in applied fatigue science
- relevant stakeholders (e.g. the FRMS Manager) reviewing publications related to fatigue science.

The operator's FRMS could also have provisions to commission an independent review of the FRMS to ensure that decisions and actions are consistent with current processes and practices informed by fatigue science.

3.6.2 Management of change

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclauses 5.2, 5.3 and 7.

The FRMS must include formal processes to identify changes in the operational environment and in the AOC's organisational structure that may affect the performance of the FRMS.

The processes must include how the organisation assesses any such changes to determine the impact of these changes on the performance of the FRMS, and consequently what amendment, change or modification must be made to the FRMS as a result.

The FRMS change management procedures must clearly document how the applicant will amend or modify any element of the FRMS.

There are possible operational and organisational factors that may change over time, affecting the performance of the FRMS. Examples of changes include, but are not limited to:

- changes to FDPs, FTLs, & ODPs
- changes to FCMs 'away' accommodation
- bringing new operations under the scope of the FRMS
- adjusting the FRMS training programmes
- a significant alteration to the workforce profile
- a change in the FRMS Manager
- the introduction of a new route, aircraft or BMM.

So that unmitigated fatigue risks are not introduced by these changes, the organisation must follow a formal management of change process, noting that, for 'significant changes', the written approval of CASA is required before the proposed change can be made (refer to the following section).

Prior to the introduction of any change that is not significant, the FRMS should ensure:

- hazard identification and risk management processes are implemented
- safety assurance processes are engaged during the implementation of the change to monitor and measure the impact of the change
- consideration is given to the available tools that could be used to maintain or improve FRMS performance prior to the introduction of any change.

The operator's FRMS will need to ensure that safety assurance processes address the implementation of the change to identify and mitigate any unexpected risks or hazards introduced by the change.

While CASA does not prescribe the management of change process to be followed under the FRMS, the organisation should ensure their processes are comprehensive, systematic and follow the well-established steps for formal management of change which include:

- identifying the nature, scope, and context of the change
- determining the case for and impact of the change
- communicating and consulting
- identifying the hazards, risk assessing these hazards and developing mitigations
- planning the change, identifying resources, responsibilities, milestones and timelines
- implementing the change
- monitoring and reviewing.

The CASA assessor(s) will verify the operator has established processes to identify and manage changes to their operations which may affect the FRMS.

3.6.2.1 Significant changes

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclauses 7.1, 7.2, 7.5 and 7.6.

The following areas require the application of change management procedures in accordance with clause 7 of Appendix 7 of CAO 48.1 as the changes are 'significant changes.'

- any increase in the maximum flight times, flight duty periods and duty periods
- any decrease in the minimum off duty periods
- any other change to any element of the FRMS that does not maintain or improve, or is not likely to maintain or improve, aviation safety.

In determining whether a change to any element of the FRMS does not (or is not likely to) maintain or improve aviation safety, the FRMS procedures will need to clearly demonstrate how the operator made this determination. For example, a change that superficially appears minor – for example, a change to thresholds

or data parameters in a BMM – may in fact be a ‘significant change’ if the change is not likely to maintain the current level of safety.

In view of the variability of the impacts across an extensive range of changes, it is not possible for CASA to produce a comprehensive list of what is or is not a ‘significant change.’

The operator must apply to CASA for approval of a significant change, and the operator must not make a significant change without the approval of CASA. Approval of a proposed significant change occurs when CASA concurs that the proposed significant change has mitigated any associated fatigue risk and does not introduce any unintended fatigue risk. To achieve this outcome, the applicant will need to support their application with a safety case, or similar with appropriate evidence.

As such, the operator will need to document procedures in the FRMS Manual which set out:

- what constitutes a significant change (in accordance with the CAO and with respect to the operation)
- the formal process to evaluate the proposed changes to determine whether the change is significant
- how the operator identifies what type of safety case with what level of supporting evidence may be needed to support the significant change application
- how the operator will apply to CASA with the intention to make the significant change
- what the operator will provide to CASA in support of their application
- how the operator will introduce the significant change following the formal approval of the change by CASA.

3.6.2.2 Changes not defined as ‘significant change’

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclauses 7.1, 7.2 and 7.7.

Further to the processes above, the operator will need to formally manage changes that are not defined as ‘significant changes’, as these changes may have the potential to impact on the operational alertness of FCMs. The operator must have processes to ensure the changes are not ‘significant changes’ (i.e. if the change does not maintain or improve, or was not likely to maintain or improve, aviation safety).

The change management procedures should ensure the primary involvement of the functional group that is responsible for coordinating the fatigue management activities within the organisation (the FSAG) as the primary stakeholder.

The operator’s management of change procedures should include assessing the cumulative impact of a number of changes which, when taken in isolation, are deemed not to be significant. This is to ensure that the combined effect of the changes does not result in a ‘significant change’.

The operators procedures must include that, for a change that is not significant, the operator must notify CASA in writing of the change in accordance with the time frame specified in the exposition or the approved SMS, or within seven days (if the operator has neither an exposition nor an approved SMS).

3.6.2.3 Changes directed by CASA

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclause 7.4.

CASA may, in writing, direct an AOC holder to amend, change or modify the FRMS, including the practices and documents, and the AOC holder must comply. This power is effectively an emergency power for safety purposes only.

Accordingly, the change management procedures must make provision for how such a change will be managed. The procedures must include how the organisation will comply to make a directed change within the time specified by CASA in the direction.

3.7 FRMS promotion process

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclause 6.

To support and continuously improve all elements of the FRMS, the FRMS safety promotional processes must include:

- training programs to ensure competency commensurate with the roles and responsibilities of management, crew and all other involved personnel in the FRMS
- an effective communication plan that explains FRMS policies, procedures and responsibilities to all relevant stakeholders, and which describes communication channels used to gather and disseminate FRMS-related information.

3.7.1 FRMS training

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclauses 1.2(e) and 6.2(a).

All personnel involved in the FRMS must have appropriate training to establish their competence for their roles and responsibilities under the FRMS. The personnel involved in the FRMS must be identified by the operator, and these will include, but may not be limited to:

- FCMs
- personnel involved in crew scheduling or biomathematical modelling
- operational decision-makers
- all members of the FSAG
- personnel involved in hazard identification, operational risk assessment and resource allocation
- senior management, in particular the CEO accountable for the FRMS
- senior leadership in any department managing operations within the FRMS.

The training required to establish competence will vary according to the role of the individual as discussed below.

Note that, in accordance with CAO 48.1, Appendix 7, subclause 1.2(e), CASA must approve the safety promotion procedures for the trial and, as such, all safety training procedures for all work groups must be documented and verifiable at this stage.

