



Australian Government
Civil Aviation Safety Authority

CIVIL AVIATION ADVISORY PUBLICATION CAAP 48-01 v3.3

Fatigue management for flight crew members

Date	March 2024
File ref	D23/509013

This Civil Aviation Advisory Publication (CAAP) provides guidance, interpretation and explanation on complying with the Civil Aviation Regulations 1988 (CAR) or a Civil Aviation Order (CAO).

This CAAP provides advisory information to the aviation industry in support of a particular CAR or CAO. Ordinarily, the CAAP will provide additional 'how to' information not found in the source CAR, or elsewhere.

Civil Aviation Advisory Publications should always be read in conjunction with the relevant regulations/orders.

Audience

This Civil Aviation Advisory Publication (CAAP) applies to all holder of:

- an Air Operator's Certificate (AOC) or Part 141 certificate
- a flight crew licence.

Purpose

This CAAP provides guidance on meeting the AOC holder and flight crew member (FCM) obligations in relation to fatigue risk management, required under Civil Aviation Order (CAO) 48.1 Instrument 2019.

It does not provide specific guidance in relation to fatigue risk management systems (FRMS) under Appendix 7 of CAO 48.1, including ultra-long range operations. This CAAP provides limited guidance to operators utilising transitional provisions of CAO 48.1 Instrument 2019.

For further information

For additional information on this CAAP, contact CASA's fatigue management specialists (telephone 131 757).

Status

This version of the CAAP is approved by the National Manager, Emerging Technologies & Regulatory Change Branch.

Note: Changes made in the current version are annotated with change bars.

Version	Date	Details
v3.3	March 2024	Appendix C section C10.2.1 – Appendix 2 ODP requirements – correction to ODP required when the FCM is away from home base and the FDP does not exceed 12 hours and restructured for clarity.
v3.2	May 2020	Minor editorial to Sections 3-5 and Appendices
v3.1	December 2019	Minor editorial changes to address errors within the document (e.g. section references).
v3.0	September 2019	Major rewrite, revised to align with <i>Civil Aviation Order 48.1 Instrument 2019</i> and includes additional guidance.
v2.0	October 2016	Reflects changes made to CAO 48.1 as a result of <i>Civil Aviation Order 48.1 Amendment Instrument 2016 (No 1)</i> and makes minor editorial changes.
(1.1)	January 2016	Revised to account for the new applicability date of Civil Aviation Order 48.1 Instrument 2013, being 1 May 2017.
(1)	February 2015	Adds further guidance on the practical application of <i>CAO 48.1 Instrument 2013</i> (predominately contained in new Appendices A, B and C), and makes minor editorial changes.
(0)	August 2013	This is the first CAAP on this subject and has been produced in accordance with the Civil Aviation Safety Authority (CASA) safety-related functions under Subsection 9 (2) of the <i>Civil Aviation Act 1988 (the Act)</i> .

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1 Reference material

1.1 Acronyms

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

Acronym	Description
AOC	Air Operator's Certificate
CAAP	Civil Aviation Advisory Publication
CAO	Civil Aviation Order
CAR	Civil Aviation Regulations 1988
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulations 1998
FCM	flight crew member
FDP	flight duty period
FRMS	fatigue risk management system
FTL	flight and duty time limits
ICAO	International Civil Aviation Organization
ODP	off-duty period
PIC	pilot-in-command
PVT	psychomotor vigilance test
REM	rapid eye movement
SMS	safety management system
WOCL	window of circadian low

1.2 Definitions

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

Where these definitions differ in wording from those in *Civil Aviation Order 48.1 Instrument 2019*, the wording for this CAAP was chosen to simplify complex definitions. The wording in the Instrument takes precedence and was necessary for legal drafting purposes; however, the wording chosen for the CAAP was chosen to aid understanding.

Term	Definition
access	No restriction on, or impediment to, a flight crew member's (FCM's) immediate and actual use of a necessity.
acclimatised time	The local time at the location where an FCM is acclimatised.
adaptation period	A continuous off-duty period (ODP) for an FCM to become acclimatised to a particular location/time zone.

Term	Definition
adequate sustenance	Food and drink (including clean drinking water) in quantities sufficient to reasonably sustain a person in their circumstances.
augmented crew operation	An aircraft operation in which one or more FCMs, additional to the minimum required number of FCMs, are engaged in a flight to allow one or more FCMs to be relieved of duty during flight time.
call-out	Being required by an operator to commence a duty period during a standby.
complex operation	An operation that involves 1 or more of the following: <ul style="list-style-type: none"> a. a flight duty period (FDP) with a displacement time of 2 hours or more b. an augmented crew operation c. an FDP that commences when the FCM is: <ul style="list-style-type: none"> i in an unknown state of acclimatisation, or ii acclimatised to a location other than the location where the FDP commences.
consecutive	A continuous, unbroken period of time for the duration of the hours or days mentioned.
crew rest facility	One of the following defined classes of rest facility on board an aircraft that is available to an FCM: <ul style="list-style-type: none"> a. Class 1 means a bunk or other surface that: <ul style="list-style-type: none"> i is fit for the purpose of an FCM obtaining sleep in a horizontal sleeping position ii is located separate from both the flight deck and passenger compartment in an area that: <ul style="list-style-type: none"> A. is temperature-controlled B. allows the FCM to control light C. provides isolation from noise and disturbance b. Class 2 means a seat in an aircraft cabin that: <ul style="list-style-type: none"> i is fit for the purpose of an FCM obtaining sleep in a horizontal or near-horizontal sleeping position ii is separated from passengers by at least a curtain that provides darkness and some noise mitigation iii is reasonably free from disturbance by passengers or crew members c. Class 3 means a seat in an aircraft cabin or flight deck that: <ul style="list-style-type: none"> i is fit for the purpose of an FCM obtaining rest ii reclines at least 40 degrees from the vertical plane iii provides leg and foot support in the reclined position.
cruise	The period of a flight from not less than 30 minutes after take-off until not less than 60 minutes before the estimated time of landing.
cumulative duty	The progressive sum of duty periods.
cumulative flight time	The progressive total of flight time accrued by the FCM when acting as a crew member on board any aircraft but excluding flight time accrued during recreational private operations. <p style="text-align: center;">Note: This includes time spent resting during augmented crew operations but does not include time spent positioning.</p>

Term	Definition
day	The period between local midnight at home base and the subsequent local midnight at home base.
displacement time	<p>The difference in local time between:</p> <ol style="list-style-type: none"> a. the place where an FCM commenced an FDP b. the place where the FCM undertakes an off-duty period following the FDP. <p>Note: Local time as defined below.</p>
duty	<p>Any task that a person who is employed as an FCM is required to carry out associated with the business of an operator.</p> <p>Note: This includes admin, simulator, positioning, private category operations on behalf of an operator</p>
duty period	A period of time that starts when an FCM is required by an operator to report for duty and ends when the FCM is free of all duties. A duty period includes any time spent by the FCM in positioning or administration.
early start	<p>Under Appendix 2 of CAO 48.1:</p> <ol style="list-style-type: none"> a. if the FCM is acclimatised — an FDP that commences between the hours of 0500 and 0659 local time at the location where the FCM is acclimatised b. if the FCM is in an unknown state of acclimatisation — an FDP that commences between the hours of 0500 and 0659 local time at the location where the FCM was last acclimatised. <p>Under an Appendix of CAO 48.1 other than Appendix 2, an FDP that commences between the hours of 0500 and 0659 local time at the location where an FCM commences the FDP.</p>
emergency service operations	<p>An aircraft operation:</p> <ol style="list-style-type: none"> a. for the purpose of law enforcement, or saving or protecting life or property, and b. conducted by, or at the request of, an organisation recognised by an Australian governmental agency as having responsibility to conduct or request the operation as part of the organisation's functions.
fatigue	<p>A physiological state of reduced alertness or capability to perform mental or physical tasks, which:</p> <ol style="list-style-type: none"> a. may impair the ability of the FCM to safely operate an aircraft b. is caused by one or more of the following: <ol style="list-style-type: none"> i the FCM's lack of sleep ii the FCM's extended wakefulness iii the FCM's circadian phase at any relevant time iv the FCM's workload of mental activities, and/or physical activities at any relevant time. <p>Note: An individual's level of fatigue and state of alertness can also be influenced by their health, diet, fitness and overall well-being.</p>

Term	Definition
fatigue risk management system (FRMS)	<p>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:</p> <ol style="list-style-type: none"> a. includes all of the elements set out in Appendix 7 of CAO 48.1 b. is approved for implementation by CASA.
fit for purpose	<p>For a crew rest facility, or suitable sleeping accommodation, means that it has ergonomic characteristics that make it suitable for an FCM to obtain sleep or rest (as the case requires).</p>
flight crew member (FCM)	<p>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.</p>
flight duty period (FDP)	<p>A period of time that:</p> <ol style="list-style-type: none"> a. 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 b. ends at the later of: <ol style="list-style-type: none"> i the person's completion of all duties associated with the flight, or the last of the flights, or ii 15 minutes after the end of the person's flight, or the last of the flights. <p>Note: FDP does not include positioning, administrative or simulator duties conducted after the last flight.</p>
flight time	<p>The time when an FCM is acting in the capacity as a crew member on board an aircraft that includes:</p> <ol style="list-style-type: none"> a. 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 b. 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. <p>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.</p>
flight training	<p>For a flight crew licence, rating or endorsement, means the training mentioned in regulation 61.195 of the <i>Civil Aviation Safety Regulations 1998 (CASR)</i> for the licence, rating or endorsement.</p> <p>Note: This does not include flight reviews, proficiency checks or training and checking activities conducted under CAR217.</p>

Term	Definition
flight training associated with aerial work	<p>Flight training for the grant, under Part 61 of CASR, of a rating or endorsement mentioned in paragraph (a), (b), (c) or (d):</p> <ol style="list-style-type: none"> a. the following operational ratings: <ol style="list-style-type: none"> i low-level rating ii aerial application rating iii night vision imaging system rating b. endorsements for the following operational ratings: <ol style="list-style-type: none"> i low-level rating ii aerial application rating iii night vision imaging system rating c. the following endorsements on the flight instructor rating: <ol style="list-style-type: none"> i low-level rating training ii aerial application rating training – day training iii aerial application rating training – night training iv night vision imaging rating training endorsement v sling operations training vi winching and rappelling training d. the following endorsements on the flight examiner rating: <ol style="list-style-type: none"> i low-level rating training ii aerial application rating training iii night vision imaging system rating flight test endorsement.
home base	The location, assigned by the operator to the FCM, from where the FCM normally starts and ends a duty period or a series of duty periods.
in-flight rest	In an augmented crew operation, the period of time, or periods of time, during which an FCM has access to a crew rest facility.
late-night operation	An operation where an FDP includes more than 30 minutes between the hours of 2300 and 0530 (local time).
local night	A period of eight (8) consecutive hours that includes the hours between 2200 and 0500 (local time).
local time	<p>For a location means:</p> <ol style="list-style-type: none"> a. local time in the time zone of the location, or b. local time in a time zone (the alternative local time): <ol style="list-style-type: none"> i that adjoins the time zone of the location; and <p>whose nearest boundary is reasonably proximate to the location provided the alternative local time is:</p> <ol style="list-style-type: none"> ii specified in the operator’s operations manual; and iii used consistently as local time for the location.
medical personnel	A person with medical, paramedical or nursing qualifications, and who has responsibilities directly related to the qualifications.

Term	Definition
medical transport operation	<p>An aircraft operation consisting of one or more flights for any of the following purposes:</p> <ol style="list-style-type: none"> a. delivery of urgent medical assistance to a person, when determined to be necessary by a medical transport tasker b. transportation of any of the following, when determined to be necessary by a medical transport tasker: <ol style="list-style-type: none"> i an ill or injured person ii another person directly involved with the ill or injured person (for example, a close relative or the police) iii medical personnel intended to be, or who are, directly involved with the ill or injured person mentioned iv blood, tissue or an organ for transfusion, grafting or transplantation, including a person who has authorised custody of the item c. the return of the aircraft to its base because an operation mentioned above is completed.
medical transport tasker	Medical personnel, or an organisation whose purpose is, or whose purposes include, medical transport tasking.
multi-pilot operation	A multi-pilot operation is an operation conducted under multi-pilot procedures. However, this does not include contracted recurrent training or contracted checking unless it is conducted as a multi-crew operation within the meaning of regulation 61.010 of CASR.
mustering operation	<p>An aircraft operation to herd or otherwise control livestock, which includes the following:</p> <ol style="list-style-type: none"> a. aerial mustering in accordance with the meaning found in of CAO 29.10 b. aerial livestock spotting c. aerial livestock culling d. flight training associated with aerial work for any of the activities mentioned in this definition.
off-duty period (ODP)	A period of time during which an FCM is free of all duties and standby associated with their employment.
operator	An AOC holder or Part 141 certificate holder.
positioning	<p>Means being transported, as a passenger, to a location, by any mode of transportation, as required by the operator and:</p> <ol style="list-style-type: none"> a. does not include being transported to or from suitable accommodation after or before an FDP b. if undertaken immediately before duty that includes the person flying an aircraft as an FCM (flying duty) — must be considered part of their FDP c. if undertaken immediately after the person's flying duty and no other flying duty is to be conducted in the duty period — is not part of their FDP or off-duty period d. is duty and part of the duty period.
recreational private operation	Flying conducted by an FCM in a personal capacity, and at and for the FCM's leisure. A flight conducted by an FCM as a private operation is not a recreational private operation if it is conducted for, or on behalf of, an entity (regardless of whether or not the entity is an operator).

Term	Definition
reporting time	<p>The time assigned to an FCM to commence an FDP.</p> <p>Note: This is the reporting time for any duty including positioning prior to flight duty.</p>
roster	A list made available to an FCM by an operator, setting out the times when the FCM is assigned to undertake duties or standby.
sector	<p>The following meanings:</p> <ol style="list-style-type: none"> a. except for a rotorcraft—any flight consisting of a take-off and a landing, when conducted by a person in the capacity of an FCM b. for a rotorcraft — the period: <ol style="list-style-type: none"> i from when the rotor blades start turning until they stop turning, and ii during which an FCM on the rotorcraft conducts 1 or more flights, each consisting of a take-off and a landing. c. each hour, or each part of an hour, of an FDP spent in a synthetic training device.
single-pilot operation	Any operation other than a multi-pilot operation.
sleep inertia	The degraded vigilance, increased drowsiness and impaired performance that occurs after awakening.
sleep opportunity	<p>A period of time during an ODP when an FCM:</p> <ol style="list-style-type: none"> a. is not meeting the reasonable requirements of bodily functioning, such as: <ol style="list-style-type: none"> i eating ii drinking iii washing iv dressing; and b. has access to suitable sleeping accommodation without, under normal circumstances, being interrupted by any requirement of the operator. <p>Note: Normal circumstances refer to those situations where the operator wishes to preserve the prior-sleep opportunity. Abnormal circumstances refer to the case where the operator needs to contact the FCM and in which this means that the prior-sleep opportunity has been interrupted. This, in turn, may impact the ODP and the subsequent FDP.</p>
split-duty rest period	<p>A predefined period of time during which an FCM:</p> <ol style="list-style-type: none"> a. has access to suitable resting accommodation or suitable sleeping accommodation; and b. is relieved of all duties associated with their employment by the operator. <p>Note: Time required for refuelling or flight administration is not included in a split-duty rest period.</p> <p>Note: For Appendix 4B and Appendix 5, the period of time may or may not be predefined.</p>
standby	<p>A period of time during which an FCM:</p> <ol style="list-style-type: none"> a. is required by an operator to hold themselves available for duties b. has access to suitable sleeping accommodation c. is free from all duties associated with their employment.

Term	Definition
standby-like arrangement	<p>A period of time during which an FCM:</p> <ol style="list-style-type: none"> is required by an operator to hold themselves available for duties, and does not have access to suitable sleeping accommodation, and is free from all duties associated with his or her employment
suitable resting accommodation	<p>A comfortable resting area that:</p> <ol style="list-style-type: none"> has a comfortable temperature and minimal noise levels contains at least a comfortable chair provides access to adequate sustenance at times appropriate to the duty requirements. <p>Note: A suitably comfortable aircraft seat may provide suitable resting accommodation depending on temperature and onboard activity.</p>
suitable sleeping accommodation	<p>Accommodation not within an aircraft that is fit for purpose for an FCM to obtain sleep, and that includes all of the following:</p> <ol style="list-style-type: none"> a comfortable room, compartment or facility a single occupancy, at the discretion of the FCM access to clean, tidy and hygienic amenities, including a toilet and hand washing basin a bed that is comfortable, flat and horizontal, allowing the occupant to sleep on their stomach, back, and either side minimum noise levels, including low occurrence of random noise the means to control light, temperature and ventilation access to adequate sustenance.
time zone	<p>A defined region of earth with a uniform local time that differs by one hour, or by part of one hour, from the uniform local time of an adjoining region of the earth.</p>
unforeseen operational circumstance	<p>An unplanned exceptional event that becomes evident after the commencement of the FDP (i.e. un-forecast weather, equipment malfunction, or air traffic delay).</p>
window of circadian low (WOCL)	<p>Under Appendix 2 of CAO 48.1:</p> <ol style="list-style-type: none"> 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. <p>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.</p> <p>Note: A duty infringes the WOCL if the duty is performed during all or any part of the WOCL.</p>

1.3 References

Regulations

Regulations are available on the Federal Register of Legislation website <https://www.legislation.gov.au/>

Document	Title
	<i>Civil Aviation Act 1988 (the Act)</i>
CAR 1988	<i>Civil Aviation Regulations 1988</i>
CASR 1998	<i>Civil Aviation Safety Regulations 1998</i>
CAO 48.1	Civil Aviation Order 48.1 Instrument 2019

Advisory material

CASA's Civil Aviation Advisory Publications are available at <http://www.casa.gov.au/CAAP> and Advisory Circulars at <https://www.casa.gov.au/AC>

Document	Title
AC 61-08	Teaching and assessing non-technical skills for single pilot operations
CAAP 5.59a-1(0)	Competency Based Training and Assessment in the Aviation Environment
CAAP SMS-3(1)	Non-Technical Skills Training and Assessment for Regular Public Transport Operations
CASA Fatigue Management guidance	Available at: www.casa.gov.au/fatigue/
International Civil Aviation Organization (ICAO) website	Fatigue Management resources, available at: https://www.icao.int/safety/fatiguemanagement/Pages/Resources.aspx

Note: Titles and links to external guidance material were correct at the time of publication.

2 Introduction

2.1 Fatigue management

- 2.1.1 Fatigue management for flight crew members (FCMs) is a shared responsibility between FCMs, operators and CASA.
- 2.1.2 Civil Aviation Order (CAO) 48.1 Instrument 2019 outlines the requirements for fatigue management for FCMs. Within CAO 48.1, there are a number of obligations that individuals (flight crew licence holders) and operators (air operator certificate (AOC) holders and Part 141 certificate holders) must meet. This CAAP provides guidance on meeting those obligations.
- 2.1.3 The rules around fatigue management provide operators with the choice of three broad approaches to fatigue management:

Basic (Appendix 1 of CAO 48.1) which sets prescriptive flight and duty time limitations without the need for enhanced risk management processes; however, these limitations are relatively restrictive.