3.7.1.1 Overall requirements and standards

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclauses 1.2(e) and 6.2(a).

The operator must establish an FRMS training program to ensure all individuals associated with the FRMS are appropriately trained for their roles.

This should include:

- identifying training requirements relevant to the roles performed through a formal training needs analysis (TNA) or similar
- establishing and documenting standards for initial and recurrent training for all personnel (crew and non-crew)
- determining whether and under what circumstances the recognition of prior learning is appropriate
- ensuring initial training is delivered on commencement with crew trained prior to commencing any operational duty, and with non-crew trained prior to any FRMS related decision making or activity
- developing a training program with a formal assessment process to evaluate staff competency. This will need to include retraining and subsequent assessment requirements in the event of a trainee being deemed not competent.
- scheduling recurrent training by identifying the specific intervals between the last training received and the next training to be delivered. For at least the first three years after the FRMS approval, consistent with the standards identified by ICAO, CASA highly recommends that fatigue training delivered annually (either as standalone, or as part of the SMS or HF/NTS programs) would be appropriate. The frequency may be reduced (e.g. biennially) provided CASA can be satisfied the training has been highly effective.
- adopting an appropriate training method that allows and confirms the transfer of knowledge and assessment of competence

- FRMS Instructors should have:
  - appropriate knowledge of fatigue science relevant to the scope of operations
  - comprehensive knowledge of the workings of the operator's FRMS
  - a formal training qualification demonstrating the ability to develop and deliver training, and design and conduct competence assessments.

The competence of all persons with responsibilities under the FRMS must be assessed to ensure they are competent to appropriately perform their roles and responsibilities.

The assessment must be against a designated standard consistent with the level of training provided. One goal of assessment is to determine to what extent the trainees have learnt the material. Different phases of training (awareness, knowledge and skills) will entail different forms of assessment. Operators should conduct the assessments across multiple domains (i.e. multiple choice, free text, and verbal responses) and, where necessary, include behavioural assessment to demonstrate that knowledge components have been integrated into professional fatigue management behaviours.

Recurrent training must be delivered and assessed so the operator can continuously be assured these persons remain competent to conduct their roles under the FRMS.

The training program will be subject to safety monitoring and assurance processes, including at least audit, tracking of relevant SPIs, and formal annual review to ensure the training achieved the required outcomes and remains relevant.

As there is an overlap between many areas within the FRMS and HF&NTS, the operator should consider incorporating the training required for the FRMS under the HF&NTS training and assessment program.

3.7.1.2 Curriculum: FCM

The level and sophistication of the training and assessment of FCMs must ensure they are competent to perform their roles under the FRMS. The syllabus for initial training for FCMs should include at least the following:

Fatigue Science Module (with at least the basic topics as described in the CAAP)

- fatigue
- sleep
- countermeasures.

FRMS Processes and Outcomes Module

- overview of the FRMS structure, how it works and who is involved
- FCM and operator responsibilities with respect to the FRMS including mandatory fatigue reporting
- requirements relating to fitness for duty and removal from duty due to fatigue
- the roles of FCMs in FRMS processes particularly the fatigue reporting system, the importance of participation in surveys, and implementing mitigations
- the value of accurate fatigue data – both subjective and objective
- identification of the specific fatigue hazards of the operations, and how the risk management processes establish the limits and other required mitigations
- participation in any internal FRMS sub-committees e.g. pairing/roster review
- FRMS publications and information availability.

FCMs may be required to make critical operational decisions based in part on the knowledge acquired in training. As such, the operator needs to be able to demonstrate that crew comprehend the information provided and can competently apply this in an operational context. To achieve this, the operator will need to establish a minimum standard for assessing an FCM as competent. The operator will also need a documented process to deal with retraining and reassessment should the FCM be assessed as not yet competent.

Recurrent training must be delivered and assessed so the operator can continuously be assured FCMs remain competent for their roles under the FRMS. The syllabus for recurrent training for crew should include at least:

- an updated version of Fatigue Science from initial training (condensed if appropriate)
- an updated version of FRMS Processes and Outcomes from initial training (condensed if appropriate)
- new or changed fatigue risks identified in the operation, and the new mitigations introduced as a result
- recent fatigue reports, events and incidents, and the lessons learnt.

3.7.1.3 Curriculum: crew schedulers

The training program ensures that training is provided to crew schedulers, rostering staff, staff in the operations control centre, staff involved with using the BMM and so on, prior to any FRMS related activities by these staff. The training should include:

- Fatigue Science Module as per crew initial training
- FRMS Processes and Outcomes Module from crew initial training
- how scheduling affects sleep opportunities and can disrupt the biological clock, the fatigue risk that this creates, and how it can be mitigated through appropriate scheduling
- the use and limitations of any rostering, scheduling tools or BMMs
- the role of crew schedulers, rostering staff etc in the FRMS with respect to fatigue hazard identification, risk assessment and reporting
- processes and procedures for assessing the potential fatigue impact of planned scheduling changes
- processes and procedures for implementing scheduling changes recommended by the FSAG
- processes and procedures for removal of crew from duty due to reported fatigue.

3.7.1.4 Curriculum: FRMS Manager and FSAG

Training is provided prior to any FRMS related decision making and includes:

- enhanced Fatigue Science Module
- enhanced FRMS processes and outcomes Module
- the responsibilities and accountabilities of different stakeholders in the FRMS
- functioning of the FSAG including fatigue risk management, management of change and safety assurance processes
- links between the FSAG and the SMS, and other relevant parts of the organisation; for example, the scheduling department, flight operations, medical department etc.
- regulatory requirements for the FRMS
- the use and limitations of any rostering, scheduling tools or BMMs
- understanding the application of an open and fair reporting culture and its principles
- processes and procedures for removal of crew from duty due to reported fatigue.

The FRMS Manager and FSAG are responsible for development of the FRMS training program and so may also acquire fatigue and FRMS knowledge outside of the organisation. As the persons holding these roles must be appropriately qualified, experienced and trained to perform their responsibilities, the training program should also address the potential for appointment to a role in circumstances where there may be minor deficiencies in training, with a professional development plan to resolved these in a specified timeframe.

3.7.1.5 Curriculum: Senior management

The training provided to senior management, including the CEO, should include:

- an overall understanding of flight crew member fatigue, and the safety risk this may represent to the organisation
- an overview of the FRMS and how it works, including the concepts of shared responsibility, an effective reporting culture, and the role of the FSAG
- the responsibilities and accountabilities of the stakeholders in the FRMS
- an overview of the types of fatigue risk management and mitigation strategies used
- the use and limitations of any rostering, scheduling tools and BMM
- FRMS safety assurance processes and metrics used by the organisation
- understanding the application of open and fair reporting culture and its principles
- regulatory requirements for the FRMS.