Enhanced fatigue management (Appendices 2 to 6 of CAO 48.1) which allows greater flexibility with less restrictive flight and duty time limitations. This approach requires operators to implement risk management processes, continuous monitoring processes and a training program for FCMs.

- While it is expected that the majority of AOCs will be able to conduct their operations within Appendices 2-6, CASA recognises that there is substantial diversity in the nature of the operations being conducted across Australia. To support AOCs whose operational characteristics fall slightly outside of the nominated Appendices but are not at a level of complexity to warrant an FRMS, CASA will consider requests for "minor variations."
- Minor variations will permit operators to deviate from the prescriptive rules in a narrow range of circumstances where the prescriptive schedules are manifestly inappropriate to a particular operation, but where development of an FRMS is not warranted. Processes for the grant of such variations will follow CASA standard processes.
- Guidance on the minor variation process is available on the CASA fatigue management resources page.

Fatigue risk management system (FRMS; Appendix 7 of CAO 48.1) which is the most comprehensive fatigue risk management approach. This is a data-driven means of continuously monitoring and managing fatigue-related safety risks, based upon scientific principles and knowledge together with operational experience, that aims to ensure relevant personnel are performing at adequate levels of alertness.

This CAAP focuses primarily on providing guidance for complying with the 'Basic' and 'Enhanced fatigue management' approaches. Some of this material is also likely to be relevant to an operator operating under an FRMS. Operators choosing to develop and implement an FRMS

should refer to the additional guidance on the CASA website in conjunction with ICAO, IATA, IFALPA guidance.

2.1.4 To provide readers with guidance relevant to their interests, the body of this CAAP is split into three main parts:

- Fatigue science
- Individual obligations
- Operator obligations

2.1.5 The appendices of this CAAP then cover more specific areas of guidance, such as how to interpret the limits and requirements of CAO 48.1.

2.2 Individual obligations

2.2.1 Subsection 16 of CAO 48.1 places a condition on all flight crew licences that requires pilots not to commence a flight or related tasks if they are likely to be unfit to perform the task due to fatigue.

2.2.2 Similarly, pilots are required to comply with their fatigue management responsibilities set out by their operator.

2.2.3 Section 4 of this CAAP expands on these obligations.

2.3 Operator obligations

2.3.1 Subsection 14 of CAO 48.1 imposes obligations on holders of Air Operator Certificates and Part 141 certificates, variously referred to as AOC holders, holders, or operators throughout CAO 48.1.

2.3.2 Above all, an operator must not assign a duty on a flight to an FCM if the operator reasonably believes that the FCM is unfit to perform the duty because of fatigue.

2.3.3 The operator also has obligations in relation to:

- documenting flight and duty time limitations in their operations manual
- documenting the responsibilities of their employees in their operations manual
- providing opportunities for FCMs to consume meals
- record keeping and reporting
- determination of home bases for its FCMs (except for operations under Appendix 5 or 5A)
- publishing rosters.

2.3.4 Operators who choose to comply with the enhanced fatigue management approach in the appendices from Appendix 2 to 6 of CAO 48.1 have additional obligations. Under subsection 15 of CAO 48.1, these operators must have the following documented within their operations manual: (refer to section 5 of this CAAP, for further guidance)

- procedures for hazard identification
- procedures for determining limitations that take into account potential hazards
- procedures for the continuous monitoring and evaluation of policies, limitations and practices

- transition procedures when operations under multiple appendices are conducted
- initial and recurrent fatigue training program for their FCMs.

2.3.5 Section 4 of this CAAP addresses the applicable obligations of all operators.

2.4 Fatigue requirements during transitional period

The CASA fatigue management page, www.casa.gov.au/fatigue, provides guidance for transitioning to the new fatigue rules.

2.5 Fatigue science

2.5.1 Fatigue science overview

2.5.1.1 This section provides a brief overview of the fatigue science upon which the obligations and limitations contained in CAO 48.1 are based.

2.5.1.2 The International Civil Aviation Organization (ICAO)¹ have established four (4) basic scientific principles which should underpin fatigue management regulations. The following is a summary of these scientific principles and provides an insight into the basis of the limitations in CAO 48.1.

2.5.2 Scientific principle 1: The need for sleep

2.5.2.1 Sleep is an essential aspect of life with approximately one-third of your lifetime spent asleep. Obtaining quality sleep in sufficient quantities during your optimum window for rest is essential. The average adult requires between seven (7) to nine (9) hours of quality sleep per day to sustain normal performance.

2.5.2.2 In the absence of sufficient sleep, the brain does not operate effectively as it cannot form or maintain pathways required for learning and the creation of memories. Behaviourally, concentration and decision making are negatively impacted. Emotionally, chronic sleep loss increases risks of depression and stress, while intensifying negative emotions. Physiologically, chronic sleep loss is associated with increased cardiometabolic risk factors, other medical disorders, and reduced immune responses. The effects of restricting sleep accumulate. Accordingly, pilots will become progressively less alert and functional with each subsequent day of sleep restriction. This is described as accumulating a sleep debt.

2.5.2.3 Factors such as the environment (i.e. temperature, noise, light level), sleep disorders, age, well-being, personal circumstance (i.e. a new baby, being a caregiver, working standby), caffeine, nicotine, and alcohol are just some of the sources of sleep disturbance and/or disruption.

2.5.2.4 To maximise the restorative value of sleep, an uninterrupted period of time is required within your optimal sleep window where the body is able to effectively cycle through the

¹ International Civil Aviation Organization (ICAO), Manual for the Oversight of Fatigue Management Approaches, Second edition, 2016 (Doc 9966)

various stages of sleep. All stages of sleep have a role in maintaining overall health and performance. The inherent limitations of sleep obtained in the workplace, such as inflight rest facilities, split duty rest facilities or standby mean that these opportunities are less effective for facilitating restorative sleep.

2.5.2.5 The longer an individual remains awake, the more performance degrades due to homeostatic pressure for sleep which increases with time awake. Higher continuous time awake is over represented in air and road accidents.

2.5.3 Scientific principle 2: Sleep loss and recovery

2.5.3.1 The minimum recovery period from sleep debt is yet to be clearly established in the scientific literature. However, it is generally accepted that several days of customary sleep will be required for normal cognitive performance to be restored (Caldwell, Caldwell, Thompson, & Lieberman, 2019). This phenomenon (in the red dashed circle in Figure 2-1), along with the previously mentioned sequential decrements in performance are highlighted in Figure 2-1 below.

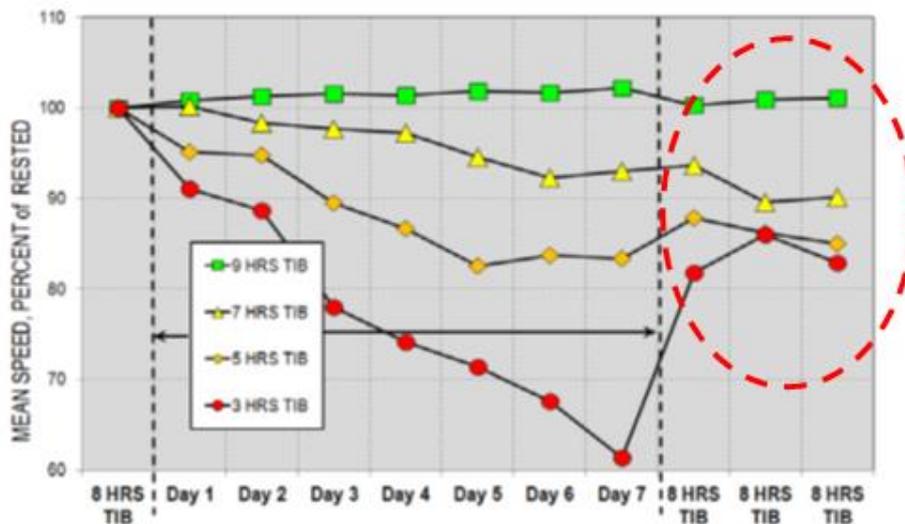


Figure 2-1 - Impact of time in bed (TIB) on performance (Adapted from Figure 2-24, U.S. Department of Transportation Federal Motor Carrier Safety Administration Report No. DOT-MC-00-133, May 2000.

2.5.3.2 Processing speed and attention are impacted by insufficient sleep and can be measured in situ with a variety of tools. More complex mental tasks, such as anticipating events, planning and reacting to novel situations are also impacted. These capabilities are critical to aviation safety, particularly during critical phases of flight or during in-flight emergencies. Additionally, once people are sufficiently fatigued, they are no longer able to reliably assess their own levels of fatigue. This means that relying solely on self-assessment can be flawed.

2.5.3.3 Accumulating sleep debt coupled with extended time awake increases the pressure for sleep. This pressure can become overwhelming, resulting in falling asleep uncontrollably for brief periods, known as micro-sleeps. Across a number of peer reviewed studies, pilots are reporting inadvertently falling asleep in the cockpit.

2.5.4 Scientific principle 3: Circadian effects on sleep and performance

- 2.5.4.1 Humans exhibit various predictable physiological and behavioural rhythms within a period of about a day (circadian rhythms). The internal regulating system for wakefulness and sleep is located within the suprachiasmatic nuclei (SCN) of the hypothalamus. The reduction of alertness corresponds with body temperature decreasing to its lowest level from 0300 to 0600 hours and, to a lesser extent, from 1600 to 1800 hours.
- 2.5.4.2 Circadian rhythms are synchronised to the solar day by rhythmic external factors, referred to as zeitgebers, the most important of which is the external light-dark cycle. The photosensitive ganglion cells of the eye have distinct neural connections to the SCN, noted previously as the site of the sleep/wake pacemaker. Furthermore, the photosensitive cells also have direct and indirect (via the SCN) projections to brain areas implicated in the regulation of arousal.
- 2.5.4.3 The circadian rhythm coupled with the light-dark cycle help explain why night-work is problematic because it calls for an overriding of circadian variations and demands.
- 2.5.4.4 This presents a paradox for pilots who are frequently expected to sustain performance working across the window of circadian low (WOCL), crossing multiple time zones, and working a disruptive pattern of scheduled flight duties. Research consistently supports that sleep loss and circadian misalignment contribute substantially to fatigue and performance risks in short haul, long haul and ultra-long-range flight operations.
- 2.5.4.5 Because light exposure is one of the prime influences on your body's circadian rhythm, regulating light exposure may help you adjust to your new location. This is the biological basis for the jetlag mitigations. That is, following a westward flight across multiple time zones, staying awake while it is daylight at the destination and trying to sleep when it gets dark promotes re-entrainment of your circadian clock. Whereas following an eastward flight, especially travelling more than eight time zones, wearing sunglasses and / or avoiding bright light in the morning, and then allowing as much sunlight exposure as possible in the late afternoon for the first few days in your new location facilitates circadian reset. This adjustment of the body clock assists the body's melatonin secretion at the right time. It takes longer to reset or re-entrain the circadian clock following eastward than westward flight.

2.5.5 Scientific principle 4: The influence of workload

- 2.5.5.1 Piloting an aircraft require concurrent attention to a variety of tasks. In addition to the demands of the flight deck is the fluidity of environmental conditions which, when combined, create high cognitive workloads. The situational awareness required to handle the flightpath is based on monitoring the flight parameters. This activity can be interrupted by air traffic communications which may further necessitate the pilot to perform mental calculations of the flight parameters to make the appropriate adjustments to the flight path with requisite time, distance and fuel consumption modifications. Pilot activity and cognitive load is greatest during take-off, approach and landing phases of flight.
- 2.5.5.2 While the level of automated technologies in the cockpit has reduced some of the workload, the time and effort pilots spend monitoring instruments remains a source of

cognitive strain. Accordingly, systems management to detect changes in the various systems within aircraft has become the main activity for many pilots during flight. This does not exclude the potential for a state of active fatigue which is associated with cognitive overload, especially when the pilot must make numerous and frequent control movements due to autopilot failure, such as in the case of the 1990 crash of Avianca flight 52. Nevertheless, a major challenge for pilots is to maintain their systems' awareness through continuously managing the input from the display system of the aircraft. An in-depth understanding of the relevant information among the myriad of output on the displays is crucial for the pilot in unanticipated or emergency situations in which the time available for understanding the problem could be limited. Importantly, studies have found that the routine monitoring-type behaviour of pilots can lead to a state of passive fatigue which is associated with declines in task engagement, cognitive underload, and reduced challenge appraisal.

2.5.6 Other important factors

- 2.5.6.1 Fatigue is a growing complaint among all classes of employment, with one in seven visiting a GP due to a fatigue-related issue. Monotonous or repetitive work, long working hours, the type of shift (day or night), pattern (permanent or rotating), and duration of the work shift have been found to be associated with fatigue. Work environment conditions, such as light, temperature, humidity, sound, and ventilation, are also risk factors for work-related fatigue. However, individual biopsychosocial factors are also implicated.
- 2.5.6.2 Specifically, the areas of physical and psychological well-being, nutrition, social milieu, home environment, and health behaviours are all factors unique to the individual. These factors can either act to minimise or amplify workplace risk and fatigue factors. Thus, the shared responsibility between pilots and operators is an important concept within the aviation community.

3 Individual obligations

3.1 Fitness to fly – individual cognitive and physical fitness (applicable to all FCMs, including private pilots)

3.1.1 Individual alertness measurement

3.1.1.1 Determining fitness to fly has always been a complex and challenging task, both for operators who provide training to employees on understanding how to meet their responsibilities, and for the pilots themselves.

3.1.1.2 A multi-method approach is particularly useful as research has demonstrated that without training humans are quite poor at determining their actual level of fatigue. The ideal approach to measure alertness is to combine information from a range of physiologic and cognitive sources. For example, the subjective assessment of how fatigued one feels is not comparable from one time to the next or between individuals. However, pilots using validated scales, such as the Samn-Perelli scale, increase the reliability of self-assessment. This is further enhanced though the additional consideration of information such as:

- sleep history, particularly if they have kept a personal sleep diary or electronic sleep tracking
- monitoring behavioural/cognitive/emotional indicators (e.g. drooping eyelids, slower information processing time, negative mood)
- considering important factors relevant to fatigue (e.g. sleep length, sleep quality, sleep environment, time zones crossed-circadian rhythms)
- completing a psychomotor vigilance test (PVT)
- examining scores from sleep monitoring tools.

3.1.1.3 Reduced alertness may impact judgement. To manage the potential for poorer judgment and decision making associated with a fatigued FCM, CASA recommends involving a non-fatigued individual along with multiple methods for measuring alertness to assist the FCM when assessing fitness to fly.

3.1.1.4 To assess FCM alertness, there are a number of Alertness Consideration Applications that may be found at the iOS App Store or the Google Play Store. For example: Fatigue SAFE or Fatigue Guru. These applications could be used as a starting point in the assessment of an individual's fatigue level. Keep in mind, if you choose to use an App of any sort be sure all of your members are using the same App for consistency. CASA has published additional information on alertness consideration applications on the fatigue management website.

3.1.1.5 These tools are examples of a decision-making aid when determining fitness to fly. Operators or FCMs may utilise any number of methods/tools for determining fitness for duty. Simple 'go or no-go' fatigue-based decisions relying on limited or predictive data is strongly discouraged unless erring on the side of caution. In addition, an individual's fatigue risk may be under-estimated due to several factors such as:

- having experienced poor or restricted sleep

- experiencing high levels of stress
or
- having engaged in high levels of physically stressing activity prior to reporting for duty.

3.1.2 Health and well-being

3.1.2.1 FCMs should monitor their health and general well-being and when necessary seek appropriate treatment, as physical health can impact on fatigue. Health and well-being include:

- short-term (acute) and chronic health conditions
- genetic predispositions
- nutrition
- hydration
- physical fitness
- stress and coping mechanisms (i.e., work-life balance, personal relationships, work or financial pressures)
- sleep difficulties (a wide range of sleep difficulties can affect fatigue such as circadian dysregulation, sleep quantity and sleep quality)².

3.1.2.2 Sleep disorders range in severity from occasional and inconvenient (e.g., jet lag when on holiday) to chronic and potentially life-threatening (e.g., obstructive sleep apnoea syndrome). When managing fatigue, employees have a duty of care to monitor and manage any health concerns that may impact on their fitness to fly, which may include contacting a medical specialist. FCMs should be cognisant that the onset of sleep difficulties may occur at any time for numerous reasons. When sleep issues (e.g., trouble falling asleep, staying asleep, waking up feeling tired) persist, professional assistance should be engaged and the situation treated accordingly to minimise the potential impact on aviation operations.

3.1.3 Workload

3.1.3.1 While various conceptualisations of workload exist, mental workload can be described as a subjectively experienced physiological processing state that reflects the interaction between one's limited and multidimensional cognitive resources and the cognitive demands of the environmental conditions. Simply put, workload is mental effort required by an FCM to meet the demands of the situation that are limited by their inherent cognitive capabilities.

3.1.3.2 FCM workload management requires consideration of workload in a dynamic environment where:

- demands on attention (monitoring flight parameters)

² There is a broad range of sleep disorders from a psychological perspective, which are listed in the current Diagnostic and Statistical Manual of Mental Disorders (5th edition). In addition to this, there is the International Classification of Sleep Disorders diagnostic and coding manual where new categories are continually being added.

- processing capacity (identifying potential threats such as collision, failures, weather)
 - multi-tasking (maintaining CRM, communications with ATC, monitoring instruments)
 - prioritising tasks (decision-making).
- 3.1.3.3 Although workload management minimises the risk of human error, it is likely that FCM fatigue levels reduce the capability to meet workload demands while are simultaneously increased by the efforts to meet these challenges.
- 3.1.3.4 Typical techniques for managing workload while on duty include:
- task delegation
 - task rotation
 - personnel rotation.
- 3.1.3.5 Current biomathematical fatigue models have minimal consideration of workload factors in predicting alertness.
- 3.1.3.6 Overall, existing data suggests that the relationships between workload, performance and subjective fatigue are complex. For aviation personnel, the negative impact on visual, auditory, attention, working memory and executive functions leading to diminished decision-making capabilities cannot be overemphasised.