3.7.2 FRMS communication

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix ,7 subclause 6.2(b).

The operator's communication programs must be capable of supporting and continuously improving all elements of the FRMS in the delivery of optimum safety level.

For the FRMS communication to be effective, it should not only explain all elements of the FRMS to management, FCMs, and all other relevant personnel, but also describe the communication channels that must be used to gather, disseminate and apply FRMS-related information.

The CASA assessor(s) will verify that the FRMS Communication are effective at communicating FRMS policies, procedures and responsibilities to all stakeholders, and that communication channels are effective at gathering and disseminating FRMS-related information.

CASA considers that, as a minimum, communications need to be responsive to fatigue data, operational changes, changes to fatigue mitigations, limits and FRMS procedures as well as training. To achieve this outcome, the FRMS Communication should address the following requirements:

- the confidential nature of communication from and by crew (reports, surveys etc.) and the data gleaned from such activity
- a policy detailing the ethical use of information and data from crew communications
- all fatigue reports are responded to ensuring the reporter has confirmation the report has been received
- all fatigue reports subject to any level of enquiry or investigation result in the generation of a further response to the reporter at the completion of the enquiry/investigation processes to summarise any relevant actions and/or findings
- the minutes of FSAG etc. are made available to all stakeholders via the intranet or by physical distribution (de-identification may need to be undertaken to ensure the confidentiality of reports, investigations etc.)
- accurate concise and timely FRMS publications (through paper pubs, e-pubs, SMS, social media etc.) about fatigue and the activities and safety performance of the FRMS are:
  - developed and disseminated to all stakeholders
  - endorsed by CEO
  - produced regularly to ensure fatigue issues are brought to the attention of stakeholders; CASA expects updates will be provided following FSAG meetings
  - appropriately focused to ensure fatigue messages are not obscured by other information
  - relevant with information about recent fatigue events, hazards and/or investigations to demonstrate the need for vigilance
  - method to assess the uptake/readership/effectiveness of the messages and messaging system

– appropriate to reinforce the concept of shared responsibility and the application of an open and fair reporting culture.

4 Trial FRMS implementation approval

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclauses 1.2, 1.4 and 10.3(c), and clause 8.

The trial FRMS implementation approval is conditional upon CASA being satisfied that:

- each element of the AOC holder's FRMS complies with and meets the requirements, attributes and characteristics of a FRMS as described in clauses 2 - 7 of Appendix 7 of CAO 48.1
- the FRMS is a safe, integrated, data-driven, system that appears to be reasonably capable of continuously and effectively monitoring and managing fatigue-related safety risks, using scientific principles and knowledge, and operational experience
- the FRMS will enable the AOC holder to assess the extent to which FCMs and other relevant personnel perform at levels of alertness sufficient to ensure the safety of operations.
- The FRMS can deliver:
  - the identified safety outcomes
  - the fatigue-risk data and reports and
  - continuous improvement in the delivery of safety outcomes.

If CASA is satisfied on these matters, the operator may be granted a trial approval for maximum duration of 24 months.

The assessment by CASA of the functionality of the FRMS is referenced above in this handbook. As noted above, apart from the FRMS Manual itself, the applicant must provide the CASA assessor(s) with reasonable access to relevant information and evidence to demonstrate the appropriate functionality of the FRMS processes and systems.

For CASA to be satisfied that the applicant's FRMS is developed to the extent that a trial approval may be appropriate, this evidence may include (but not be limited to) the following as appropriate to the operations:

- operational records including rosters as scheduled and rosters as flown; flight duty records; reports of extensions, diversions and the like
- governance records including agenda, Minutes and publications of the FSAG and associated bodies; subordinate documents associated with FRMS processes (e.g. procedures for rostering, work instructions for the use of BMMs)
- hazard identification, risk assessment and risk mitigation records
- information acquired from other operators; as well as scientific data analysis, studies, evaluations or reports used in the operators FRMS
- fatigue reports and documents associated with the enquiry and investigation of fatigue related incidents
- records of BMM processes, activities and outcomes
- monitoring records including FCM sleep diaries; inflight alertness evaluations; fatigue surveys; audit reports and records of the FRMS; SPI establishment and tracking records
- records of management of change activities
- safety promotion records, including operations notices, bulletins, newsletters etc.
- training records including TNAs, syllabuses, competency standards, assessment.

CASA acknowledges smaller operators with limited resources may not be able to produce the same evidence as other organisations. CASA understands that information will be produced in relation to size and complexity of the operation and level of potential fatigue risk.

4.1 The FRMS trial

4.1.1 FRMS trial – validation and verification

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclauses 1.2 and 1.5; and clauses 8 and 9.

After the approval for a trial FRMS implementation has been issued, the operator will need to have regular contact with CASA to ensure CASA remains fully informed as to the functionality of the FRMS, as this will be pivotal in deciding whether to issue a full FRMS approval.

The operator will need to provide evidence, as specified by CASA, to demonstrate the functionality of all aspect the FRMS, including that:

- the FRMS safety assurance procedures are used to review the FRMS SPIs against its agreed targets and can identify and undertake necessary actions
- the FSAG is identifying any new fatigue hazards, with the subsequent risk assessment and mitigations applied
- the safety assurance processes are monitoring the effectiveness of the mitigations and suitability of the outer limits of the FRMS
- all procedures are being correctly applied
- all training has been completed, and recurrent training is scheduled
- the operator's communication strategies are implemented, and there is evidence these ensure the continuous and effective communication of FRMS policies, procedures and responsibilities to all stakeholders
- the operator's communication channels, such as fatigue reporting mechanisms, ensure continuous and effective gathering and dissemination of FRMS-related safety information
- the operator's documentation and procedures have been kept up-to-date and represent the operating FRMS at any time during the trial.

The information CASA expects to be provided during the trial, in relation to the matters above, is the same type of information as was provided during the initial assessment phases.

To provide structure and consistency to the verification processes, CASA's expectations are that the operator will initially provide requested information at the 3, 6, 9 and 12 month points with the time-frame commencing from the date on which the trial FRMS approval was issued.

All information provided during trial must be recorded in CASA's systems, as this information is part of the evidence that CASA uses to make the decision as to whether it is satisfied or not. In accordance with government requirements relating to evidence-based decision-making, CASA is required to acquire and retain any information relevant to its decision-making processes.

The CASA assessor(s) may also conduct the verification process in part through:

- site visits to review the operation of systems and processes
- attendance at FSAGs etc.
- desktop reviews of sample data
- review of documentation
- interviews with personnel involved with FRMS.