3.1.4 Fatigue mitigating strategies (countermeasures)

- 3.1.4.1 An FCM can manage fatigue before, during and after flight by employing a range of fatigue mitigation strategies that work for their personal sleep needs. It is helpful to establish effective sleep habits, such as:
- scheduling sleep at a set time
 - trying a quiet activity like reading, relaxation or meditation just prior bedtime
 - establishing a bedtime routine
 - limiting alcohol intake as alcohol impacts sleep quality
 - limiting caffeine intake in the afternoon unless using it for operational purposes
 - avoiding napping in the afternoon (unless essential for operational requirements)
 - consuming your last meal as far from bedtime as possible and try to avoid heavy, spicy or sugary food
 - avoiding staying in bed if you cannot sleep (try a quiet activity such as reading)
 - avoiding light emitting devices (e.g. tablets, phones and computers) as well as artificial light as much as possible in the evening
 - investing in a comfortable bed (it is the place you spend 1/3 of your life)
 - arranging the sleep environment to be conducive to rest, specifically making sure it has a cool temperature, is dark and quiet.
- 3.1.4.2 One of the most effective fatigue countermeasures is napping or controlled rest. However, this activity should not be considered an alternative to regular night's sleep. Napping can be useful when supplementing too little or poor-quality sleep, and just 15-20 minutes can delay the onset of fatigue. When planning controlled rest, remember that napping for periods greater than 30 minutes can result in greater sleep inertia.

- 3.1.4.3 Exercise is a beneficial fatigue risk mitigator, as it improves cardiometabolic health, energy, stamina and mood, while relieving stress and improving the quality and quantity of subsequent sleep. Similar to a bedtime routine, keeping to a regular exercise regime provides optimal benefits.
- 3.1.4.4 Adequate nutrition and hydration are important for managing and preventing fatigue. Ideally, the FCM should:
- discuss individual dietary needs with DAME / GP / Treating Doctor
 - discuss the appropriateness with their DAME / GP / Treating Doctor when considering intermittent fasting regimes
 - plan meal composition and timing in advance
 - minimise consumption of processed foods
 - consume adequate water and electrolytes throughout the day
 - avoid late night meals (which result in slower digestion).
- 3.1.4.5 A popular fatigue countermeasure is the use of the stimulant caffeine. It can improve alertness temporarily (taking 15-30 minutes to have an effect) and often lasting several hours. Nonetheless, there are individual differences in terms of the effects of caffeine so the 'dosage' to achieve an effect will vary among people. Caution is warranted when consuming high quantities or drinks with levels of caffeine as tolerance can develop with usage and withdrawal symptoms when ceasing. Caffeine intake should be limited in the afternoon unless using it for operational purposes as subsequent sleep quantity and quality may be affected.
- 3.1.4.6 Before commencing any dietary supplement, over-the-counter or prescription medication (including sleep aids), that may impact your alertness discuss the aeromedical implications with your DAME (or CASA Aviation Medicine section).
- 3.1.4.7 An ideal way for FCMs to keep track of their sleep quality or the effectiveness of used fatigue countermeasures is to keep a sleep log or sleep diary. Research suggests that people (including pilots) tend to overestimate the amount of sleep they are getting, so a daily log can assist with accurate recording. An example log/sleep diary could incorporate:
- time in bed
 - time getting to sleep
 - time of awakening
 - nutrition/alcohol consumption from the previous day
 - sleep quality (e.g. number of awakenings during the night)
 - the sleep environment (i.e. a comfortable bed, ventilation, lighting)
 - smartphone applications and actigraphy (wearable or sleep monitoring technology), which can provide an automated method for collecting and analysing data.

3.1.5 Sleep hygiene

- 3.1.5.1 FCMs should utilise off-duty periods to ensure fitness for their next rostered duty period or standby time. If adequate sleep cannot be obtained by an FCM, they need to discuss this with the operator before commencing duty.

- 3.1.5.2 Similarly, private pilots must ensure they get sufficient sleep to enable them to perform during planned flights. Keeping a sleep log of some sort enables self-assessment and awareness.
- 3.1.5.3 To meet their obligations, FCMs are expected to have access to suitable sleeping facilities at home and use operator provided, or other facilities, when deployed. Prescribed off-duty periods should be used to maximise alertness for planned duty periods and FCMs are required to advise operators if adequate sleep could not be achieved for any kind of reason (noise, sick child, uncomfortable bed).
- 3.1.5.4 The sleep environment should allow for an adequate sleep period with defined blocks of time during which FCMs are not interrupted. The ergonomics of rest areas should be considered as they can have a large influence on the quality and quantity of restorative rest. The environment should be cool, dark and quiet while providing relief from postural constraints of the work and other environmental factors.
- 3.1.5.5 Appropriate accommodation should consider the following factors:
- noise
 - physical configurations
 - locations
 - privacy needs
 - lighting
 - vibration
 - micro-climate (air flow, ventilation, temperature, temperature gradient, humidity)
 - hygiene.
- 3.1.5.6 FCMs should consider their personal ergonomic and environmental needs/requirements when determining suitable sleeping accommodation/conditions at home.

3.1.6 Time zones and acclimatisation

- 3.1.6.1 The responsibility for managing the effects of time zone changes and acclimatisation is shared between the operator and the FCM. The operator should provide adequate fatigue training, as well as provide tools for staff to use when assessing their alertness.
- 3.1.6.2 The FCM has an obligation to apply fatigue training learnings to their situation when deciding their fitness to fly. FCMs should be cognisant of their time zone adaptation requirements. The hours required by an individual for adaptation may differ from what CAO 48.1 specifies. Where an FCM believes they are not fit to fly following an off-duty period after crossing time zones, it should be reported to the operator so the operator can determine if their limitations and fatigue policies are adequate for XXXXXX.

3.1.7 Augmented crew operations

- 3.1.7.1 Augmented crew refers to a flight crew comprising more than the minimum number of FCMs required to operate the aircraft as per the aircraft's Flight Manual and in order to allow one or more FCMs to be relieved of duties during flight time.
- 3.1.7.2 With appropriate in-flight resting facilities, crew can rotate rest times and share facilities to manage their fatigue. It is important that crews consider that, with an augmented crew, there will be variability in terms of alertness and circadian (i.e., time zone/body

clock) adjustment among FCMs. Caffeine use during augmented crew or split duty periods may adversely impact the ability to achieve recuperative rest or sleep during planned rest periods. Crew members should discuss planned rest times in accordance with operator training. Generally, rest or sleep is scheduled to provide optimal alertness to the crew members conducting the approach and landing.

- 3.1.7.3 Research has demonstrated that sleep inertia can result in diminished performance, vigilance and/or disorientation immediately after waking. A return to active duty protocol should be established to permit safe return to safety related duties (from 15 minutes onwards, as appropriate).

3.1.8 Controlled rest (modelled on TC 720.23)

- 3.1.8.1 Presently, CASA does not formally recognise the positive impact of controlled rest practices on fatigue in the same way as split duties or class of rest facilities. Nevertheless, the use of controlled rest as a fatigue countermeasure is well supported by research findings. Accordingly, CASA does support the inclusion of controlled rest methods in the training provided to flight crew as part of the general principles of fatigue and fatigue countermeasures.
- 3.1.8.2 For AOC's who adopt controlled rest on the flight deck practices, the pilot-in-command should, in consultation with the crew during the pre-flight briefing, determine if operational considerations allow or the use of controlled rest;
- 3.1.8.3 Should controlled rest be used, the flight crew members' rest periods should be planned and included in the pre-flight briefing to enable FCMs to anticipate and maximise the sleep opportunity and to manage their alertness.
- 3.1.8.4 The briefing should consider the choice of rest sequence, planned and unplanned wake-up criteria, transfer of control procedures, and co-ordination with cabin crew.
- 3.1.8.5 Pre-rest period activities should take approximately 5 minutes and should include the handover of duties, an operational briefing, toileting needs, co-ordination with the cabin crew, and time for the FCM preparing to rest to become comfortable in the flight deck seat.
- 3.1.8.6 Controlled rest should only be engaged in by one FCM at a time, with the resting FCM's duties completed by the non-resting flight crew member(s). This requires the non-resting FCM to remain on the flight deck throughout the rest period.
- 3.1.8.7 Rest period should be limited to a maximum of 30 minutes to avoid sleep inertia when the flight crew member is awakened and should occur only during the cruise phase of the flight. All rest should be completed at least 30 minutes before planned top of descent, workload permitting.
- 3.1.8.8 Unless required due to an abnormal or emergency situation, at least 15 minutes without any flight duties should be provided to the awakened flight crew member to allow sufficient time to become fully awake before resuming normal duties; and an operational briefing shall be given to the awakened flight crew member.

3.2 Shared responsibility between the FCM and their operator

3.2.1 Fatigue occurrence reporting

3.2.1.1 Operators' hazard identification obligations are reliant on FCMs reporting when they believe fatigue contributed to a reduction in safety margins or would have led to a reduction in safety margins had some mitigating action not been taken. Operators must make every effort through fatigue training and practices to highlight the importance of accurate voluntary reporting. Broadly speaking, there are four instances when fatigue reporting is essential for effective hazard identification (refer to Appendix E for an example of a fatigue occurrence report):

- a. When an FDP has not commenced or is not completed due to fatigue (entirely or in part). This includes when the FDP is completed, but only after some mitigating action, for example:
 - i. adding an extra crew member
 - ii. reducing the workload of the duty
 - iii. delaying the reporting time
 - iv. creating the opportunity for an unscheduled inflight rest
 - v. increasing supervision/monitoring.
- b. Following an FDP if the FCM believes, on reflection, that the level of fatigue they or other crew members were suffering meant sufficient safety margins had not been maintained throughout the flight(s).
- c. When the FCM notices something in their operating environment that is likely to impact on their or other crew members' alertness to the extent that safety margins could be reduced to unsatisfactory levels.
- d. When an incident or event has occurred where fatigue may have been a contributing safety factor. To enable this, it is preferable for there to be a fatigue reporting facility or prompt on the operator's occurrence reporting mechanism to include a 72-hour sleep history even when fatigue is not suspected as a factor.

3.2.2 Living arrangements – distance from base

3.2.2.1 FCMs should consider how their living arrangements and commute time to work may affect their fatigue levels. Any potentially problematic conditions should be discussed with the operator if it is having, or is likely to have, an impact on operational performance.

3.2.2.2 Individuals' (including FCMs) living situations are dynamic and these changes should also be considered in the context of their impact on fatigue levels and subsequent operational performance. Living situations that may have an impact on a person's fatigue level include:

- having shared or alternating living locations
- long and variable commute times (e.g. due to distance and traffic congestion)
- personal and work-related relocation decisions

- noisy living environments/disruptions to home resting areas (e.g. council/road works, neighbourhood construction/renovations, care requirements for babies/children, traffic noise, non-soundproof walls)
- overly well-lit living environments/resting areas (e.g. bright city lighting, inadequate window coverings during allocated daytime rest periods).

3.2.2.3 Commuting times can directly impact on fatigue by reducing sleep opportunities and increasing time awake in addition to the potential stress of traffic conditions and the workload involved in the commute. Reporting time can dramatically impact commuting time in major cities depending on the relationship to peak traffic periods. Alternative commuting methods (shuttle service) and scheduling practices (off peak starts) can mitigate this risk.

3.2.3 External employment and other tasks

3.2.3.1 FCMs have an obligation to manage any external employment and other activities to ensure that they do not impact on their fatigue levels during operations. External employment or activities such as:

- flying work
- shift work
- running a business
- physically intensive activities
- exposure to extreme environmental conditions
- study/education
- long-distance driving.

3.2.3.2 FCMs should consider any potentially adverse fatigue effects of other tasks and discuss these effects with the operator. External tasks that may affect fatigue levels include:

- home duties
- leisure activities
- family duties
- volunteer-type work conducted outside of work hours.

3.2.4 Private flying

3.2.4.1 An FCM who undertakes private flying and acts as an FCM for an operator may have an obligation to declare private flights. Private flying operations cover a wide range of activities. For the purposes of fatigue management, these activities can be divided into two broad areas:

- recreational private operations
- non-recreational private operations.

3.2.4.2 A recreational private operation can be conducted by an FCM, and there are no prescribed limits that apply. In the normal course of events where an FCM does some recreational private flying on a day-off, there may be no need for the FCM to disclose this. However, the FCM must be mindful of operators' policies concerning fatigue and recreational flying. While private recreational flying is permitted during off-duty periods,

pilots should remain cognisant of the need to achieve adequate restorative sleep prior to any subsequent private or commercial flight.

- 3.2.4.3 Some FCMs undertake private flying that is not considered recreational (i.e. paid work, ferry flights, flight testing and conversion training). Private, non-recreational flying contributes to cumulative flight time limits; private, non-recreational flying also counts as duty time which can impact flight duty period start times and off duty periods. These activities should be reported to the operator in order to maintain accurate records.

3.2.5 Open and fair reporting culture

- 3.2.5.1 In accordance with maintaining an open and fair reporting culture, FCMs need to disclose any situations, which are affecting or may in the future affect their alertness and compliance with CAO 48.1. The operator needs to support a workplace safety culture where employees are comfortable to freely disclose information and discuss factors with the operator that may affect fatigue and alertness. This requires a workplace culture that supports an open, communicative and non-threatening environment.

4 Operator obligations

4.1 Setting limitations

- 4.1.1 The first step in meeting an operator's obligations is to set limits within the operations manual. Operators should not simply copy the limits contained within their corresponding appendix or appendices within CAO 48.1. The operations manual needs to document the prescriptive limits applicable to all FCMs. These limits must not exceed those contained in the relevant appendix or appendices with which the operator chooses to comply. Limits are required to be tailored to the specific risks relevant to the operation. Operators' limits may change over time in response to fatigue reporting or emerging hazard identification. It is acceptable to have reduced flight duty periods or increased off-duty periods associated with individual rosters or pairings.
- 4.1.2 The operations manual must explicitly specify the limitations applicable to the operator's FCMs; these become the 'hard' limits. FCMs must be aware of these limitations.
- 4.1.3 Fatigue risk may not be sufficiently managed by limiting the hours of duty and commensurately providing for minimum length ODPs. Specifically, there may be further need for an operator to control fatigue risk due to such things as:
- individual variability
 - operational environment
 - workload.
- 4.1.4 An operator choosing to operate in Appendices 2 to 6 of CAO 48.1 must have hazard identification processes in place that assist in determining operator-specific limitations and any additional fatigue controls. Section 5.3 provides detailed guidance about setting limitations for operators complying with any appendix between Appendices 2 and 6 of CAO 48.1.
- 4.1.5 Where an operator does not intend to conduct certain operations available under an applicable appendix, the operator should include a simple statement in their operations manual acknowledging this. For example, if an operator conducting operations under Appendix 2 does not intend to conduct augmented crew operations, or an operation complying with Appendix 4, will not make use of the split-duty rest period provisions; this should be stated in their operations manuals.

4.2 Determination of home base

- 4.2.1 An operator is required to determine and notify each of its FCMs of their 'home base' unless the FCM only conducts operations under Appendix 5 or 5A of CAO 48.1.
- 4.2.2 Details of the process for making these home base determinations must be set out in the operator's operations manual. This allows FCMs to understand the procedures associated with these determinations (i.e. time available to move locations, if necessary).
- 4.2.3 Operators must ensure that changes in home base will not adversely affect aviation safety. A change of home base may be convenient for scheduling but introduce a

substantial commuting burden or significant family disruption that may increase an FCM's level of fatigue.

- 4.2.4 Determinations of home base should be assigned with a degree of permanence to not disrupt an FCM's fatigue recovery routines between duties.

4.3 Publishing of rosters

- 4.3.1 Studies have demonstrated that shift workers are able to partially adapt to working at sub-optimal times by adapting their daily routine to match required work patterns. This can be more difficult in aviation due to changes in rostered duty times on consecutive days as a result of schedule constraints.
- 4.3.2 Publishing duty rosters allows FCMs to plan adequate rest before their next assigned duty. Operators should be aware that their FCMs will require some degree of certainty in organising their work/life balance and organising their sleep routine.
- 4.3.3 For scheduled operations, operators should publish a planned roster at least seven (7) days prior to commencement of the roster period.
- 4.3.4 Rosters must be designed to account for the relevant prescriptive limits including flight duty periods, off duty periods and cumulative requirements. Small operators may design rosters using paper-based templates or simple spreadsheets. More complex operators may have rostering software with crew bidding processes and built in bio-mathematical modelling. Regardless of the complexity of the rostering system, rosters should be designed to cater for reasonably foreseeable delays such as ground handling, extended taxi requirements, holding requirements and immigration requirements without the need for operational extensions.
- 4.3.5 For ad hoc operations (i.e., charter or firefighting), particularly those where FCMs are employed on a casual basis, there may be little opportunity to provide notice of an upcoming FDP. Nevertheless, an operator should have procedures in place that involve offering an available FDP to a casual FCM with a minimum 24-hour notice. These procedures would allow the casual FCM, prior to accepting the FDP, to consider their fitness for duty (i.e., whether they will be able to ensure adequate rest). In addition, if there is any increase to the FDP limit via the use of augmented crew or a split-duty rest period, then the notification period needs to be increased appropriately.
- 4.3.6 While late changes to rosters are sometimes unavoidable, operators should make all reasonable efforts to ensure that these changes are kept to a minimum. Procedures need to be in place so that any fatigue risk resulting from the effects of late roster changes is identified and managed. This is particularly important for augmented crew operation's in-flight rest planning.
- 4.3.7 When allowing FCMs to swap roster duty times or bid for additional duties or if the AOC makes an ad hoc or late roster change, it is advisable for an operator to account for the increased risk of fatigue and assess the FCM(s) impacted by the scheduling change during the operation to ensure fitness for duty.

4.4 Fitness for duty

4.4.1 Selecting suitable sleeping accommodation for off-duty periods

- 4.4.1.1 Operators should be mindful of the requirement for FCMs to have a prior sleep opportunity before undertaking an FDP or standby. This sleep opportunity must be at suitable sleeping accommodation. This may be at home or at another sleeping facility (e.g. a hotel).
- 4.4.1.2 To maximise the restorative value of sleep, an uninterrupted period of time is required to effectively cycle through the various stages of sleep. The more sleep is fragmented by waking up, the less restorative value sleep has in terms of how people feel and function when they awake. Operators should document procedures that minimise interruptions to FCMs' sleep. ODPs should include defined blocks of time (sleep opportunities) during which FCMs are not to be contacted. All relevant personnel (e.g. crew rostering personnel) should be aware of these protected sleep opportunities. Operators should also develop procedures to protect FCMs' sleep at layover facilities.
- 4.4.1.3 The physical ergonomics of sleeping and resting facilities should be considered to ensure FCMs can obtain suitable recovery (from fatigue) and be fit for the next duty. Operators should consider workplace ergonomic factors, as well as, the facilities comprising the rest/sleep area when managing fatigue in operations.

4.4.2 Location of sleeping accommodation

- 4.4.2.1 Operators should carefully consider and manage how the location of sleeping accommodation may affect sleep quality. When considering a location for suitability, operators should consider the following factors:
- travel distance to and from the facility and the airfield
 - transport options
 - potential interruptions/disruptions
 - communication
 - cleaning
 - room service
 - maintenance work
 - temperature control
 - crew sharing options
 - lighting control
 - social factors (e.g. times of availability for local meals, arrival/departure times of other guests)
 - security at each location.
- 4.4.2.2 Operators should also consider how the resting/sleeping facility location may interact with time zones, as well as time zone changes from where the last duty ended to where the next duty will commence. For example, having layover accommodation an hour away from the sign-on base could:
- place it in a different time zone
 - impact on meal availability and sleep/awakening times

- require FCMs to adjust accordingly to the local time.

4.4.3 Acclimatisation and time-zone changes

- 4.4.3.1 Acclimatisation is a complex issue. While CAO 48.1 defines acclimatisation, specifically when an FCM is considered to be in an unknown state of acclimatisation and the method to become reacclimatised, it is important that operators understand that there is significant individual variation in the impact of crossing time zones and time-zone adaptation.
- 4.4.3.2 Acclimatisation is a formal term applicable to operators complying with Appendix 2 of CAO 48.1. Whether an FCM is in a known state of acclimatisation, or an unknown state of acclimatisation, determines the maximum FDP and minimum ODPs for an FCM. While other appendices do not specifically address the impact of crossing time zones, the increase in fatigue risk must be managed.

- 4.4.3.3 The responsibility for managing the effects of time zone changes and acclimatisation is shared between the operator and the FCM. The operator should provide adequate fatigue training, as well as tools for staff to use when assessing their alertness.

Note: The operator must not require an FCM to commence a duty when they are not fit for that duty.

- 4.4.3.4 The FCM has an obligation to apply fatigue training to their situation when deciding their fitness for duty. FCMs should report to their operator when they feel unfit for duty after crossing time zones. This process enables an operator to assess the adequacy of their limitations and/or fatigue policies. Although the applicable limitations and policies may be in accordance with CAO 48.1, the operator must consider the operational characteristics in order to ensure FCMs are fit for duty.
- 4.4.3.5 Appendix D provides various examples for determining an FCM's state of acclimatisation for the purposes of CAO 48.1. These scenarios should be considered as guidance only and may not guarantee that an FCM is acclimatised, or in an unknown state of acclimatisation, as described.

4.4.4 Meals

- 4.4.4.1 Failure to provide adequate sustenance can exacerbate the effects of fatigue. Operators are required to provide an opportunity for FCMs to consume meals throughout an FDP at intervals of not more than 5 hours and FCMs should have ongoing access to hydration.
- 4.4.4.2 An operator should attempt to schedule meals in conjunction with a break of at least 30 minutes during the FDP.
- 4.4.4.3 During long sectors, it is reasonable for the FCMs to consume a meal during the cruise. Operators should consider procedures that ensure that the safety of flight is not compromised if meals are consumed during flight (e.g. providing a meal just prior to an onboard rest/sleep opportunity).

4.5 Managing operational disruptions

4.5.1 Operational disruptions can occur in advance of an FDP or after an FDP commences. The rules regarding operational disruptions depend on the timing and nature of the disruption in three broad categories:

- Reassignment
- Delayed reporting
- Extension due to unforeseen circumstances.

4.5.2 Reassignment covers the case when an FCM is required to perform different or additional sectors after the FDP has commenced.

4.5.3 Delayed reporting covers the case when the operator is aware that the first sector will be delayed prior to the FCM reporting for duty.

4.5.4 Extension due to unforeseen circumstances covers the case when the planned sectors will take longer than originally planned due to unforeseen circumstances.

4.5.5 FDP reassignments

Note: Appendix 1 does not allow for FDP reassignments.

4.5.5.1 Operational requirements may give rise to situations in which an FCM is reassigned flights after the commencement of an FDP. This will often mean that the duration of the FDP may be longer than originally rostered. This can be problematic because FCMs may have planned their sleep to align with the planned duty, particularly for flights after midday or a rotating schedule.

4.5.5.2 The limitations in CAO 48.1 provide for an FDP to be reassigned up to the maximum FDP limit relevant to the FDP (based on start time, number of sectors etc.). For example, if an FCM is rostered for a 5-hour FDP, this could be increased to the relevant FDP limit contained in the operator's operations manual.

4.5.5.3 Operators should provide FCMs with a means to assess their fitness for reassignment. To be reassigned, an FCM must first confirm that they are fit to do so. At a minimum, such an assessment should consider the FCM's time awake (without sleep) at the end of the reassigned FDP. Any FDP resulting in time awake of over 16 hours without sleep should not be permitted without implementing appropriate fatigue countermeasures, such as split duty or crew augmentation (see Appendix C sections C.4 and C.).

4.5.6 Delayed reporting

Note: Appendix 1 does not allow for delayed reporting.

4.5.6.1 Delaying a reporting time can result in extended periods of wakefulness and, if not managed properly, has the potential to impact on fatigue risk. If the operator becomes aware of circumstances that necessitate a delay to the FCM's reporting time for an FDP in the time preceding the commencement of a rostered FDP, then it is reasonable that the FDP be delayed.

4.5.6.2 Depending on the length of the delay, there can be an increase in fatigue risk that may impact on the safety of a flight following that delay. Operators must have procedures

that address this potential for increased fatigue risk and ensure safeguards are in place to mitigate any increased risk.

4.5.6.3 Additional guidance on applying the delayed reporting requirements can be found in section C.6 to Appendix C of this CAAP.

4.5.6.4 The delayed reporting provisions depend on the length of the delay and whether the operator includes specific operations manual procedures to communicate delayed reporting.

Delay greater than 10 hours without specific procedures

4.5.6.5 Where an operator does not have specific procedures and the delay is greater than 10 hours the delay provides a full sleep opportunity between being informed and the revised reporting time. In this case, the period of delay can be treated as an off-duty period and normal limits apply to the delayed duty. Operators and FCM should consider, if appropriate, a reduced sleep propensity during the unexpected sleep opportunity.

Delay 10 hours or less without specific procedures

4.5.6.6 Where an operator does not have specific procedures and the delay is 10 hours or less, then the flight duty period commences at the original reporting time. This means that the FDP commences when the FCM had planned to report to work. Therefore, the maximum FDP is based on the original reporting time.

Delayed reporting procedures

4.5.6.7 Where an operator has specific delayed reporting procedures, the intent of these procedures is that FCM sleep is not disturbed by the notification and the FCM becomes aware of the delay prior to departing the sleeping accommodation. This allows the FCM to remain rested even if further sleep is not achieved.

4.5.6.8 These procedures must be familiar to FCMs and consistently applied by operations staff. In developing operations manual procedures, an operator should consider matters such as contact/delay notification protocols at home base and away from home base, while paying attention to protecting and not interrupting an FCM's sleep opportunity.

Delay greater than 10 hours with specific procedures

4.5.6.9 Where an operator has delayed reporting procedures and the delay is greater than 10 hours the delay provides a full sleep opportunity between being informed and the revised reporting time. In this case, the period of delay can be treated as an off-duty period and normal limits apply to the delayed duty. Operators and FCM should consider, if appropriate, the reduced sleep propensity during the unexpected sleep opportunity.

Delay less than 4 hours with specific procedures

4.5.6.10 For delays less than 4 hours, the assumption is that the FCM may be able to rest; however, it is unlikely they will be able to return to sleep. The maximum FDP limit that applies is based on the more restrictive of the original reporting time or the delayed

reporting time and the FDP commences at the revised reporting time. This addresses the likelihood that the FCM did not have an opportunity to organise their awakening time to suit the later reporting time, and they will likely remain awake during the period of the delay, while addressing the potential for the delay to impact the WOCL.

4.5.6.11 The total of the delay period and immediately following FDP must not exceed 16 hours unless the FDP includes augmented crew operations or split-duty rest.

Delay between 4 and 10 hours with specific procedures

4.5.6.12 For delays between four (4) and 10 hours, the assumption is that the FCM may be able to rest; however, it is unlikely they will be able to return to sleep. The FDP is taken to commence four (4) hours after the original reporting time. The maximum FDP limit that applies is based on the more restrictive of the original reporting time, or the time the FDP was taken to commence. This addresses the likelihood that the FCM did not have an opportunity to organise their awakening time to suit the later reporting time, and they will likely remain awake during the period of the delay, while addressing the potential for the delay to impact the WOCL.

4.5.6.13 The total of the delay period and immediately following FDP must not exceed 16 hours unless the FDP includes augmented crew operations or split-duty rest.

4.5.7 Extensions due to unforeseen operational circumstances

4.5.7.1 For all operations (excluding Appendix 5 or 5A, and in some circumstances Appendix 4B of CAO 48.1), extensions beyond FDP limits may only be made in unforeseen operational circumstances and should not be made on a regular basis. The intention behind the use of the term 'unforeseen circumstances' is to prevent operators continually rostering flight and duty times to their maximum limits and regularly relying on extensions to achieve their operational goals. As well as operational experience, hazard identification and risk assessments can be utilised to foresee potential disruptions or delays, for example:

- weather patterns
- air traffic control instructions
- peak traffic during departure/landing times
- sickness of crew members during a duty.

4.5.7.2 The options available for extension depend on whether the unforeseen operational circumstances arise prior to or during the last planned sector. Where circumstances arise prior to the last planned sector, the opportunity exists to change crew or cancel the flight and avoid the fatigue risk. Following commencement of the final sector, the pilot in command should consider the relative risks of unplanned diversion or increased fatigue due to the extension.

4.5.7.3 For an FDP to be extended, the pilot-in-command of a flight must consult each FCM of the operating crew and be satisfied that each FCM considers themselves fit for the extension. In doing so, the pilot-in-command and each FCM should actively consider their training regarding their time awake at the projected end of the extended FDP. Where FCM are likely to be unfit for duty at the end of an extended FDP, the pilot in

command should consider cancelling the last sector or diverting to a suitable enroute alternate, particularly where FCMs expect their time awake to exceed 16 hours.

- 4.5.7.4 Following a decision to extend, crew should consider and implement appropriate fatigue countermeasures, such as:
- strategic use of caffeine
 - ensuring sustenance is accessible
 - where possible, schedule a controlled rest opportunity
 - make a conscious effort to maintain effective communication
 - monitor the alertness and procedural compliance of fellow FCMs.
- 4.5.7.5 Extensions should only occur in under 5% of any sample of similar FDPs or similar operations. The sample of FDPs should be based on capturing a common root cause for the extension. For example, an airport turn-around time is programmed for 45 minutes but takes 1 hour and 15 minutes in one third of cases. This information informs the operator that planning for a 45-minute turnaround when rostering an FCM for an FDP that is at or close to the maximum is not appropriate for this particular airport.
- 4.5.7.6 Where an operator experiences extensions in more than 5% of the sample, the operator should consider revising its rostering practices by creating or amending documented rostering rules both for developing a roster and for day-of-operations management that provide greater assurance that the flight and duty time limits prescribed in the operator's operations manual will reliably not be exceeded.
- 4.5.7.7 For an operator complying with Appendix 2 to 6 of CAO 48.1 to meet their obligations, the reports on extensions should be entered into their hazard identification and continuous monitoring processes (refer to section 5 of this CAAP, for further guidance).

4.6 Fatigue occurrence reporting

- 4.6.1 The willingness of FCMs to participate in fatigue occurrence reporting will reflect their level of understanding of their roles and responsibilities in relation to fatigue risk management and/or the safety culture of an organisation and should not be misinterpreted as indicating any deficiency in professionalism. That is, fatigue reporting is indicative of the safety system within which the FCM operates. An effective fatigue reporting system requires an open and fair reporting culture. It needs to:
- use forms or processes that are easy to access, complete and submit at appropriate times
 - have clear unambiguous rules about confidentiality of reported information
 - have clear unambiguous voluntary reporting protections
 - include regular analysis of the reports to provide feedback to crew members about decisions or actions taken based on the reports and lessons learned.
- 4.6.2 A fatigue report form, either paper-based or electronic, should include information on:
- recent sleep
 - duty history (the minimum should be the last three (3) days)
 - time of day of the fatigue-related event

- measurement of different aspects of fatigue-related impairment (for example, validated alertness or sleepiness scales).
- 4.6.3 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 E.
- 4.6.4 Management should actively encourage crew members to complete and submit a fatigue occurrence report in the following instances:
- Through the voluntary reporting system when an FDP has not commenced or is not completed, due to fatigue, either entirely or in part. This includes when the FDP is completed but only after some mitigating action. For example:
 - o adding an extra crew member
 - o reducing the workload of the duty
 - o delaying the reporting time
 - o creating the opportunity for an unscheduled inflight rest
 - o increasing supervision/monitoring.
 - Through the voluntary reporting system following an FDP, if the FCM believes that the level of fatigue they, or other crew members experienced increased the risk of potential error throughout the flight(s).
 - Through the voluntary reporting system when the FCM notices something in their operating environment that is likely to impact on their or other crew members alertness to the extent that there is an increased risk of error.
 - Through the occurrence reporting system when an incident or event has occurred where fatigue may, or may not, have been a contributing safety factor. To enable this, it is preferable for there to be a fatigue reporting facility or prompt on the operator's occurrence reporting mechanism. In these instances, it is advisable to request a 72-hour sleep history.

4.7 Record keeping

- 4.7.1 In accordance with the operator obligations in CAO 48.1, an operator must maintain records in relation to FCM rosters, actual duty times and flight times (including reports of instances where an FDP is extended under an 'extension' provision).
- 4.7.2 These records and reports must be retained for five (5) years. Operators must maintain records of the duration of all duty periods performed by an FCM, such as any task that an FCM is required, by an operator, to carry out associated with the business of the operator (this includes administration).
- 4.7.3 Where an extension provision is used that exceeds a 'hard' limit contained in the operator's operations manual, a report must be completed by the operator (refer to Appendix E to this CAAP for an example of a fatigue occurrence report). The purpose of these reports is to facilitate identification of fatigue hazards and the improvement in an operator's fatigue management policies (i.e. limitations). There must be sufficient detail in the report to enable it to be used effectively for this purpose.

- 4.7.4 The reports must be provided to CASA upon request. CASA inspectors will review these reports and may follow up on how these are being used to provide for continuous improvement of the operator's fatigue management policies.
- 4.7.5 An increase in fatigue reports can be expected following fatigue training. Such an increase is expected where organisations have a just culture and healthy reporting culture. CASA reviews fatigue reports to confirm that reports are contributing to improvements in fatigue management.

4.8 Augmented crew operations

Note: Augmented crew operations are only permitted under Appendix 2.

- 4.8.1 Augmenting the crew is a strategy that operators can use to assist with managing crew alertness. With appropriate procedures in the operator's operations manual, and appropriate crew rest resting facilities, crew can rotate in-flight rest times and utilise facilities to manage their alertness, while mitigating the effects of fatigue. When developing procedures, operators should consider:
- designating a pilot responsible for making command decisions at all times when the pilot-in-command (PIC) is utilising in-flight rest
 - a requirement for a comprehensive briefing prior to FCMs rotating through in-flight rest
 - direction to crew that the in-flight rest requirements do not take priority over the need to optimise the crew experience levels on the flight deck for managing unplanned operational threats.
- 4.8.2 Sleep inertia defines a period of transitory reduced vigilance, where confusion, disorientation of behaviour, as well as impaired cognitive and sensory-motor performance may impair performance for a brief period following awakening from a sleep of 30 minutes or greater. There are various studies that have described the effects of sleep inertia on performance, particularly when awakening from deep sleep³. Operators and FCMs should be aware of and manage the effect of sleep inertia in flight operations, such as exclusion from controls or safety decision making for 15 minutes after waking. This requires discipline and training, particularly if the captain is woken due to abnormal operation.
- 4.8.3 When using augmented crews operators should be aware of and consider individual variability in alertness and circadian (time zone/body clock) adjustment.
- 4.8.4 FCMs have different sleep needs and different performance effects from countermeasures (e.g. caffeine), each of which should be taken into consideration. Additional crew will still become fatigued even when they are not in an operational role.

³ Studies include: Ferrara, M & DeGennaro, L. 2000. The sleep inertia phenomenon during sleep-wake transition: Theoretical and operational issues. *Aviation, Space and Environment Medicine*, 71(8), 843-848; Caldwell, J., Prazinko, B., & Caldwell, J. (2002). *Fatigue in aviation sustained operations, the utility of napping, and the problem of sleep inertia*. Paper presented at the Research and Technology Organisation Human Factors Medicine Lecture Series, Fort Tucker, Alabama.

Operators need to ensure that FCMs receive training regarding the appropriate use of augmented crews and in-flight crew rest facilities.

- 4.8.5 Appendix 2 of CAO 48.1 stipulates the minimum time an FCM requires the in-flight crew rest facility to be available. However, these times are only minimums and adequate alertness may require a substantially longer time be made available to gain adequate in-flight rest/sleep. As a guide, the augmented crew FDP limits in Appendix 2 of CAO 48.1 assume that most of the FDP is flight time, and that available rest/sleep time (cruise phase) is fully utilised and distributed as evenly as possible among FCMs. The number of sectors is limited so that an augmented crew operation is only undertaken in FDPs containing sufficiently long sector lengths to allow adequate time for rest/sleep.
- 4.8.6 In-flight rest facilities do not guarantee that the crew will achieve adequate rest. Where the planned landing crew do not achieve in-flight rest, consideration should be given to in-flight diversion or a change in plan for landing crew. Advice should be sought from duty operating management due to the potential for fatigue induced impairment of decision making among the FCMs on board.
- 4.8.7 In-flight rest facilities need careful design and consideration in order to permit adequate rest and sleep for crew. Classes of in-flight crew rest facilities are defined in CAO 48.1. When determining appropriate rest facility specifications, the following factors should be considered:
- relief from postural constraints of the work (e.g. prolonged periods strapped to a flight seat)
 - noise
 - physical configurations
 - locations
 - privacy needs
 - lighting
 - vibration
 - micro-climate (air flow, ventilation, temperature, temperature gradient, humidity)
 - hygiene (avoidance of pathogens, shielding)
 - communications
 - restraint mechanisms
 - access
 - evacuation procedures
 - requirements for emergency equipment.
- 4.8.8 The effectiveness of class 3 rest facilities is improved when the resting crew member is not directly next to a passenger and has a curtain for enhanced separation.

5 Enhanced fatigue management obligations (under Appendices 2 to 6)

5.1 Enhanced obligations

5.1.1 Operators who choose to operate under Appendices 2 to 6 of CAO 48.1 are subject to enhanced fatigue management obligations. These include:

- hazard identification procedures
- procedures for establishing limitations (taking into account hazards)
- procedures which provide for continuous monitoring and evaluation of fatigue data, with a view to improving the operator's limitations, policies and practices (refer to Appendix F and G for examples of how continuous monitoring procedures can be used in practice to satisfy the obligations)
- fatigue training and assessment for FCMs.

5.1.2 Operators with an effective safety management system (SMS) will be familiar with these processes, and an active SMS will most likely enable compliance with the hazard identification, continuous monitoring and evaluation of the fatigue related obligations.

5.2 Hazard identification (including use of biomathematical models)

5.2.1 As with all risk management, hazards related to human fatigue and alertness need to be identified, safety risks need to be assessed and managed e.g., putting in place controls and mitigation strategies. This is consistent with ICAO Annex 19 - Safety management and the ICAO Safety Management Manual (Doc 9859).