Following the initial 12 months of the trial approval, the provision of information will be reviewed, and further advice will be provided to the operator.

CASA is aware that refinement of the operator's FRMS processes and procedures may occur during the trial.

For example, the initial FRMS SPIs developed and agreed on may be significantly amended as the efficacy of the SPIs is more accurately determined. By the end of the trial, all parties need to be confident in the effectiveness of the SPIs and targets. Similarly, the operator may identify that the combinations of certain

limits, in particular pairings or rosters, resulted in unanticipated fatigue profiles, and the operator needs to amend these limits to reduce the fatigue risk.

Such changes are part of the normal operation of an FRMS, and the operator should be confident to freely discuss these with CASA to demonstrate the FRMS is functioning as intended.

As the trial progresses, CASA will review the information provided by the operator and provide feedback, as necessary, to facilitate improved outcomes; however, any breach or non- compliance of approved FRMS Trial will be managed as outlined in CASA's Surveillance Manual.

Changes to the FRMS during the trial

It is anticipated the operator may need to make changes to the FRMS during the trial.

Further, as noted in section 4.6.2 item 3, after issuing the approval to conduct the FRMS Trial, CASA may give a written direction to amend, change or modify the FRMS within a specified period.

Any change to the FRMS made during the trial must be managed in accordance with the management of change processes discussed above.

4.1.2 Extending the trial period

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclause 8.2.

The rationale behind the length of the trial period is in part to enable capture of relevant data over all seasons and aspects of operation. Prior to the operator receiving trial FRMS implementation approval, the trial period will be determined and stated on the instrument.

CASA may, by issuing a new trial FRMS implementation approval, extend the duration of the initial trial approval. Any written application by the operator for an extension beyond the date stipulated in the instrument will be considered by CASA.

CASA may also elect extend the duration of the trial approval by issuing a new trial approval on its own initiative if CASA considers that aviation safety requires a longer trial FRMS implementation approval period before a full FRMS implementation approval.

4.1.3 Revocation or suspension of the FRMS trial approval

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, clause 10.

CASA may revoke or suspend a trial FRMS approval. The circumstances under which CASA may take such action are, in summary:

- the AOC holder does not comply with the requirements of CAO 48.1 for implementation or use of an FRMS, or
- CASA considers that continued implementation or use of the FRMS would adversely affect aviation safety, or
- the AOC holder refuses CASA reasonable access to any information or records produced under or for the FRMS which CASA requests in writing for the purpose of assessing the effectiveness and safety of the FRMS.

Furthermore, CASA may revoke an FRMS approval if CASA wishes to reissue the approval in a varied form.

While it is anticipated the circumstances leading to the revocation of a trial approval would be rare, operators should note that the trial approval is contingent upon CASA being satisfied in relation to a number of requirements.

To be satisfied, CASA requires access to information relating to the FRMS to assess the effectiveness of the FRMS. Should circumstances arise during a trial in which an operator does not provide CASA access to the requisite information and records, CASA may not be satisfied and, so, may commence processes to revoke or suspend the trial approval.

4.2 Assessment for full FRMS implementation approval

Civil Aviation Order 48.1 Instrument 2019 (as amended), Appendix 7, subclauses 1.2 and 1.5; and clause 9.

After the AOC holder has held a trial FRMS implementation approval for at least 12 consecutive months, the AOC holder may apply in writing to CASA for a full FRMS implementation approval.

The full FRMS implementation approval is, in part, conditional upon CASA being satisfied that:

- each element of the AOC holders FRMS complies with and meets the requirements, attributes and characteristics of an FRMS as described in clauses 2 - 7 of Appendix 7 of CAO 48.1
- the FRMS is a safe, integrated, data-driven, system that will continuously and effectively monitor and manage fatigue-related safety risks, using scientific principles and knowledge, and operational experience
- the FRMS will enable the AOC holder to ensure the FCMs and other relevant personnel perform at levels of alertness sufficient to ensure the safety of operations.

The AOC holder must satisfy CASA, by providing relevant data and reports, that the FRMS is capable of demonstrably delivering the safety outcomes expected when the trial approval was given and is capable of delivering continuous improvement in the safety outcomes.

After being on the trial approval for at least 12 months, the operator may request CASA to conduct the final assessment for the full FRMS approval implementation by providing evidence that the FRMS is delivering the required safety outcomes. The applicant will need to provide CASA sufficient time (at least three months) to review the evidence provided and issue the full approval.

On the completion of the assessment, the CASA assessor(s) will make a recommendation to the delegate to issue, or not, the full FRMS implementation approval. The recommendation will document both the outcomes of the assessment and the reasons for the recommendation.

The CASA assessor(s) must only recommend the issue of the full FRMS implementation approval if the operator has fully met all relevant requirements of CAO 48.1.

If the final recommendation is a refusal to issue the full FRMS approval, it is the responsibility of the CASA assessor(s) to inform the operator of the recommendation before the recommendation is submitted to the CASA delegate for action.

4.2.1 Full FRMS not approved by CASA

Should the full FRMS implementation not be approved, the operator must have an alternate mechanism by which they manage flight and duty times for flight crew members in any continued operations. To achieve this, the operator would need to have a system in place to be able to comply not only with CAO 48.1, but also one or more of Appendix 1 to 6 to permit the continuation of operations at the conclusion of the trial.

As per clause 9 of CAO 48.1, the operator may apply again to CASA for a trial FRMS implementation approval.

5 Reserved

Appendix A
FRMS manager assessment guidance

To satisfy CASA that the nominee for the role of FRMS Manager is competent with respect to their roles and responsibilities under the FRMS, the nominee may be required to participate in an interview and respond to questions on, but not limited to:

- the primary duties and responsibilities of the role
- the primary elements of an FRMS
- FRMS reporting lines and accountabilities
- other roles held, and time available for this role
- FRMS personnel resources
- the roles and responsibilities of any direct reports
- continuity during periods of absence from the role
- formal and informal training and experience with FRMS in an AOC
- the FRMS governance process, including the role and functions of the FSAG
- their role in ensuring commercial decisions do not introduce operational fatigue risk
- the identification of operational fatigue hazards, risks and mitigations
- determining the maximum and minimum limits
- actions taken when maximums are too high and minimums too low
- developing schedules and rosters
- the use, thresholds and limitations of any BMM
- managing fatigue risk on ‘day of operations’
- fatigue reporting, their role in the reporting process, and the factors affecting reporting
- skills experience and training in investigation
- how FRMS investigations are conducted, under what circumstances, and by who
- the FRMS audit program
- developing SPIs
- management of change, significant and non-significant changes
- developing FRMS training syllabuses
- assessing the effectiveness of FRMs training
- FRMS promotional activities and publications.