5.2.2 CASA has designed a set of prescriptive limitations that are designed to broadly manage the risk of fatigue due to sleep loss, time awake, time on duty and the time of day effects. However, there are many additional operational factors which are known to contribute to fatigue. These factors are specific to the operational environment and may include but are not limited to:

- night flying
- time critical operations
- cockpit temperature and pressurisation
- environmental degradation
- lack of automation
- route variations
- aerodrome unfamiliarity and
- high noise or vibration levels.

5.2.3 CASA has only provided minimal consideration of these influences within the limitations, for example, the number of sectors flown. Operators should consider their circumstances using prior company experience, or discussions with other operators and groups so that operationally specific fatigue hazards may be identified within their operations manual.

- 5.2.4 To set the limits for each of appendices 2-6 as wide as reasonably possible CASA relies on operators to proactively manage their FCM fatigue within the parameters of each appendix. For this reason, simply copying the maximum limits from an appendix into the operator's manual is not permitted without an attendant fatigue hazard risk identification. Without the operator enhanced obligations CASA would have been obliged to set limits to a lower level – as is the case with Appendix 1 where the enhanced obligations do not apply.
- 5.2.5 Hazard identification requires formalised processes, which may include:
- hazard identification workshops (i.e., group brainstorming)
 - risk assessments (i.e., formal risk assessments can uncover new hazards)
 - hazard reporting
 - hazard logging in registers (e.g., through electronic systems).
- 5.2.6 Hazards do not occur in isolation and may combine in unforeseeable ways. Seemingly trivial hazards when co-occurring may result in undesirable outcomes, incidents and/or aircraft accidents.
- 5.2.7 The methods for hazard identification should be commensurate with the proposed extent of the limits in the applicable appendices. If the proposed limits in the operations manual are at, or near, the limits in the applicable appendices, CASA expects that the operator would have reactive, proactive, and even predictive hazard identification processes in place to ensure fatigue risk is managed properly.
- 5.2.8 Hazards can be identified from a range of sources including, but not limited to:
- pilots input from their experience of particular types of operations
 - development of risk scenarios
 - trend analysis
 - fatigue reports
 - feedback from training
 - safety surveys and operational oversight safety audits
 - monitoring of normal operations
 - use of appropriately validated biomathematical models
 - State investigation of accidents and serious incidents
 - literature review of the relevant topical areas (i.e., SMS, FRMS studies)
 - information exchange systems (similar operators, regulators etc.).
- 5.2.9 Having an active database of reported or potential operational hazards enables an organisation to:
- identify 'hot spots' of fatigue risk that need particular attention
 - conduct trend analysis that can provide the basis for improvement of hazard identification.
- 5.2.10 The value of information provided by FCMs regarding factors which may increase fatigue risk cannot be underestimated. These factors should be considered in a similar way as general operational-specific hazards. For example, when FCMs report on issues concerning commuting to work, the additional time or conditions of the commute spent is a hazard. Specifically, increased hours of sustained wakefulness or levels of stress or

cognitive workload during the commute could adversely affect their alertness during their duty or on their subsequent commute home.

- 5.2.11 Fatigue hazards should be dealt with in two ways:
- a. when determining flight and duty time limitations
 - b. as part of continuous improvement of policies and practices.
- 5.2.12 Biomathematical models of fatigue can assist operators by providing predictions of human fatigue and/or sleep opportunity factors that can assist the fatigue management regime. A primary role of many models is to provide a strategic rostering support tool aimed at providing initial indications on fatigue likelihood for newly developed or modified rosters. Models can also assist incident or accident investigation by assessing the fatigue risk associated with actual duty and sleep data.
- 5.2.13 While not mandatory, biomathematical models of 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. Biomathematical fatigue models 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
 - incomplete description of all fatigue physiology factors
 - using predicted rather than actual time asleep
 - limited testing (validation) against aviation specific conditions (i.e. cabin pressurisation, workload).
- 5.2.14 Because each model has different strengths and limitations, CASA's recommended approach is to consider a range of predictive processes (including biomathematical models) to identify fatigue hazards. When using a biomathematical model, CASA suggests the operator take a cautionary approach, which considers the model's limitations and validity in that particular operational context (i.e., whether it has been validated against fatigue data from operations similar to those the operator is undertaking). When making decisions about roster design, model predictions should not be used without reference to operational experience and conditions.
- 5.2.15 A low fatigue score for an FDP generated by a biomathematical model does not guarantee that fatigue risk will be low.
- 5.2.16 For further details about comparing the properties, strengths and limitations of various fatigue models, refer to the [Biomathematical Fatigue Models Guidance Document](#) available on the CASA website. A fatigue management regime should be designed as a comprehensive, multi-layered system in which biomathematical models provide an optional supportive role.

5.3 Setting limitations taking into account hazards

- 5.3.1 When determining flight and duty time limits, operators need to consider the unique needs of their operational environment and tailor the regulatory promulgated limitations

accordingly. This operational environment changes over time such as changes in planned activities, aircraft or external changes. Consequently, any changes need to be appropriately risk assessed. The operator also needs to regularly revisit and modify flight time and duty limits to ensure continued relevance to current operations.

- 5.3.2 Operators should consider the consequences of organisational or operational changes on fatigue and crew performance. Where fatigue-related issues arise associated with changing operations (e.g. different routes), or introducing new operations, operators should consider further mitigations to manage fatigue and crew performance. To assess the risk of any change, a risk assessment should be conducted, which includes looking at the likelihood and consequences of fatigue risks associated with that change.
- 5.3.3 CASA surveillance activities will expect evidence of risk assessment and change management in assessing fatigue limits, even if significant change is not warranted.
- 5.3.4 Any changes to limits identified as part of the risk mitigation process are documented in the operations manual as a new set of limits. It is acceptable to have unique limits for a specific operation to address the fatigue risk identified for that operation, subject to the unique limits also complying with the prescriptive limits of the relevant appendix.
- 5.3.5 While CAO 48.1 is primarily concerned with the impact of fatigue on planned flying activity, operators should also consider the impact of fatigue on the quality of simulator training.
- 5.3.6 All types of training (in an aircraft, simulator, classroom or CBT) could potentially affect the alertness of FCMs and their subsequent operational performance. From a workload perspective the monitoring or training of another FCM is often more fatiguing than regular operations. Operators should consider an appropriate reduction in maximum FDP limits when the FDP includes a period of training beyond the prescriptive limits on training flight time.
- 5.3.7 Training flights in a simulator are considered duty and must be included in an FDP if they are conducted prior to a flight and are not separated from that flight by a prior off duty period. While a simulator training that is conducted after the last flight in a duty period does not need to be included in the FDP, consideration of the fatigue associated with the increased cognitive workload and time awake should be taken in the scheduling of the FCM(s) involved.

5.4 Continuous improvement of policies and practices

- 5.4.1 Operators need to monitor and evaluate the effectiveness of their fatigue management controls, such as policies and practices. Where controls are found to be inadequate or ineffective, the operator must address deficiencies as part of their continuous improvement.
- 5.4.2 Monitoring and evaluation processes within the enhanced fatigue management obligations would readily be met through the collection and analysis of fatigue related data gathered under operational circumstances. The collecting of fatigue data may improve an organisation's performance across a number of domains. For example, the addition of data will help inform the organisation of the effectiveness of mitigation efforts, such as training and scheduling.

- 5.4.3 Data could be collected from a variety of sources including fatigue surveys, sleep and work diaries, fatigue scales (e.g., the Samn-Perelli Fatigue scale), or objective measurements of performance. Appendix G contains additional guidance on data collection and evaluation procedures.
- 5.4.4 Policies and practices to consider include:
- scheduling and rostering practices
 - layover accommodation conditions
 - augmented crew procedures
 - rest / sleep facilities
 - training syllabi
 - fatigue countermeasures.
- 5.4.5 For instance, a small operator conducting early starts (i.e., WOCL infringing) should account for potential sleep debt the scheduling produces by systematically reducing FDP's prior to the mandatory 3 consecutive WOCL rule. Additionally, there are numerous potential interventions such as breaks for rest, controlled rest in the cockpit, limits on secondary duties that may also reduce potential fatigue related performance decrements.
- 5.4.6 Similarly, a large operator running long-haul routes across international time zones should have established policies for considering their operational needs when selecting and booking accommodation for FCMs. These accommodation venues should be able to meet policies addressing at least the following:
- noise management
 - temperature control
 - light-blocking facilities.
- 5.4.7 Where available, an operator should make use of their SMS for this process. For operators without an SMS, Appendix F provides further examples of the types of hazards that may need to be addressed.
- 5.4.8 Safety meetings, fatigue reports and incident investigation should inform an AOC regarding the need for potential changes in fatigue policies and practices. Consideration of the contribution of fatigue from operator processes such as FDAP and LOSA may highlight sectors with suboptimal levels of operational performance which could be indicative of fatigue risks.
- 5.4.9 An operator's policies and practices should be always be reassessed for adequacy when there are adjustments to:
- schedules
 - routes
 - flight time limitations
 - duty time limitations.

5.5 Transition between appendices

- 5.5.1 Depending on the operational characteristics, operators may need to incorporate multiple CAO 48.1 appendices and transition their FCMs between these appendices as required. Transitioning FCMs between different appendices may produce inconsistencies in duty/flight/standby/off-duty requirements. Procedures need to ensure the FCM remains compliant with the appropriate Appendix requirements when making these transitions. The fatigue risks resulting from transitioning between appendices within specific operating contexts and environments must be assessed and any risks identified with procedures and/or adjustment of their limits addressed by the operator.
- 5.5.2 To ensure compliance, particular consideration must be given by operators transitioning from Appendix 4B, 5 or 5A to CAO 48.1 (medical transport and emergency service operations, and aerial work operations) to the other appendices. Specifically, standby rules are dealt with differently in these appendices (to provide more flexible standby arrangements) and, therefore, may conflict with the requirements and limits in other appendices. Subsection 13A of CAO 48.1 sets out specified days off when transitioning from Appendix 4B, 5 or 5A to another appendix. Further guidance about operating under multiple appendices is contained in Appendix B.

5.6 Fatigue training and assessment

- 5.6.1 Operators are required to conduct fatigue training and assessment. To meet their obligations, operators should:
- allocate adequate resources for fatigue training (including trainers, materials and time)
 - review the training package against current and world's best practice in fatigue science in both content and delivery
 - accept that the benefits of fatigue training will not be realised without management endorsement with ongoing investment, effort and operational reinforcement.
- 5.6.2 There are three main subject areas which form the substance of a suitable fatigue training program (fatigue, sleep and countermeasures). The following is a basic list of topics that would comprise these subject areas:
- Fatigue:
 - o types of fatigue
 - o contributors to fatigue
 - o consequences of fatigue on safety
 - o fatigue in accidents
 - o high risk situations.
 - Sleep:
 - o sleep physiology
 - o circadian body clock
 - o the sleep-wake cycle
 - o amount of sleep required
 - o sleep debt and recovery
 - o quality of sleep

- o sleep disorders and individual differences
 - o shift work
 - o jet lag.
 - Countermeasures:
 - o managing sleep habits
 - o tailoring the sleep environment
 - o napping
 - o exercise
 - o nutrition and hydration
 - o caffeine
 - o avoidance of alcohol
 - o use of sleep aids
 - o avoidance of nicotine
 - o keeping a sleep log.
- 5.6.3 In addition to these generic fatigue management topics, operators should tailor their training programs to include relevant topics for their own operation. For example, training should provide FCMs with an understanding of the specific fatigue hazards being addressed within the operator's operations manual procedures, limits and operator and the individual obligations being highlighted.
- 5.6.4 Training must be conducted on an initial and recurrent basis. The interval between training should be determined by the operator, given their operational characteristics and training needs analysis. A training interval of not more than three (3) years is recommended; however, where an operator identifies a need for training at closer intervals, this should be acted on.
- 5.6.5 The training required by CAO 48.1 may be integrated with other training conducted by an operator (i.e. human factors/non-technical skills training).
- 5.6.6 Fatigue training must be assessed against a designated standard that is consistent with the level of training provided.
- 5.6.7 A goal of assessment is to determine to what extent those participating in the training program are learning the material. Different phases of training (awareness, knowledge and skills) will entail different forms of assessment. Operators should be mindful that the assessment(s) are being conducted across multiple domains (i.e., multiple choice, free text, and verbal responses).
- 5.6.8 Another goal of assessment is to act as a feedback mechanism to permit adaptive changes to training content and methods of instruction for training whether it is being maintained within an AOC or conducted by an external contractor. The diagnostic use of assessment to provide feedback to instructors and students during a program of instruction is an element of formative assessment.
- 5.6.9 The other main form of assessment (referred to as summative assessment) traditionally uses a behavioural evaluation or written paper after a specified period following training to enable judgements about what measurable level of learning has occurred. Essentially, it provides insight into how well the material has been integrated into the FCM's professional and personal repertoire of fatigue management behaviours.

- 5.6.10 The use of formative and summative assessment enables an AOC to adjust the practice and design of fatigue training (i.e. re-teaching/revision, implementing alternative instructional approaches, and adding extra opportunities for practice) to the specific operational conditions present within an organisation.
- 5.6.11 Assessment criteria should be drawn from the initial fatigue training needs analysis of the organisation. Training personnel are encouraged to use all available information about fatigue hazards (i.e., experience, reports, survey feedback, scientific papers) to develop assessment criteria tailored to a particular operation. CASA has published a Fatigue Management Toolkit on its website including material that may be useful in developing and facilitating a fatigue management training course.

Appendix A

The Appendices of CAO 48.1

A.1 Choosing which Appendix of CAO 48.1 to operate under

A.1.1 The appendix or appendices of CAO 48.1 available for use by an operator depends on the types of operations being conducted. Multiple appendices may be appropriate for a particular type of operation, and it is up to an operator to determine which appendix or appendices is/are suitable for them given their unique circumstance.

A.1.2 It is impossible to design a single set of prescriptive limits that are relevant for every type of operator and operation. CAO 48.1 provides multiple appendices with prescriptive limits relevant to different sectors of industry.

A.1.3 Appendix 1 - basic limits

A.1.3.1 Appendix 1 is available to all operators conducting any type of operation. However, the window within which an FDP may be undertaken does not permit operations in the early hours of the morning (between 1am and morning civil twilight/7am, whichever is earlier).

A.1.4 Appendix 2 - multi-pilot operations except flight training

A.1.4.1 Appendix 2 is available to operators that conduct operations with multi-pilot procedures. As well operations that involve multi-pilot certified aircraft, the appendix is also available to operators who conduct operations with 2 or more pilots in a single-pilot certified aircraft.

A.1.4.2 While operations that involve contracted checking or contracted recurrent training conducted as a multi-pilot operation are permitted under Appendix 2, flight training for the grant of a licence, rating or endorsement must not be conducted under this appendix.

A.1.5 Appendix 3 - multi-pilot operations except complex operations and flight training

A.1.5.1 Appendix 3 is available to multi-pilot operations as per Appendix 2 but excludes 'complex operations'. A complex operation is one that involves augmented crew operations (carrying more than the minimum number of FCMs for the purpose of relieving one or more FCMs of duty during flight time), operations that involve a displacement time of two (2) hours or more (where a time zone change from the beginning to the end of the duty period is two (2) hours or more), or operations where an FCM is not acclimatised to the location where they commence an FDP.

A.1.5.2 Simple multi-pilot operations that do not cross time zones may find Appendix 3 more suitable than Appendix 2. Appendix 2 is available to these operators and the resulting limitations would be the same; however, Appendix 3 does not have the complexity of Appendix 2.

A.1.6 Appendix 4 - any operations

A.1.6.1 Appendix 4 is designed for single pilot operations; however, nothing prevents an operator using this appendix for multi-pilot, aerial work or flight training operations. Use of a single appendix for all operations can significantly simplify fatigue management procedures.

A.1.7 Appendix 4A - balloon operations

A.1.7.1 Appendix 4A is available and tailored specifically to operators that operate balloons.

A.1.7.2 However, nothing prevents a balloon operator from choosing either Appendix 1, 4 or 7 instead of this appendix if they prefer.

A.1.8 Appendix 4B - medical transport operations and emergency service operations

A.1.8.1 For an operator to conduct an operation under Appendix 4B, the operation must be a medical transport operation, or an emergency service operation. These terms have specific meanings in CAO 48.1. The appendix is tailored around the operating characteristics in this segment of the industry.

A medical transport operation means an aircraft operation consisting of one or more flights for any of the following purposes:

- a. delivery of urgent medical assistance to a person, when determined to be necessary by a medical transport tasker
- b. transportation of any of the following, when determined to be necessary by a medical transport tasker:
 - i. an ill or injured person
 - ii. another person directly involved with the person mentioned in sub-subparagraph (i), for example, a close relative or the police
 - iii. medical personnel intended to be or who are directly involved with the person mentioned in sub-subparagraph (i)
 - iv. blood, tissue or an organ for transfusion, grafting or transplantation (an item), including a person who has authorised custody of the item
- c. the return of the aircraft to its base because an operation mentioned in subparagraph (a) or (b) is completed.

An emergency service operation means an operation involving an aircraft:

- a. for the purpose of law enforcement, or saving or protecting life or property, and
- b. conducted by, or at the request of, an organisation recognised by an Australian governmental agency as having responsibility to conduct or request the operation as part of the organisation's functions.

A.1.8.2 For an operation to be classified as a medical transport operation, there must be procedures in place that set out the means and considerations by which the medical transport tasker (medical personnel or an organisation whose purpose is, or whose purposes include, medical transport tasking) determines that a flight is medically necessary. Such matters should include, at a minimum, a risk assessment considering the nature of the flight(s).

- A.1.8.3 If an operator does not have procedures that allow an operation to be classified as a medical transport operation or emergency service operation, Appendix 4B is not available to them and a different appendix of CAO 48.1 must be complied with.
- A.1.8.4 If an operator also conducts charter operations, another appendix, such as Appendix 4, would need to be complied with when conducting such operations. Special provisions apply for transitioning from Appendix 4B to another appendix (refer to section B.2.2 of Appendix B to this CAAP).

A.1.9 Appendix 5 - aerial work operations and flight training associated with aerial work

- A.1.9.1 Appendix 5 is available to all operations that are classified as aerial work under the *Regulations*. Flight training associated with aerial work (i.e. training for the grant of certain ratings and endorsements that permit typical aerial work-type operations) may also be permitted under Appendix 5.
- A.1.9.2 Operators who conduct non-aerial work operations, such as charter operations will need to consider a different appendix, for example Appendix 4, when conducting such operations. Special provisions apply for transitioning from Appendix 5 to another appendix (refer to section B.2.2 of Appendix B to this CAAP).

A.1.10 Appendix 5A - daylight aerial work operations and flight training associated with aerial work

- A.1.10.1 Similar to Appendix 5, Appendix 5A is available to all operations that are classified as aerial work under CAR, but it is restricted to operations that are conducted during daylight hours, for example, helicopter mustering operations. Flight training associated with aerial work (i.e. training for the grant of certain ratings and endorsements that permit typical aerial work-type operations) may also be permitted under Appendix 5A.
- A.1.10.2 Operators who conduct non-aerial work operations, such as charter operations, will need to consider a different appendix, for example Appendix 4, when conducting such operations. Special provisions apply for transitioning from Appendix 5A to another appendix (refer to section B.2.2 of Appendix B to this CAAP).