Appendix B
FSAG Terms of Reference – example

Terms of Reference for the Fatigue Safety Action Group – adapted from ICAO

[Insert Company Name] Terms of Reference: Fatigue Safety Action Group (FSAG)

Purpose

The Fatigue Safety Action Group (FSAG) is responsible for coordinating all fatigue risk management activities at [insert Company name]. This includes responsibility for gathering, analysing, and reporting on data that measures fatigue among flight crew members. The FSAG is also responsible for ensuring that the FRMS meets not only the safety objectives defined in the FRMS Policy, but also regulatory requirements. The FSAG exists to improve safety and does not get involved in industrial issues.

Terms of Reference

The FSAG is directly responsible to the [insert role e.g. FRMS Manager] and reports through the [insert name of the safety committee, SRB etc]. Its membership includes at least one representative of each of the following groups: management, scheduling, flight crew members, [insert other relevant staff], and specialists as required.

The tasks of the FSAG are to:

- develop, implement, and monitor processes for the identification of fatigue hazards
- ensure that comprehensive risk assessment is undertaken for fatigue hazards
- develop, implement, and monitor controls and mitigations as needed to manage identified fatigue hazards
- develop, implement, and monitor effective FRMS performance metrics
- cooperate with the Safety Department to develop, implement and monitor FRMS safety assurance processes, based on agreed safety performance indicators and targets
- be responsible for the design, analysis, and reporting of studies that measure crew member fatigue, when such studies are needed for the identification of hazards, or for monitoring the effectiveness of controls and mitigations (such studies may be contracted out but the FSAG is responsible for ensuring that they are conducted with the highest ethical standards, meet the requirements of the FRMS, and are cost-effective)
- be responsible for the development, updating, and delivery of FRMS education and training materials (these activities may be contracted out but the FSAG is responsible for ensuring that they meet the requirements of the FRMS and are cost-effective)
- ensure that all relevant personnel receive appropriate FRMS education and training, and that training records are kept as part of the FRMS documentation
- develop and maintain strategies for effective communication with all stakeholders
- ensure that crew members and others receive response to their fatigue reports
- communicate fatigue risks and the performance of the FRMS to senior management
- develop and maintain the FRMS intranet site
- develop and maintain the FRMS documentation
- ensure that it has adequate access to scientific and medical expertise as needed, and that it documents recommendations made by these specialist advisors and the corresponding actions taken
- keeps informed of scientific and operational advances in fatigue risk management principles and practice
- cooperate fully with the regulator in relation to FRMS auditing; and
- manage effectively and be accountable for FRMS resources
- The FSAG will meet monthly. Minutes will be taken during meetings and distributed within ‘X’ working days after each meeting.

Appendix C
Safety performance indicators – examples

As part of this process, the operator needs to define the parameters by which they determine what is relevant with respect to at least the following:

- FDPs being longer than scheduled
- reduced rest breaks (inflight, split duty etc.) within duty periods
- reduced ODPs between duties.

These tables are not exhaustive, and an AOC will likely want to have SPIs to target specific areas where the operator is aware of potential issues or areas of the operation that have not been examined for the impact of fatigue.

Table 7 Schedule related SPIs

Operational/schedule-related SPIs	SPI assessed
Number of crew duty day exceedances into allowable excesses e.g. longer than 14 hours	
Number of flight duty periods greater than a specified number of minutes longer than planned e.g. 30 or 60 minutes	
Number of flight times more than a specified number of minutes longer than planned e.g. 30 or 60 minutes	
Number of flight duty periods starting within window of circadian low (WOCL)	
Number of landings within the WOCL greater that a specified number during a specified time period	
Number of duty periods with more than a specified number of flight sectors	
Number of times crew monthly flight hours reach a predetermined threshold e.g. 90% of allowable maximum	
Number of times the use of 'captain's discretion' is invoked	
Number of successive early wake-ups for reporting time	
Number of successive early wakeups combined with long transits between flights	
Number of successive early wakeups combined with long duty days	
Number of reduced rest breaks within duties (by more than a specified number of minutes determined to be ‘significant’)	
Number of reduced rest breaks between duties (by more than a specified number of minutes determined to be ‘significant’)	
Number of reserve crew call-outs on particular flights, at a particular crew base etc. due to fatigue	
Number of flight deviations or flight completion not accomplished on specific city pairings, due to fatigue, lack of staff, medical emergencies etc.	

Operational/schedule-related SPIs	SPI assessed
Number of early starts in a 28-day period	
Number of sectors in long duty periods	

Table 8 Safety assurance SPIs

Safety assurance SPIs	SPI assessed
The level of conformance with the FRMS audit program	
Number of risk controls/mitigations reviewed within a set period	
Number of risk controls/mitigations implemented within a set period	
The number of findings raised against the FRMS during internal audit against a pre-set standard	
The amount of reduction in findings raised against the FRMS from year to year	
The ratio of FRMS investigations completed within a designated time frame to those that went beyond the time	
The ratio of completed Action Items from audit findings or investigation recommendations within a designated timeframe to those that went beyond the time	

Table 9 Safety promotion SPIs

Safety promotion SPIs	SPI assessed
The number of days from the FRMS trial commencing and FRMS induction training delivered to all relevant personnel	
The number of days from the first day after hiring and FRMS induction training being delivered once the FRMS is approved	
The percentage of FRMS recurrent training delivered within the documented training timetable	
The number of persons failing the competence assessment at initial FRMS training (include number of re-sat exams)	
The number of persons failing the competence assessment at FRMS recurrent training (include number of re-sat exams)	
The number of FRMS promotional actions achieved as per the pre- determined schedule	
Annual publications	
Multimedia presentations/videos	
Training opportunities	

Appendix D
Fatigue report form – example

Fatigue Report Form

IF CONFIDENTIALITY REQUIRED TICK HERE •

NAME | Employee No. | Pilot/CCM (circle)

WHEN DID IT HAPPEN?

Local report date | Time of event (local report time)

Duty description (trip pattern)

Sector on which fatigue occurred — From | To

Hours from report time to when fatigue occurred | Disrupt? Yes / No

Aircraft type | Number of crew

WHAT HAPPENED?

Describe how you felt (or what you observed)

Please circle how you felt

1	Fully alert, wide awake	5	Moderately let down, tired
2	Very lively, somewhat responsive, but not at peak		
3	OK, somewhat fresh	6	Extremely tired, very difficult to concentrate
4	A little tired, less than fresh	7	Completely exhausted

Please mark the line below with an 'X' at the point that indicates how you felt

alert ---------- drowsy

WHY DID IT HAPPEN?