A.1.11 Appendix 6 - flight training

- A.1.11.1 Appendix 6 is available to and suitable for operators who solely conduct flight training (training for the grant of a licence, rating or endorsement under Part 61 of the *Civil Aviation Safety Regulations 1998 [CASR]*), including multi-pilot flight training.
- A.1.11.2 If an operator conducts single-pilot flight training as well as other single-pilot operations, the limitations in Appendix 4 could be chosen instead of Appendix 6, therefore keeping all operations under the one appendix.

A.1.12 Appendix 7 - fatigue risk management system

- A.1.12.1 Appendix 7, which allows an operator to manage FCM fatigue risk under an FRMS, is available to all operators. This permits an operator to develop and implement their own unique set of limitations which, subject to CASA approval, may differ from the prescriptive limitations.

A.1.12.2 This CAAP does not deal with the development or implementation of an FRMS. An operator contemplating an FRMS should consider the guidance material available on the CASA website, as well as the guidance material published by ICAO upon which CASA bases its assessment and oversight.

Appendix B

Operating under multiple Appendices of CAO 48.1

B.1 General

- B.1.1 Operating under multiple appendices means either, or both, of the following:
- combining multiple appendices within a single FDP
 - switching from one appendix to another on consecutive FDPs.
- B.1.2 Operating under multiple appendices requires a two-step process. The first step is to ensure the FCM is within the limits of the new appendix prior to transitioning. Then, if the FCM will be operating to more than one appendix in an FDP, the second step is to determine the limits that will apply to the proposed FDP.
- B.1.3 Within CAO 48.1, the following sections need to be considered when developing procedures for operating under multiple appendices and, in particular managing fatigue risk through transitions from one appendix to another:
- subsection 10
 - subsection 13
 - subsection 13A, if operating under Appendix 4B, 5 or 5A or Subpart 137.Q of CASR
 - paragraph 15.2 (d).
- B.1.4 Subsection 10 of CAO 48.1 requires:
- each operator to comply with limits and requirements mentioned in the applicable appendices
 - each FCM, employed by the operator, to comply with the limits in the appendices the operator has chosen to comply with.
- B.1.5 In some circumstances, meeting all the requirements of an appendix prior to operating under that appendix could potentially be more restrictive than is necessary to manage potential fatigue risk associated with transitioning.
- B.1.6 The requirements for combining multiple appendices within a single FDP have specific requirements that are addressed within subsection 13 of CAO 48.1, and operators must have procedures that comply with these requirements.
- B.1.7 If transitioning from Appendix 4B, 5 or 5A or Subpart 137.Q of CASR to another appendix, subsection 13A of CAO 48.1 sets the number of off-duty days that must be taken prior to commencing an FDP under an appendix other than Appendix 4B, 5 or 5A or Subpart 137.Q of CASR.

B.2 What to do before allowing changes from one appendix to another

- B.2.1 An operator must identify the hazards associated with their FCMs transitioning between appendices and manage the risks through the application of limits and transition procedures, in accordance with subparagraph 15.2 (d) of CAO 48.1. This is to ensure that transitions do not result in an increase in risk to aviation safety.

B.2.2 Transitions from Appendix 4B, 5 and 5A to other appendices

- B.2.2.1 Appendices 4B, 5 and 5A have no requirement for a specific number of off-duty days to be completed across a 28-day period for cumulative fatigue recovery. This may result in

an FCM having less off-duty days than the minimum required to commence an FDP under Appendix 2, 3, 4 or 6.

- B.2.2.2 If an operator wanted to transition an FCM from Appendix 4B, 5 or 5A operations to charter work under Appendix 4, the FCM must first meet all the cumulative requirements of the new appendix. This includes the six (6) days off in 28 days requirement contained in Appendix 4.
- B.2.2.3 Paragraph 13A.2 allows for a short-term transition to another Appendix (other than to Appendix 1) without the FCM meeting the cumulative off duty requirement of six (6) days off in 28 days. However, certain conditions must be met:
- the off-duty period immediately before the first FDP or standby under the other Appendix is at least 12 hours
 - the report time for the FCM for the first FDP is not earlier than 0700 hours local time
 - the FCM's previous FDP was less than eight (8) hours
 - the first FDP is less than eight (8) hours in duration
 - after the first FDP, there is only one subsequent FDP, also of less than eight (8) hours, before the six (6) days off in 28 days requirement must be complied with.
- B.2.2.4 Subparagraph 15.2 (d) of CAO 48.1 requires that transitions between appendices do not adversely affect aviation safety. Operators should monitor the fatigue levels of FCMs and increase minimum periods if required. An example of a way an operator could monitor this is via surveys or regular meetings to discuss fatigue with the FCMs involved (the effectiveness of this approach would depend on the safety culture evident in the organisation at the time).

B.3 Operating under two or more appendices in a single FDP

- B.3.1 If the operator intends to undertake operations where two or more appendices apply to a single FDP, the operations manual must contain procedures that ensure that:
- the maximum FDP is the FDP limit that applies to the specific activity that is being conducted at the time. The maximum FDP for the activity that is being conducted at any one time is always based on the start time of the entire FDP, not the point in time when the FCM switched to that activity⁴.
 - the maximum flight time that an operator and an FCM must comply with is the flight time limit contained in the appendix under which the operation is being conducted at that particular time (based on the assumption that the entire FDP was conducted under that appendix). It must be based on the original start time of the FDP, not on the start time of operations under each appendix.

⁴ For example, if the operator rosters the FCM for an aerial work flight under Appendix 5 prior to a non-aerial work flight (e.g. charter under Appendix 4), then before the FCM transitions to the charter flight, the FCM must be able to conduct the planned charter flight within the maximum FDP limit worked out under the charter limits. This means the charter flight(s) must end within the maximum FDP limit calculated under the charter limits based on the start time of the duties associated with the aerial work flight as if the FCM had been conducting charter since that start time (refer to Figure 2).

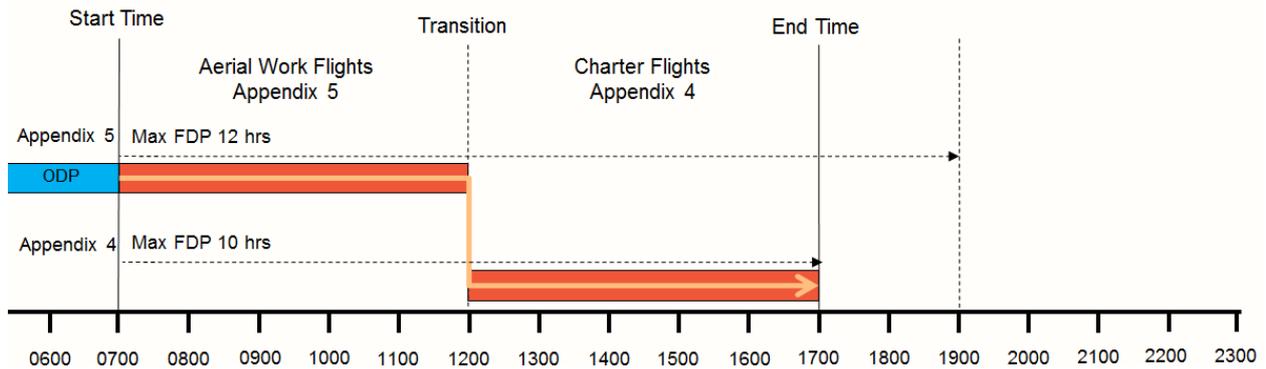
- the ODP that must be applied following the FDP is the greater of the minimum ODPs. This is calculated by assuming the entire FDP was conducted under each appendix. For example, the procedure should require that:
 - o the operator works out the minimum ODPs required (if the entire FDP was conducted under each appendix)
 - o the longest minimum ODP that was calculated is then the minimum ODP, which must be completed before the FCM can commence another FDP under any appendix.

Operating under two or more appendices in a single FDP – Maximum FDP

Procedure:

- Determine the maximum FDP limit for Charter (Appendix 4) from the Aerial Work start time
- In this example it is 10 hours (from Appendix 4) however it should be the limit in the operations manual
- The charter flight must end at least 15 minutes before 1700 (0700 + 10 hours)

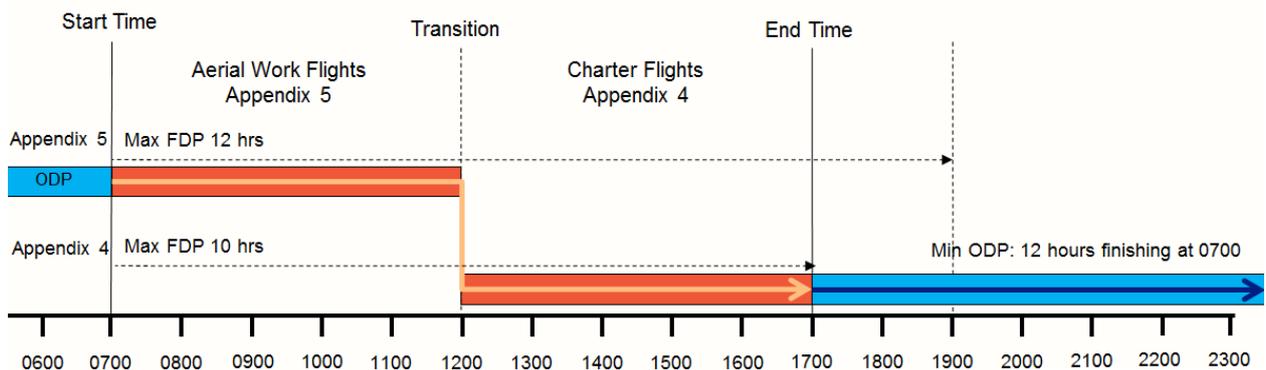
Note: If the order of flights were reversed with aerial work second, the FDP could run until 1900



Operating under two or more appendices in a single FDP – Minimum ODP

Procedure:

- Establish the total length of FDP: 10 hours in this case
- Work out the minimum ODP if the whole FDP was completed under each appendix:
 - Aerial Work – Appendix 5: 10 hours (8 hours would not include 2300 and 0529 local time)
 - Charter – Appendix 4: 12 hours at home base (10 hours away from home base)
- As the FCM is at home base the minimum ODP is 12 hours (the higher of the minimum ODPs)



Appendix C

Developing operations manual content - CAO 48.1 limits and associated requirements

C.1 Introduction

- C.1.1 The guidance material in this appendix can be used to develop content for an operations manual to ensure it has satisfactory procedures and limits for the clauses in each appendix that an operator wishes to adopt and comply with (i.e. split duty, augmented crew operations, standby, positioning etc.).
- C.1.2 Each section of this appendix has been divided up according to the clauses in each of the appendices of CAO 48.1. For each clause, there is an introduction setting out the general rationale for the limits and/or requirements, as well as a section entitled 'What should be in your operations manual' including specific aspects for each appendix of CAO 48.1. Readers should consider the information for the appendix or appendices relevant to their operation.
- C.1.3 An operator's operations manual could be structured to contain limits and requirements under the following headings:
- Sleep opportunity before an FDP or standby
 - FDP and flight time limits
 - Increase in FDP limits by split duty
 - Increase in FDP and flight time limits in an augmented crew operation (Appendix 2 only)
 - Delayed reporting time
 - Reassignment and extension
 - Standby limits and standby-like arrangements
 - Positioning
 - Off-duty period (ODP) limits
 - Limit on cumulative flight time
 - Limit on cumulative duty time
 - Limits on infringing the WOCL and early starts.

C.2 Sleep opportunity before an FDP or standby

C.2.1 Introduction

- C.2.1.1 An FCM needs to have adequate sleep prior to an assigned FDP to be well rested for the FDP. In general, an FCM should have the opportunity to sleep for at least eight (8) consecutive hours, ideally ending as close as reasonably practicable to the start of the FDP.
- C.2.1.2 There are minimum sleep opportunity requirements in all appendices except Appendix 4B and 5; however, Appendix 4B and 5 have a requirement that, if duties are undertaken in the eight (8) hours immediately preceding an FDP, a reduction in the available FDP duration is then required.
- C.2.1.3 There should be mutual understanding between the FCM and the operator as to where the sleep opportunity sits within the period preceding the FDP.
- C.2.1.4 The FCM should not be contacted by the operator during the prior sleep opportunity, except in a manner that could reliably be expected not to interrupt the FCM if they were

asleep. Normal circumstances refer to those situations in which the operator wishes to preserve the prior sleep opportunity. Abnormal circumstances refer to the case where the operator needs to contact the FCM, and it is understood that this will mean that the prior sleep opportunity has been interrupted. The FCM will then not be able to commence the FDP without completing a period of prior sleep opportunity commencing from the end of the interruption. An example of when this might occur is if the operator needs urgent information from the FCM, such as airworthiness related information about an aircraft the FCM flew in the previous FDP, and the operator has decided it cannot wait until the prior sleep opportunity is over.

Example:

If the commute time at a particular away base location is 15 minutes, then the operator must ensure the ODP allows for:

- commuting to and from the suitable sleeping accommodation (in this case 30 minutes in total)
- a period sufficient for meeting the reasonable requirements of bodily functioning, i.e. eating, drinking, washing and dressing (60 minutes might be appropriate)
- the required minimum sleep opportunity (eight (8) hours).

As in this example, there will be many cases where the minimum ODP will more than cover the requirements to ensure an eight-hour prior sleep opportunity; however, when longer periods are required, such as when commuting time is longer, where extended hotel check-in or check-out times are required or extended customs/quarantine clearance periods are required, then the ODP may need to be extended to ensure the eight-hour prior sleep opportunity.

C.2.1.5 The requirement for prior sleep opportunity may result in an increased minimum ODP at some locations if there is not sufficient time available for the prior sleep opportunity. Table 1 below can be used to help determine the required minimum ODP to ensure the minimum sleep opportunity requirements are met.

Table 1 - Calculating an off-duty period taking into account commute time and sleep opportunity

Requirement	Time required	ODP
Commute time to suitable sleeping accommodation from the end of prior duty period	____ hours: minutes	Determine minimum ODP using the limits in Section C9 and enter below:
Sufficient time for the reasonable requirements of bodily functioning, such as eating, drinking, washing and dressing	____ hours: minutes	
Prior sleep opportunity	eight (8) hours	
Commute time from suitable sleeping accommodation to sign-on	____ hours: minutes	
Total time	____ hours: minutes	_____ hours
Actual Minimum ODP (higher of two totals in the row above)	____ hours: minutes	

C.2.2 What should be in your operations manual

C.2.2.1 Where there is the requirement for prior sleep opportunity (in all appendices except Appendix 4B and 5), the operations manual should have:

- the operator’s policy for managing the prior sleep opportunity requirements so that FCMs are aware when sleep should be planned with reference the start time of their assigned FDPs. This policy should be determined after consultation with FCMs.
- procedures to ensure that the minimum sleep opportunity prior to an FDP or standby can be met within rostered off-duty periods.
- procedures directing the operator’s employees not to interrupt the FCM’s sleep opportunity when contacting FCMs prior to the start time of an FDP.
- procedures detailing specified contact methods and protocols that have proven to be effective at not interrupting the FCM’s prior sleep opportunity, as well as identifying and communicating suitable times of contact⁵.
- procedures to ensure that, as far as reasonably practicable, each FCM is aware that they have a responsibility to make appropriate use of the sleep opportunity prior to commencing an assigned FDP (or standby period, if standby is allowed by the applicable appendix) to achieve adequate alertness for the assigned FDP.

Note: Required procedures could be as simple as ensuring FCMs, rostering personnel and all those that might have reason to contact an FCM prior to an FDP, have been informed of this requirement on induction into the company. They should all be made aware that any contact (other than in accordance with the

⁵ These procedures should be in a form that is clear and readily available to the operator’s employees who are involved in rostering activities, as well as affected FCMs.

operator's procedures) during the sleep opportunity period, has the potential to impact the FCMs fitness for duty for the subsequent FDP.

Appendix 1

The operations manual must have procedures to ensure that an FCM has at least:

- eight (8) consecutive hours of sleep opportunity at home base within the 12 hours immediately preceding the start of an FDP
- eight (8) consecutive hours of sleep opportunity if away from home base, within 10 hours immediately preceding the start of an FDP.

Appendices 2, 3 and 4

The operations manual must have procedures to ensure that an FCM has at least:

- eight (8) consecutive hours of sleep opportunity at home base within the 12 hours immediately preceding the start of an FDP or standby
- eight (8) consecutive hours of sleep opportunity if away from home base, within 10 hours immediately preceding the start of an FDP or standby.

The operations manual should reflect that, if an FDP is delayed:

- the requirements for sleep opportunity relate to the original FDP start time rather than the delayed start time when the delay is less than 10 hours
- when there is a single delay of 10 or more hours, the prior sleep opportunity is required before commencing the FDP at the delayed start time, and (if the operator has procedures for delayed reporting time) may be taken during the period of the delay.

Appendix 4A

The operations manual must have procedures to ensure that an FCM has at least either:

- eight (8) consecutive hours of sleep opportunity in the 10 hours immediately preceding the FDP, or
- 10 consecutive hours of sleep opportunity, of which at least six (6) must be consecutive, within the 24 hours immediately before commencing the FDP.

Appendices 4B and 5

Appendix 4B and 5 deal with the need for adequate sleep prior to an FDP differently than the other appendices. These appendices stipulate that if the operator requires the FCM to perform non-flying duties in the eight-hour period immediately prior to the start of the FDP, the maximum allowable FDP is reduced by the duration of time it took to complete those non-flying duties or by 30 minutes (whichever is greater).

The intent of this requirement is that the maximum FDP is reduced by any time away from suitable sleeping accommodation that results from the operator requiring the performance of non-flying duties. Therefore, any time spent commuting between suitable sleep accommodation and the location where the operator requires the non-flying duties to be performed should also be included in the time it took to complete the duties.

This requirement does not apply to an FCM voluntarily doing a task that would otherwise be considered a duty. This is particularly the case if the FCM was doing the task as part of a personal means of reducing anxiety.

Operators should not take advantage of an FCM engaging in voluntary activities prior to an FDP that would otherwise be considered required duties.

An operator must not schedule FDPs in such a manner that there is so little time available prior to the flight that meeting the flight commencement time is only achievable if the FCM accomplishes the required activities prior to the FDP commencing. In this case, the activities can no longer be considered voluntary.

Appendix 5A

The operations manual must have procedures to ensure that an FCM has at least eight (8) consecutive hours of sleep opportunity in the 10 hours immediately preceding the FDP.

Additionally, on each of the three (3) nights immediately prior to the FDP, the FCM must not have carried out any duties during the eight (8) hours prior to 30 minutes before morning civil twilight at the location (i.e. typically the early hours of the morning).

Appendix 6

The operations manual must have procedures to ensure that an FCM has at least eight (8) consecutive hours of sleep opportunity in the 12 hours immediately preceding the FDP.

C.3 FDP and flight time limits

C.3.1 Introduction

C.3.1.1 Limiting the duration of FDPs and flight time within an FDP is a key aspect of the management of fatigue. CAO 48.1 has FDP limits in all appendices. These are based on scientific principles and consider a number of factors, such as the time the FDP starts and the number of sectors to be flown in the FDP.

C.3.1.2 FDP limits for complex, multi-pilot operations, also take into account the acclimatised state of the FCM (affected by crossing time zones) and whether the flight crew is an augmented crew (carry additional FCMs for the purposes of relieving one or more of the flight crew during cruise).

C.3.1.3 Flight time limits are also specified for multi-pilot operations and for flight training.

C.3.1.4 CAO 48.1 includes a requirement for hazard identification and risk management for many operators (those complying with Appendices 2 to 6). The effect of this is that the limitations specified in the appendices to CAO 48.1 may need to be modified by an operator in order to mitigate fatigue risks to an acceptable level (refer to Appendix F of this CAAP).

C.3.2 What should be in your operations manual

C.3.2.1 The operations manual needs to include procedures (a roster system) to ensure that the FCM is not assigned an FDP longer than the number of hours specified in the

operations manual, which themselves must not exceed the limits in the applicable appendix.

- C.3.2.2 Documented limits should be communicated to staff, and the rostering practices should ensure that FDPs are assigned in such a manner that they provide sufficient allowance for the intended flight(s), as well as a sufficient period for pre- and post-flight duties that reasonably takes into account unavoidable requirements, such as:
- passenger check-in
 - passenger boarding duties
 - manifest, load and balance document completion
 - customs and immigration
 - pre-flight aircraft inspections and pilot maintenance (replenish oils etc.)
 - post-flight duties (i.e. flight and duty time data entry, aircraft cleaning, compressor washing, and any additional pilot maintenance).
- C.3.2.3 Training flights in a simulator are considered duty and, like all duty, must be included in an FDP if they are conducted prior to a flight and are not separated from that flight by at least a prior sleep opportunity. If the simulator training is conducted after the last flight in a duty period, it does not need to be included in the FDP. When planning any FCM training, the impact of the level of FCM fatigue on the quality of training should be considered and managed accordingly.
- C.3.2.4 Operators should not take advantage of an FCM engaging in voluntary activities prior to an FDP that would otherwise be considered required duties. An operator must not schedule FDPs in such a manner that there is so little time available prior to the flight that meeting the flight commencement time is only achievable if the FCM accomplishes the required activities prior to the FDP commencing. In this case, the activities can no longer be considered voluntary.
- C.3.2.5 If an operator records 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 of flight time), CASA deems this as acceptable.
- C.3.2.6 Likewise, for a rotorcraft operator, recording flight time from the moment the rotor blades start turning until they stop turning is also acceptable.

Appendix 1

The operations manual must have rostering procedures to ensure that:

- FDPs are only assigned to be conducted between:
 - the beginning of morning civil twilight or 0700 hours local time—whichever is earlier, and
 - 0100 hours local time of the following day
- FDPs are limited to:
 - for FDPs commencing before 0600 hours local time—eight (8) hours
 - for FDPs commencing between 0600 and 1359 hours local time—nine (9) hours
 - for FDPs commencing at or after 1400 hours local time—eight (8) hours
- not more than three (3) FDPs are assigned to finish after 2200 hours local time in a week (unless an extension results in the FDP finishing after 2200)

- if an FCM conducts flight training during an FDP, the flight training must be conducted during the first seven (7) hours flight time of the FDP. The remaining FDP may be completed conducting other, non-flight training, operations.

Note: If an FDP commences after 1700 hours on a day, the FDP must be less than eight (8) hours because an FDP must not end later than 0100 hours on the following day.

Appendix 2

Complex multi-pilot operations are typically subject to crossing time zones, and therefore may result in circadian disruption for FCMs. Therefore, FDP and flight time limits are calculated based on the location at which the FCMs ‘body clock’ is acclimatised.

Refer to Appendix D of this CAAP for guidance on acclimatisation and adaptation.

The operations manual must have procedures capable of determining whether the FCM is in an acclimatised state and, if so, where they are acclimatised to and, conversely, when they are in an unknown state of acclimatisation. These procedures must achieve the same outcome as that when using Table 2 below.

Table 2 - Determining state of acclimatisation

Difference in local time between locations	Time since FCM commenced a duty period at a location where last acclimatised	
	Less than 36 hours	36 hours or more
For a relevant location that has a difference in local time of less than two (2) hours from a location where last acclimatised	FCM is acclimatised to the relevant location.	
For a relevant location that has a difference in local time of two (2) hours or more from a preceding location where last acclimatised	FCM remains acclimatised to the preceding location where last acclimatised.	FCM is in an unknown state of acclimatisation.

There must be procedures for determining the required adaption period for an FCM who is in an unknown state of acclimatisation. The adaptation periods are specified in Table 7.1 of CAO 48.1.

The limits in the operations manual must not exceed the FDP limits for acclimatised FCMs (CAO 48.1, Appendix 2, Table 2.1) and FCMs in an unknown state of acclimatisation (CAO 48.1, Appendix 2, Table 3.1).

An FCM must not be assigned flight time of greater than 10.5 hours during a single FDP.

An FCM must not undertake more than four (4) consecutive FDPs in an unknown state of acclimatisation. Once four (4) consecutive FDPs are undertaken in an unknown state of acclimatisation, an adaptation period must then be undertaken before the FCM can undertake another FDP.

Appendix 3

The limits in the operations manual must not exceed the FDP limits in CAO 48.1, Appendix 3, Table 2.1.

An FCM must not be assigned flight time of greater than 10.5 hours during a single FDP.

Appendix 4

The limits in the operations manual must not exceed the FDP limits in CAO 48.1, Appendix 4, Table 2.1.

If an FCM conducts flight training during an FDP, the flight training must be conducted during the first seven (7) hours flight time of the FDP. The remaining FDP may be completed conducting other non-flight training operations.

Appendix 4A

The limits in the operations manual must not exceed the FDP limits in CAO 48.1, Appendix 4A, Table 4A.1.

The operations manual must have rostering procedures to ensure that an FCM does not continue in an FDP for longer than six (6) hours unless they have completed or commenced a split-duty rest period of at least four (4) consecutive hours.

Appendix 4B

The limits in the operations manual must not exceed the FDP limits in CAO 48.1, Appendix 4B, Table 1.1; however, twice a week, the FDP limit may be increased to 12 hours (for a single-pilot operation) or 14 hours (for a multi-pilot operation). To take advantage of this increase, the increased FDP must be preceded by an ODP of at least 12 hours, and the following ODP must be at least 12 hours. An FDP increased under this provision must not be further increased by a split-duty rest period. Additionally, an FCM who conducts an increased FDP must have an ODP of at least 36 hours, including two (2) local nights in that week.

If an FCM conducts flight training during an FDP, the flight training must be conducted during the first seven (7) hours flight time of the FDP. The remaining FDP may be completed conducting other non-flight training operations.

Appendix 5

The limits in the operations manual must not exceed the FDP limits in CAO 48.1, Appendix 5, Table 1.1; however, twice a week, the FDP limit may be increased to 12 hours (for a single-pilot operation) or 14 hours (for a multi-pilot operation). To take advantage of this increase, the increased FDP must be preceded by an ODP of at least 12 hours, and the following ODP must be at least 12 hours. An FDP increased under this provision must not be further increased by a split-duty rest period. Additionally, an FCM who conducts an increased FDP must have an ODP of at least 36 hours, including two (2) local nights in that week.

If an FCM conducts flight training during an FDP, the flight training must be conducted during the first seven (7) hours flight time of the FDP. The remaining FDP may be completed in other non-flight training operations.

In any 168 consecutive hours, an FCM must not be assigned or conduct more than four (4) FDPs that include any time between midnight and 0459 local time.

Appendix 5A

The operations manual must have rostering procedures to ensure that:

- FDPs are only assigned to be conducted between:
 - 30 minutes before the beginning of morning civil twilight
 - the end of evening civil twilight
- FDPs are limited to 14 hours
- if an FCM conducts flight training during an FDP, the flight training must be conducted in the first seven (7) hours flight time of the FDP. The remaining FDP may be completed conducting other non-flight training operations.

Appendix 6

The limits in the operations manual must not exceed the FDP limits in CAO 48.1, Appendix 6, Table 2.1. An FCM must not be assigned flight time greater than seven (7) hours.

C.4 Increase in FDP limits by split duty

C.4.1 Introduction

C.4.1.1 For many operators, providing FCMs with a split-duty rest period during the FDP is a useful way of addressing potential fatigue risk and, therefore, allowing an increase to the FDP limit. It involves providing the FCM with an environment that is conducive to sleep or rest during an FDP, besides relieving the FCM of all duties during this period.

C.4.1.2 Making provision for split duty is not mandatory; however, if an operator's operations manual does not include procedures for split duty, this practice is not permitted.

Note: Split duty does not provide for an increased FDP limit under Appendix 1 or 5A.

C.4.2 What should be in your operations manual

C.4.2.1 If an operator chooses to incorporate split duties into their operations, their operations manual must have procedures to ensure:

- the suitability of the accommodation is assessed and meets the minimum standard:
 - o there is a different standard for sleeping accommodation and for resting accommodation. The standard for each can be found in the definitions section of CAO 48.1 and is reproduced at the start of this CAAP
 - o an FCM's home is considered suitable
 - o assessments should be ongoing to ensure continued achievement of the standard over subsequent uses of the accommodation. This means re-assessing the standard periodically, or when you have reason to believe there may be an issue with the standard provided.
- where an FDP contains a split-duty rest period, there is enough time allocated in the roster for the FCM to travel to and from the suitable sleeping or resting

accommodation and still have enough time at the accommodation to meet the minimum requirements.

- FCMs are not disturbed during the split-duty rest period. This means having specific policies and procedures that address possible sources of disturbance. Examples are a procedure for renting rooms that requires that the hotel management agree not to try to clean the room or even the rooms nearby that being used for a split-duty rest period, or a communication protocol for managing how the FCM is contacted, and how the FCM sets their mobile phone to protect against inadvertent disturbance from incoming calls.
- except for operations under Appendix 4B or 5, split duty FDPs are assigned to an FCM as part of the roster and are assigned so far in advance of the FDP as to provide the FCM to whom it applies with a reasonable opportunity to plan adequate rest before their duty.
- the time spent in the split-duty rest period is always considered as duty and is included as a part of the FDP (although, for the purposes of calculating minimum off-duty periods and cumulative duty time, the duration of the FDP may be reduced).
- the entire minimum period of access to suitable sleeping accommodation or suitable resting accommodation must be achieved prior to the end of the maximum FDP before an increase in the FDP limit is permitted.

Note: Verification of an operator's facilities for suitable resting and suitable sleeping accommodation may be required.

Things for the operator to consider:

- the management of change to the suitable sleeping or resting accommodation
- a reporting mechanism for providing feedback on the standard of the suitable sleeping or resting accommodation
- consideration of the standard of suitable sleeping or resting accommodation in a formal periodic review process.

Appendices 2, 3, 4 and 6

If an operator chooses to incorporate split duties into their operations, their operations manual must have rostering procedures that ensure:

- for suitable sleeping accommodation, access for at least four (4) consecutive hours to increase the maximum FDP by up to four (4) hours.
- for suitable resting accommodation, access for at least two (2) consecutive hours to increase the maximum FDP by half the duration of the split-duty rest period up to a maximum of two (2) hours
- for Appendices 2 and 3, after applying the increase for split duty the maximum FDP can be no more than 16 hours
- for Appendices 4 and 6, after applying the increase for split duty the maximum FDP can be no more than 15 hours

- if a split-duty rest period includes any period between the hours of 2300 and 0529 (local time) the split-duty rest period must be a consecutive period of at least seven (7) hours, with access to suitable sleeping accommodation. In these circumstances:
 - the maximum FDP may be increased, if not already permitted, by up to 16 hours for Appendix 2 and 3, and up to 15 hours for Appendices 4 and 6
 - there is no allowed discount or reduction of the length of the resulting FDP for the purposes of determining the minimum length of the subsequent ODP or to cumulative duty time calculations⁶.
- any remaining portion of an FDP following a split-duty rest period will be no longer than six (6) hours for Appendices 2 and 3 and no longer than five (5) hours for Appendices 4 and 6.

A split-duty rest period spent at suitable sleeping accommodation is a period where fatigue is being reduced; therefore, an allowance has been made to reduce the impact of the increased length of the FDP on the subsequent minimum required ODP and cumulative duty assessments.

This allowance is as follows:

- for determining the required minimum ODP following an FDP, when that FDP contains a split-duty rest period at suitable sleeping accommodation, the FDP can be deemed to be two (2) hours shorter than it actually was
- for calculating cumulative duty, an FDP that contains a split-duty rest period at suitable sleeping accommodation can be taken to be two (2) hours shorter than it actually was.

Note: This allowance is not available when the split-duty rest period includes any period between the hours of 2300 and 0529.

Appendix 4A

If an operator chooses to incorporate split duties into their operations, their operations manual must have rostering procedures that ensure:

- access to suitable sleeping accommodation for at least four (4) consecutive hours to increase the maximum FDP by the duration of the split-duty rest period
- the maximum FDP (after applying the increase for split duty) is no more than 15 hours
- that if a split-duty rest period includes any period between the hours of 2100 and 0329 (local time), the split-duty rest period is for a consecutive period of at least seven (7) hours, with access to suitable sleeping accommodation⁷
- that any remaining portion of an FDP following a split-duty rest period will be no longer than five (5) hours.

A split-duty rest period spent at suitable sleeping accommodation is a period in which fatigue is

⁶ For Appendix 2, this requirement is based on 2300 and 0529 (acclimatised time) unless the FCM is in an unknown state of acclimatisation, in which case local time is used.

⁷ In these circumstances, the procedures must ensure there is no allowed discount or reduction of the FDP for the purposes of determining the minimum length of the subsequent ODP, or cumulative duty time calculations.

being reduced; therefore, an allowance has been made to reduce the impact of the length of the FDP on the subsequent minimum required ODP and cumulative duty assessments. This allowance is as follows:

- for determining the required minimum ODP following an FDP, when that FDP contains a split-duty rest period at suitable sleeping accommodation, the FDP can be deemed to be two (2) hours shorter than it actually was
- for calculating cumulative duty, an FDP that contains a split-duty rest period at suitable sleeping accommodation can be taken to be two (2) hours shorter than it actually was.

Note: This allowance is not available when the split-duty rest period includes any period between the hours of 2100 and 0329.

Appendix 4B

If an operator chooses to incorporate split duties into their operations, their operations manual must have rostering procedures that ensure:

- for suitable sleeping accommodation, access for at least two (2) consecutive hours to increase the maximum FDP by the duration of the split-duty rest period
- for suitable resting accommodation, access for at least two (2) consecutive hours to increase the maximum FDP by half the duration of the split-duty rest period up to a maximum of two (2) hours
- the remaining length of an FDP after the split-duty rest period ends is no greater than what the FDP limit is at that time (as if a new FDP were to commence).
- the maximum FDP (after applying the increase for split duty) is no more than 16 hours.

A split-duty rest period spent at suitable sleeping accommodation is a period in which fatigue is being reduced; therefore, an allowance has been made to reduce the impact of the length of the FDP on the subsequent minimum required ODP and cumulative duty assessments. This allowance is as follows:

- for determining the required minimum ODP following an FDP, when that FDP contains a split-duty rest period at suitable sleeping accommodation, 50% of the duration of the split-duty rest period may be deducted from the total FDP duration
- for calculating cumulative duty, when an FDP contains a split-duty rest period at suitable sleeping accommodation, 50% of the duration of the split-duty rest period may be deducted.

If an FCM achieves a split-duty rest period of at least 10 consecutive hours (plus the number of hours difference in local time between the location where the rest period is undertaken and the location where the FDP commenced, if any) and the split-duty rest period is undertaken over a local night, then the FCM is taken to meet the ODP requirements. Therefore, the FCM may commence a new FDP (up to the maximum limit) immediately following the split-duty rest period.

Appendix 5

For operations specifically under Appendix 5, the procedures may reflect the less restrictive requirement that allows a split-duty rest period and commensurate extension to the FDP to be initiated and achieved after the FDP has already started, regardless of whether it was originally

assigned to the FCM. The quality and detail of the required procedures should reflect the potential increase in fatigue risk associated with this provision. Particularly the increased risk of not being able to achieve restorative sleep during the split-duty rest period at suitable sleeping accommodation when it is required at short notice.

If an operator chooses to incorporate split duties into their operations, their operations manual must have rostering procedures that ensure:

- for suitable sleeping accommodation, access for at least three (3) consecutive hours to increase the maximum FDP by the duration of the split-duty rest period
- for suitable resting accommodation, access for at least two (2) consecutive hours to increase the maximum FDP by half the duration of the split-duty rest period up to a maximum of two (2) hours
- any remaining portion of an FDP following a split-duty rest period will be no longer than six (6) hours (unless an extension is permitted).

C.5 Increase in FDP and flight time limits in an augmented crew operation

Note: Applicable to Appendix 2 only.

C.5.1 Introduction

C.5.1.1 Operations with more than the minimum required FCMs, to allow for one or more FCMs to be relieved of duty during flight time, can increase the maximum FDP limits in a multi-pilot operation and remove the flight time limit. This is known as an augmented crew operation. Increasing the maximum allowable FDP by adding extra FCMs is only permitted in operations under Appendix 2 (or Appendix 7 (FRMS)).

C.5.1.2 Augmented crew limits are in part determined by the class of crew rest facility available. Crew rest facilities need careful design and consideration to permit adequate in-flight rest and sleep requirements for crew. Classes of crew rest facilities are defined in subsection 6 of CAO 48.1. In addition, when determining the acceptability of in-flight rest facility specifications, the factors discussed in section 4.8.7 of this CAAP should be considered. CASA may conduct a physical assessment of the adequacy of in-flight rest facilities that may include consideration of the dynamic issues in-flight.

C.5.2 What should be in your operations manual

C.5.2.1 If an operator chooses to incorporate augmented crew operations and take advantage of an increase in FDP, the limits in the operations manual must not exceed the FDP limits for acclimatised FCMs (Appendix 2, Table 5.1) and FCMs in an unknown state of acclimatisation (Appendix 2, Table 5.2).

C.5.2.2 The procedures must ensure that the minimum time an FCM requires the in-flight crew rest facility, in accordance with clause 5 of Appendix 2, is available. These times are only minimums and substantially longer times in in-flight rest may be required to maintain or restore adequate alertness. As a guide, these minimums assume that the majority of the FDP is flight time, and the available rest/sleep time (cruise phase) is fully utilised and reasonably evenly distributed among FCMs. Therefore, the procedures in

the operations manual should reflect this goal of fully utilising available in-flight periods for gaining in-flight rest. It is for this reason that the number of sectors is limited for an augmented crew operation to ensure FDPs contain longer sector lengths that allow adequate time for rest/sleep.