Fatigue prior to duty?	Yes / No	How long had you been awake when the event happened?	hrs mins
Hotel	Yes / No		
Home	Yes / No	How much sleep did you have in the 24 hrs before the event?	hrs mins
Duty itself	Yes / No		
In-flight rest	Yes / No	How much sleep did you have in the 72 hrs before the event?	hrs mins
Disrupt	Yes / No		
Personal	Yes / No	flight deck nap? Yes / No	If yes, when start end

Other comments

WHAT DID YOU DO? Actions taken to manage or reduce fatigue (for example, flight deck nap)

WHAT COULD BE DONE? Suggested corrective actions

Figure 6 Fatigue report form (ICAO)

Appendix E
Fatigue surveys

Fatigue Surveys are an effective method for collecting a large quantity of information regarding operational fatigue risk. They are often used to identify the duties that FCMs find the most fatiguing, identify specific scheduling elements associated with increased fatigue, or identify other operational variables that may be contributing to fatigue. Where possible, surveys should also collect information regarding general health, well-being, recent sleep and duty history. Surveys can be administered as a paper and pencil questionnaire, a web-based survey, or via a mobile device. An example of a brief fatigue survey is presented below.

Table 10 Sample of a fatigue survey

Fatigue survey			
Age			
Gender	male	female	
Position	(e.g. CAPT/FO/SO)		
Years in current role			
Aircraft type			
Haul type	short	long	short & long
This form was completed	pre-duty	post duty	day off

Table 11 Sample fatigue measurement

John Smith – Scale – Crew status check	
Fully alert, wide awake	1
Very Lively, responsive, but not at peak	2
Okay, somewhat fresh	3
A little tired, less than fresh	4
Moderately tired, let down	5
Extremely tired, very difficult to concentrate	6
Completely exhausted, unable to function effectively	7

During the past seven days (start with today and go back seven days – how many hours or number in an activity):

Table 12 Sample sleep/activity/duty log

	Sat	Sun	Mon	Tues	Wed	Thur	Fri
FDP Length							
Time awake at end of FDP							
Sectors Flown							
Flying Time							
Time Slept							
Time Napping							
Commuting							

Rate your overall sleep quality during the past week. Consider how many hours slept, how easily you fell asleep, how often you woke up during the night, how often you woke up earlier than you had to, and how refreshing your sleep was.

Table 13 Sample sleep quality rating

Sleep quality rating	
Very good	
Good	
Average/fair	
Poor	
Very poor	

Fatigue scale: Right now, how do you feel?

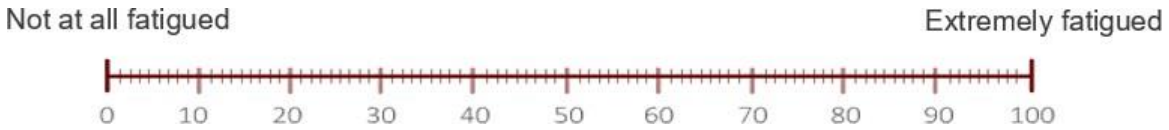

Figure 7 Sample visual analogue scale for assessing fatigue

Daily sleep/activity and duty logs:

A daily sleep/wake diary data can provide insights into the actual work habits and sleep/wake schedules of individuals across roster periods. Sleep data measured from consumer wearable devices could also be incorporated into these logs. An example form is below:

Table 14 Sample daily sleep/activity and duty logs

Name							
	Date	Date	Date	Date	Date	Date	Date
FDP length							
Sectors flown							
Flying time							
SPS score (TOD, final sector)							
Time awake at end of FDP							
Time slept							
Bed time							
Wake time							
Time napping							
Commuting time							
Other							

Appendix F
FRMS risk processes – example

This is a sample of a 'fictional' AOC and how they may approach the development of their fatigue risk process. CASA acknowledges that many AOCs have well-established risk management processes that may need little or no adjustment to be applied to fatigue risk. This example is provided to introduce operators who do not have sufficient experience or understanding of risk management concepts and processes. The examples of fatigue risk and mitigators, and the processes may not be relevant or appropriate to your AOC.

Fiction Airlines operates an overnight freight service from Cairns to Melbourne return along with regional daytime mail pick-ups. The FDP begins with a one-hour briefing, inclusive of planning and pre-flight activity. Departure is scheduled for 2000 with a 2.5-hr turnaround time. The return FDP is scheduled to end at 0500. The aircraft is operated by two FCMs and does not have crew rest facilities.

The freight service operates four days during the week with weekends off. A single crew pair, made up from the pool of nine pilots, operates the service each week. The proposed schedule for a crewing pair is for three consecutive FDPs, an ODP that includes a local night, and then the 4th FDP. The crewing pair work this pattern one week per month (unless there is an emergency call out). All other flying is daytime, 4 sector, mail collection.

Here is how the proposed WOCL cargo schedule looks when subjected to a 'formal' risk assessment process. Figure 8 below shows the various steps to go through to develop the risk assessment and decision(s) concerning this schedule.

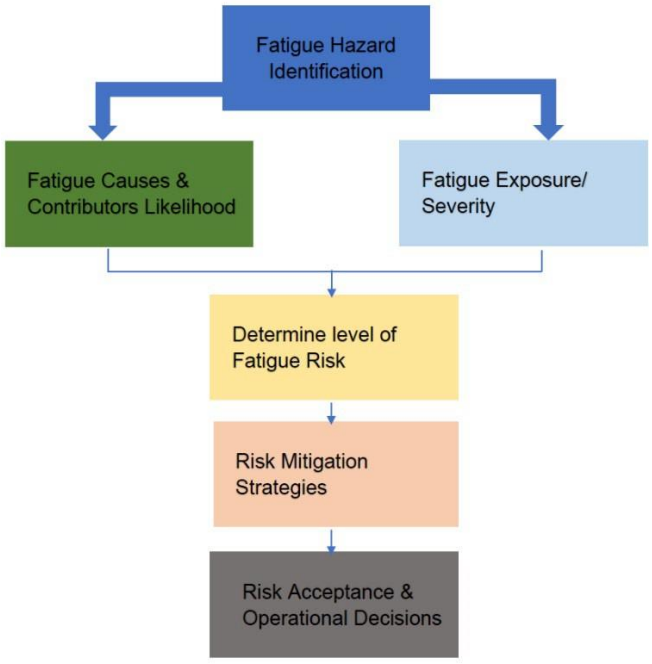

Figure 8 Risk assessment format stages

Risk assessment format stages

To identify fatigue hazards, Fiction Airlines developed a list of causes and contributors which may be related to the schedule. Table 15 below was the outcome of this activity. By having the weekly schedule laid out in this manner, Fiction Airlines can see that contributors/likelihood of fatigue increase across time given the hours when the duty is performed, and the number of duty periods.

Given that Fiction Airlines conducts night cargo operations and there is a higher likelihood of fatigue on such operations, the crew have regular discussions on fitness for duty and their experiences with various schedules; the relevant points are noted and fed into the hazard identification processes.

An operator's AOC might consider having specific Fatigue 'triggers' for having a discussion with a manager as a means of 'double-checking' levels of fatigue. Any rules an AOC may set should be based on the experiences of the organisation and the input from FCMs. Keep in mind these are for Fiction Airlines and operational and personal experiences may differ.

Table 15 Fatigue causes and contributors impacting Fiction Airlines operations

Types of operations						
	Contributors & Causes of Fatigue (This list is not exhaustive)	**FDP 1**	**FDP 2**	**FDP 3**	**Day 4 ODP**	**FDP 4**
Wellness/sleep	Less than 5 hrs of sleep in prior 24 hrs		X	X		
	Less than 10 hrs of sleep in prior 48 hrs			X		
	Poor Sleep quality		X	X		
	Over 15 hrs of time awake	X	X	X		X
	Cumulative sleep debt			X		X
Circadian factors	Unacclimatised FDP					
	WOCL infringing FDP	X	X	X		X
	Trans-meridian FDP					
	Sleep at non-optimal sleep time		X	X		
Workload/work environment	High workload periods in FDP					
	Long FDP	X	X	X		X
	Limited rest opportunities	X	X	X		X
	Multiple Sectors (> 5 sectors)					
	Short, split sleep opportunities during FDP					
	Environmental stressors					
Well-be	Poor nutrition: Dietary regime Meal composition and timing					
	Sedentary lifestyle					
	Poor fitness					
	Stress					

	Contributors & Causes of Fatigue (This list is not exhaustive)	FDP 1	FDP 2	FDP 3	Day 4 ODP	FDP 4
	Work/life balance					
	Extended periods of being seated	X	X	X		X
	Medical conditions: Personal Family/friends					
	Commute time/conditions	X	X	X		X
AOC specific	Circumstances specific to your operations (insert as required)					
Total fatigue factors present		**6**	**9**	**11**	**0**	**7**

Using Table 15, the Fiction Airlines schedulers identify the potential causes and contributors to fatigue risk and include them for consideration, noting that all FDP infringe on the WOCL.

Note that the contribution/likelihood of the various items within Table 5 are simply being checked if they are present. Over time, as the impact of the 'likelihood' items are assessed by the AOC, the Contributors & Causes may be individually weighted by an AOC based on known data/scientific support. That is, some factors may have a greater influence on the fatigue of the FCMs than others, and this would be reflected in a higher weighting in determining the likelihood of fatigue.

For an organisation that has not collected data on fatigue factors within their operations, they should use the fatigue contributors/likelihood factors (listed in Table 5) until sufficient data is collected.

In addition, Fiction Airlines has adopted a safety check in their scheduling practice as follows:

- Any factor(s) that are present in the Wakefulness/sleep category should be discussed with a supervisor. While the presence of an item(s) does not rule out starting an FDP, these factors are core contributors to fatigue and should be considered on an individual basis.

Completing Table 15, the schedulers are aware of the types and numbers of contributors/likelihood of fatigue factors that may impact the FCMs. For Fiction Airlines, the number of causes and contributors are used to determine the probability of fatigue impacting performance.

However, the number of contributors is not the only factor in determining the risk of fatigue in the crew. In Figure 9, fatigue risk assessment is determined by a combination of the cause and contribution of fatigue (number of fatigue factors) multiplied by the level of fatigue risk exposure/severity (the FDP roster pattern). The consequence ratings used were determined by Fiction Airlines Fatigue Safety Action Group (FSAG) previously and are described below:

- Minimal – rare fatigue contribution to event with little consequence
- Low – unlikely fatigue contribution with low impact consequences
- Medium – possible fatigue contribution with likely minor impact consequences to the crew or aircraft
- High – likely fatigue contribution with significant impact consequences to crew, aircraft, and/or public
- High+ – this is not acceptable risk, and the FDP would not commence if the fatigue risk cannot be sufficiently mitigated.

Fiction Airlines has determined that, prior to implementing mitigations, the impact of cumulative fatigue will increase the risk level to the next category after consecutive days of night cargo FDPs (e.g., low on FDP 1 is medium on FDP 2 and so on). Additionally, they consider that all night cargo FDPs is above minimal risk levels. Finally, a High+ risk rated FDP must not proceed without sufficient mitigated strategies to reduce the risk.

The exposure table limits (fatigue factor likelihood & risk severity level) should be based on the experience of the organisation of their operational demands, FCM fitness, and input from relevant sources. The risk level assigned should be examined as data is collected on the operations and adjusted as required.

As part of the risk assessment exercise, Fiction Airlines considered there is the rare possibility that crews might have to do four consecutive FDPs as shown in Figure 9. Consideration of the 'unexpected' or rare event in a risk assessment allows the organisation to gain an understanding of the risk in extreme circumstances, and how risk is not linear in the level of consequences.

Frequency of exposure of FCM				
Consequence level	1 day	2 days consecutive	3 days consecutive	4 days consecutive
	Fatigue Risk Level Night Cargo Rules			
Minimal				
Low	Low	Medium	High	
Medium	Medium	High		
High	High	High+	High+	High+

Figure 9 The frequency of exposure/fatigue risk

The schedule from Table 15 and the Risk levels from Figure 9 have been transposed into Figure 10 to show what risk level the proposed schedule of flying.

Fatigue factor settings	Frequency of exposure of FCM				
	Consequence level	FDP 1	FDP 2	FDP 3	FDP 4 (Following ODP)
		Fatigue Risk Level			
1-3	Minimal				
4-6	Low	Low (6)			
7-9	Medium		High (9)		Medium (7)
> 9	High			High+ (11)	

Figure 10 Proposed schedule for Fiction Airlines

Fiction Airlines potential schedule of four FDPs and one ODP (3FDP-ODP-FDP) over five days.

Fiction Airlines has a rule that they will not fly in High+ risk conditions. Figure 10 show a High+ situation for FDP3. At this point, the FDP will not be cancelled as they have not attempted to mitigate the fatigue risks.

To mitigate the potential fatigue, Table 15 is reviewed and the contributors/likelihood for each FDP assessed. There will be some aspects of the FDP that cannot be reduced, eliminated or mitigated.

However, using the following fatigue mitigations in Table 16 developed by the staff at Fiction Airlines, relevant strategies to reduce the fatigue risk from the causes and contributors may be selected. This subsequently impacts the contribution (not absolute number of) of the fatigue factors to the frequency of exposure. Specifically, the implementation of mitigation strategies reduce the impact, but not the likelihood of the fatigue risk to the FCMs.

Note: An AOC will have its own set of unique mitigation strategies based on experience and scientific data.

Table 16 Fiction airlines fatigue mitigation strategies

Mitigation Strategy	Possible (Y/N)
Local night sleep	
In flight rest (napping)	
Caffeine	
Rest/activity/light exercise breaks	
Augmenting crew	
Light exposure	
Avoid/minimise monotonous tasking	
Hydration and nutrition	
Air conditioning/temperature regulation	
Fatigue training	
Provide transport pre/post duty	
Reduce the number of duties	
Support Fatigue Call-offs	
Cross-checking calculations (in crews)	
Engage peer FCM fatigue monitoring (in crews)	

In the proposed schedule of Fiction Airlines, there are some contributors to fatigue risk that cannot be mitigated (listed as N/A). Additionally, there are some that may be reduced (but not eliminated) through fatigue mitigation strategies. The potential mitigation strategies have been placed against the fatigue contributions in Table 17 below:

Table 17 Sample fatigue contributors and their mitigations

FDP	Cause/contributor	Mitigation
Day 1	WOCL infringing FDP (2000 to 0500 FDP)	Strategic use of caffeine during FDP
	> 15 hours awake	Napping
	Long FDP	N/A
	Limited rest opportunities (no rest facilities on aircraft)	Controlled rest in the cockpit
	Commute time (between 25-45 minutes)	N/A
Day 2	< 5 sleep in prior 24 hrs (sleeping post the WOCL)	N/A
	Poor sleep quality (due to daytime sleeping)	N/A
	Sleep at nonoptimal time (due to WOCL FDP)	N/A

FDP	Cause/contributor	Mitigation
	WOCL infringing FDP (2000 to 0500 FDP)	Strategic use of caffeine during FDP
	> 15 hrs awake	Napping
	Long FDP	N/A
	Limited rest opportunities (no rest facilities on aircraft)	Controlled rest in the cockpit
	Commute time (between 25-45 minutes)	Provide accommodation/ transport
Day 3	< 5 sleep in prior 24 hrs (sleeping post the WOCL)	N/A
	< 10 sleep in prior 48 hrs (2nd lost night sleep opportunity)	N/A
	Poor sleep quality (due to daytime sleeping)	N/A
	Sleep at nonoptimal time (due to WOCL FDP)	N/A
	WOCL infringing FDP (2000 to 0500 FDP)	Napping
	> 15 hours awake	Strategic use of caffeine during FDP
	Long FDP	N/A
	Limited rest opportunities (no rest facilities on aircraft)	Controlled rest in the cockpit
	Commute time (between 25-45 minutes)	Provide accommodation/ transport
Day 4	Rest Day ODP 0500 - to Day five 2000	39 hrs off, including a local night
Day 5	WOCL infringing FDP (2000 to 0500 FDP)	Strategic use of caffeine during FDP
	> 15 hours awake	Napping
	Long FDP	N/A
	Limited rest opportunities (no rest facilities on aircraft)	Controlled rest in the cockpit
	Commute time (between 25-45 minutes)	N/A

Following the initial mitigation exercise, the schedulers re-assess the fatigue risk exposure outlined in Figure 10 and record that some of the fatigue contributors are being mitigated and that this impacts the level (not frequency) of the contributor (see Figure 11).

For the purposes of this example, if a fatigue contributor can be mitigated, the schedulers reduce the factor by 0.5, based on the ‘experience’ of Fiction Airline personnel.

The formula for the reduction in the level of fatigue risk in this example is a fictitious illustration of how the risk management/hazard identification process is applied. The effectiveness of mitigation strategies should always be assessed either by the individual or within the operational environment of an AOC. Any weighting of mitigation strategies should be based on data, scientific justification, and operational experience.

In the present example, as mitigation strategies are being implemented, the cumulative duty automatic increase in severity level is removed. Accordingly, the risk on Day 1 and 4 are reduced by 1.5 because there were three mitigation strategies (3 x 0.5 = 1.5) being used within the FDPs. In the FDPs on day 2 and 3, there are four mitigation strategies (4 x 0.5 = 2) which reduce the risk of the contributors by 2, as shown in Figure 11.

Fatigue factor settings	Frequency of exposure of FCM				
	Consequence level	FDP 1	FDP 2	FDP 3	FDP 4 (Following ODP)
		Fatigue Risk Level			
1-3	Minimal				
4-6	Low	Low (4.5)			Low (5.5)
7-9	Medium		Medium (7)	Medium (9)	
> 9	High				

Figure 11 Proposed schedule for Fiction Airlines with mitigations

Fiction Airlines potential schedule of four FDPs and one ODP (3FDP-ODP-FDP) over five days.

Fiction Airlines now can decide on their proposed scheduling practice of three days consecutive FDPs, ODP, followed by a 4th FDP during a five-day work roster.

Accepting the schedule should include feedback from the FCMs, relevant stakeholders, and any input from operational experience and scientific data.

In this example, the proposed schedule was reduced from an FDP in the High+ (no fly) risk level to having two FDPs being within the medium-risk range (see Figure 12). Recall that Fiction Airlines elevates any score on a consecutive WOCL infringement day to one level higher in risk due to the cumulative impact of fatigue across FDPs for the week when no mitigations are used to reduce fatigue risk levels.

To minimise any possible high risk FDPs, Fiction Airlines opted to alter the five Day schedule to two FDP, ODP, two FDP. This eliminated the contributor of < 10 hour of sleep in 48 hours on FDP 3 and the cumulative sleep debt in FDP 4.

Fatigue factor settings	Frequency of exposure of FCM				
	Consequence level	FDP 1	FDP 2	FDP 3 (Following ODP)	FDP 4
		Fatigue Risk Level			
1-3	Minimal				
4-6	Low	Low (4.5)		Low (4.5)	
7-9	Medium		Medium (7)		Medium (7)
>9	High				

Figure 12 Proposed schedule for Fiction Airlines with mitigations

Fiction Airlines potential schedule of four FDPs and one ODP (2FDP-ODP-2FDP) over five days.

This decision was based on the input from FCMs and a commitment to continuous improvement by Fiction Airlines. This change may also reduce the potential for chronic fatigue experienced by FCMs. The schedule and the effectiveness of the mitigation strategies will be continuously monitored under the Safety Assurance processes of the airline.