- C.5.2.3 Procedures for assigning FCMs to an augmented crew FDP must ensure that the FCMs that are part of the operating crew at the end of the FDP are the same FCMs who commenced the first sector of the FDP.

For safety reasons, this is a critical condition. If, for example, a medical emergency required the disembarkation of an FCM during the FDP, for the flight to continue all the FCMs must be replaced with a new crew, commencing a new FDP.

It is considered that managing differing FDP limits and lengths of duty and flight time, as well as allocation of in-flight rest, for each FCM is potentially too difficult for a crew and, in particular the captain to manage safely. Given the likely pressure to support the crew and achieve the task, having one or more crew members with a significantly different fatigue level could create disparity (i.e. in the approach to extensions). Extensions should be a decision that considers the fatigue level of each FCM independently; however, when only one FCM needs the extension, the other crew members may not support the decision to not extend.

Additionally, one fatigue mitigator for a crew is the general extrapolation of the FCM's level of fatigue to the crew. When one crew member identifies that they feel fatigued, they should bring it up with the crew for discussion and management and/or start to monitor the rest of the crew more closely. If a crew includes significantly different duty times, understanding when each is fatigued becomes far more difficult and less likely to be managed effectively. This added level of complexity should be managed under an FRMS.

- C.5.2.4 To use augmented crew operations, the operations manual must detail required augmented crew procedures. Appropriate augmented crew procedures should include:
- the requirement to designate a pilot responsible for making command decisions at all times that the PIC is accessing in-flight rest
 - the requirement for a comprehensive briefing prior to FCMs rotating into and out of in-flight rest
 - a means for prioritising the in-flight rest requirements so that they do not take priority over the need to optimise the crew experience levels on the flight deck for managing planned and unplanned operational threats
 - designation of a responsible person among the crew for scheduling in-flight crew rest and reassessing crew rest schedules (in the event of unforeseen operational circumstances, particularly in-flight diversions or air returns)
 - management of the possible effects of sleep inertia on performance when awakening from deep sleep
 - procedures that ensure other crew members are aware of the necessity to respect the in-flight rest requirement and avoid interrupting and reduce unnecessary noise that could disturb the sleep of FCMs utilising in-flight rest.

C.6 Delayed reporting time

C.6.1 Introduction

- C.6.1.1 An FCM has the obligation to use their preceding ODP and prior sleep opportunity period to be sufficiently rested and alert in order to perform their duties safely in the rostered FDP.
- C.6.1.2 If the start time of an FDP is delayed, the operator must consider that an extended delay will impact the FCM's preparation and overall risk of accruing a higher fatigue level by the end of the FDP.
- C.6.1.3 Delayed reporting requirements are intended to mitigate the impact of delays on the subsequent FDP.
- C.6.1.4 Additionally, if the operations manual contains documented procedures that specifically address how delays are communicated without impacting the prior sleep opportunity, in accordance with the limits contained in the applicable appendix/appendices, then the operator is permitted to make the decision to delay the FDP:
- up until two (2) hours before the start time when the FCM is at home base
 - up until one (1) hour before the time the FCM would normally have to leave their accommodation to report for duty when they are not at home base.

C.6.2 What should be in your operations manual

Appendix 1

Under Appendix 1, there are no provisions for delaying or reassigning an FCM's reporting time, or requirements to consider if delays occur. However, operators are required to assign FDPs sufficiently in advance to provide the FCM with a reasonable opportunity to plan rest before the start time.

If the operator interrupts or disturbs the sleep of an FCM in the period of the prior sleep opportunity, then the FCM has not met the requirement for a prior sleep opportunity and cannot commence the FDP. The operations manual must have procedures for protecting prior sleep opportunity as outlined in section C.2 of this Appendix.

Appendices 2, 3 and 4

Delays of less than 10 hours - without operations manual procedures

If an operator is operating under Appendices 2, 3 or 4 and does not have operations manual procedures that specifically address delays of less than 10 hours, the operator can only delay an FDP start time if the FCM is notified at least 10 hours before the original reporting time.

When the FCM is notified of a delay less than 10 hours before the original reporting time, despite a potential later start, the FDP is deemed to have started at the original reporting time. In this case, the normal limit for the FDP duration applies (i.e. maximum FDP is based on the original reporting time and can only be re-assigned to the extent of the maximum re-assignment limits). The minimum ODP requirements apply before they can be assigned another FDP. The required ODP starts at the later of either:

- the original FDP start time, or
- the time the FCM actually ceases any (non-flying) duty, which may have been performed.

The minimum ODP need only be based on the length of the actual duty achieved; however, it can be no less than the minimum ODP required following an FDP.

When informing an FCM that the reporting time has been delayed the operator must not impact meet the requirements for sleep opportunity before an FDP. The operator needs to take this into consideration when deciding on the time and manner to notify the FCM of any delay.

Delays of less than 10 hours – with operations manual procedures

Delaying a reporting time during the prior sleep opportunity is permitted if an operator is operating under Appendices 2, 3 or 4 and has operations manual procedures that specifically address communicating delays within 10 hours of the FDP. Operations manual procedures should reflect the following consideration and requirements:

- For delays of less than four (4) hours – the assumption is that, while the FCM may well be able to rest, it is unlikely that they will be able to return to sleep. If they remain awake for this period the FCM is accruing fatigue; however, they should be able to accrue fatigue at a lower rate by managing their activities, rather than if they were on duty.
- For delays of more than four (4) hours – the operator, for rostering purposes, must assume that the FCM has been awake for a reasonable period and is accruing fatigue; therefore, the maximum FDP limits are not appropriate.
- For any delay, the maximum FDP limit cannot exceed the maximum FDP limit based on the original reporting time; however, if a reporting time following a delay requires a lower maximum FDP limit than that of the original FDP, then this now becomes the maximum FDP limit.
- An operator must have procedures that set out the manner in which the FCM will be notified of the delay that taken into account, the requirement to protect the eight-hour prior sleep opportunity either:
 - in the 12 hours before the original start time if the FCM is at home base
 - in the 10 hours before the original start time if the FCM is away from home base.
- For delays of less than 10 hours that are carried out in accordance with the operations manual procedures and, therefore, meet the requirements of delayed reporting, the time between the original reporting time and the delayed reporting time is considered to be standby.
- Operators should have procedures that describe the way in which FCMs are notified of the delay prior to leaving their sleeping accommodation.
- Operators should also have procedures for managing when notification of the decision to delay will not meet the minimum requirements set out in the operations manual.

Rather than phoning the FCM directly, examples of procedures that manage notification and protect the prior sleep opportunity include:

- requiring that the FCM 'checks in' with the operator after they wake-up
or
- organising a system whereby the hotel/motel staff delay the requested wake-up call and place a message under the door of the FCM's room.

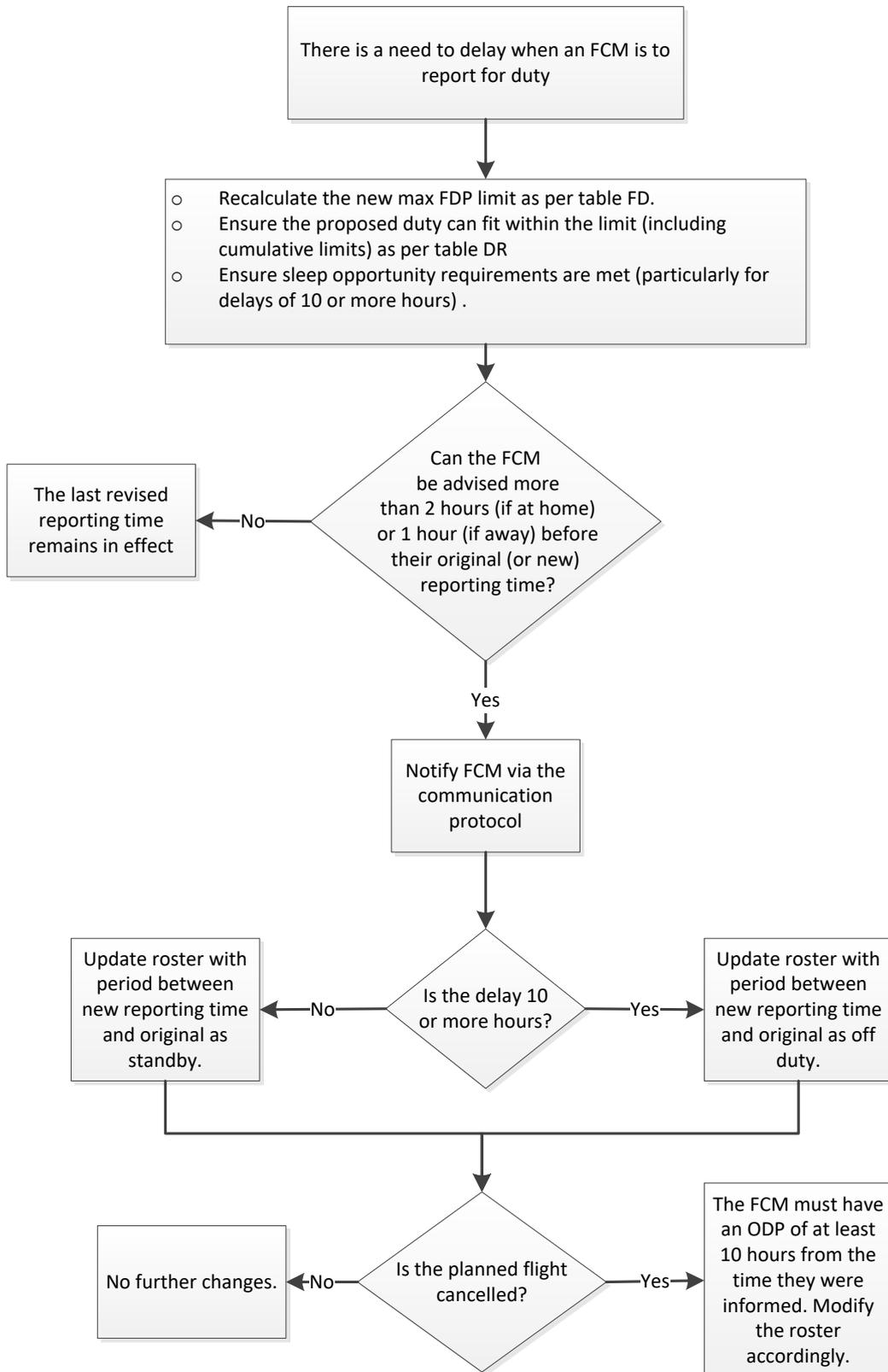
Example procedure:

All communications between Company ABC and an FCM during an ODP, or that could impact on the FCM's prior sleep opportunity, must be in accordance with the following communication protocol:

- An FCM must only be contacted during their sleep opportunity if there is to be a delay in FDP commencement time and then only by SMS.
- The FCM should ensure that their mobile is on 'silent' during sleep opportunity periods to, as best as possible, ensure uninterrupted restorative sleep.
- The FCM must check their SMS messages and reply to any SMS notifying the FCM of a delay before leaving the location of the sleep opportunity.
- An SMS sent and shown as delivered is deemed to be notification; however, the FCM shall still reply to the SMS before leaving the location of the sleep opportunity to confirm they understand the message.
- The timing and content of SMS messages (and phone calls) regarding delays will be logged in the rostering system.

Figure 4 may assist in understanding the requirements and provide an example of a procedure for inclusion in the operations manual. In the diagram, 'table FD' refers to a maximum FDP limit table, and 'table DR' refers to a table of limits that contains the cumulative flight and duty limits:

Figure 1 - Delayed reporting decision flow chart



Procedures need to adequately reflect the required adjustments to maximum FDP limits when the start time is delayed. The procedures for managing maximum FDP limits should reflect the requirements listed in Table 3.

Table 3 - Determining maximum FDP for delayed reporting time

Determining maximum FDP for delayed FDP reporting time (use		
Single or multiple delay/s that total < four (4) hours	If the new maximum FDP limit is higher or the same as the original maximum FDP limit, retain original maximum FDP limit	If the new maximum FDP limit is lower than original maximum FDP limit, use the new, lower maximum FDP limit
Single or multiple delay/s that total between four (4) and 10 hours	Step 1: If maximum FDP limit at four-hour mark is higher than original maximum FDP limit (or the same), use original maximum FDP limit	Step 1: If maximum FDP limit at four-hour mark is lower than original maximum FDP limit, use maximum FDP limit at four-hour mark
	Step 2: The FDP is taken to start four (4) hours after the original reporting time.	Step 2: The FDP is taken to start four (4) hours after the original reporting time.
A single delay of 10 hours or longer	Use new maximum FDP limit from the maximum FDP table for the delayed reporting time	

Note: The delay column refers to the total delay, rather than any single delay. This is an important consideration, as an operator may initially require a delay of two (2) hours and then make a further delay to the start time of three (3) hours. For the purposes of determining the maximum FDP, this represents a total delay of five (5) hours and must be dealt with as a five-hour delay rather than two (2) delays each of less than four (4) hours.

Cancellations where sufficient notice is provided – with, or without, operations manual procedures

- The cancellation subclause in each appendix sets out the minimum off-duty requirements when an operator cancels an upcoming FDP.
- If an operator does not have detailed delayed reporting procedures in the operations manual for delays where there is less than 10 hours’ notice, the FCM must receive the cancellation notice at least 10 hours before the original reporting time.
- If an operator does have detailed delayed reporting procedures in the operations manual for delays where there is less than 10 hours’ notice, the FCM must receive the cancellation notice before they leave their sleeping accommodation:
 - one (1) hour notice before FDP if the FCM is away from home base
 - two (2) hours’ notice if the FCM is at home base.

In both cases, the FCM must then have at least 10 consecutive hours off-duty, beginning from the time the FCM receives the cancellation notification before they can be assigned a new FDP.

- If the notification of cancellation does not meet the notification requirements above, then for the purposes of determining the minimum ODP, the FDP is considered to have commenced at:
 - the original starting time
 - or
 - the last delayed reporting time that was notified in accordance with procedures in the operation manual.
- The required minimum ODP must then be taken from that time or the cessation of any duties. The FCM must complete the minimum ODP required by the appendix adopted before the FCM can be assigned another FDP even if no flight occurred.

Appendix 4A and 6

There are no provisions in Appendix 4A or 6 that address delayed reporting; therefore, it is not specifically prohibited. The requirement in paragraph 14.11, regarding publishing rosters sufficiently in advance of the FDP to provide the FCM with a reasonable opportunity to plan rest before the start time, applies.

If fatigue risk is managed to an acceptable level, an operator may delay a start time under this appendix. In many cases, delaying an FDP start time will result in an increased fatigue hazard purely because the FCM is no longer able to achieve a rest period that would have been more appropriate for the time of start of the delayed FDP. Paragraph 15.2 of CAO 48.1 requires procedures to manage identified fatigue risk to an acceptable level.

This appendix has the requirement for a prior sleep opportunity that is always associated with the assigned FDP. If a start time is delayed, the operator must be able to demonstrate how the protection of prior sleep opportunity is achieved for the delayed start time. Any interruption or disturbance initiated by the operator should not infringe on the prior sleep opportunity.

If an operator anticipates delaying the start time of FDPs for other than relatively short delays, for example, delays of more than two (2) hours, the operations manual should contain procedures that ensure the increased risk is managed. Examples of procedures that might be used to manage increased fatigue risk due to delayed reporting are:

- Managing the process for contacting FCMs to notify them of the delay
- prohibiting increasing FDP maximum limits when a delayed start time would otherwise allow it
- requiring that, if a delayed start time requires a reduced maximum FDP (rather than the start time before the delay), said reduced maximum FDP limit applies
- providing a maximum limit on the extent to which a start time can be delayed in total. It is advisable to have a policy that does not allow delaying the start time by more than a total of four (4) hours past the original start time unless specific circumstances indicate this would not result in an unacceptable fatigue risk.

Appendices 4B, 5 and 5A

There are no provisions in Appendix 4B, 5 or 5A that address delayed reporting; therefore, it is not specifically prohibited. The requirement in paragraph 14.11 of CAO 48.1, regarding

publishing rosters sufficiently in advance to provide the FCM a reasonable opportunity to plan rest before the start time of the FDP, applies.

The nature of the activities conducted under these appendices will often result in changes to the FDP on the day of operations. While this is expected, the potential for increased fatigue risk must also be investigated and, where identified, managed.

This means that, in many cases, delaying an FDP start time will result in an increased fatigue hazard purely because the FCM is no longer able to achieve a rest period that would have been more appropriate for the delayed FDP. Paragraph 15.2 of CAO 48.1 requires procedures to manage identified fatigue risk to an acceptable level.

If fatigue risk is managed to an acceptable level, an operator may delay a start time under this appendix. The requirement to ensure that the prior eight (8) hours are free of duties remains for whatever start time is maintained. Any duty performed within this eight-hour period must be reduced from the allowable maximum FDP for that start time (minimum reduction is 30 minutes).

If an operator anticipates delaying the start time of FDPs for other than relatively short delays (e.g. delays of more than two (2) hours), the operations manual should contain procedures that ensure the increased risk is managed. Examples of procedures that might be used to manage increased fatigue risk due to delayed reporting are:

- managing the process of contacting FCMs to notify them of the delay
- prohibiting increasing FDP maximum limits when a delayed start time would otherwise allow it
- if a delayed start time requires a reduced maximum FDP period, rather than the start time before the delay, said reduced maximum FDP limit applies
- providing a maximum limit on the extent to which a start time can be delayed in total. (e.g. a policy that does not allow delaying the start time by more than a total of four (4) to five (5) hours past the original start time unless specific circumstances indicate this would not result in an unacceptable fatigue risk).

C.7 Reassignment and extension

C.7.1 Introduction

The reassignment and extension provisions cater for three different circumstances:

- a. Reassignment of an FDP longer than the original rostered FDP, but shorter than the maximum FDP. For example, a planned FDP reporting at 0800 hours for a four-hour FDP reassigned to an eight-hour FDP by adding another sector.
- b. Extension of an FDP beyond maximum flight duty period due to operational circumstances prior to the last flight. For example, a two-hour delay in the second sector of an 11-hour FDP due to unserviceability causes a need to extend the FDP to 13 hours, which is greater than the FDP limit of 12 hours.
- c. Extension of an FDP beyond maximum FDP due to operational circumstances after take-off on the final sector of an FDP. For example, an unexpected weather diversion on the final sector of a 12-hour FDP where the maximum FDP is 12 hours.

Reassignment

- C.7.1.1 These provisions set conditions on how a rostered or assigned FDP can be modified for an FCM once the FDP has commenced. Reassigning refers to increasing an FDP while remaining within the limit established in the operations manual for that activity. This is different to an extension, which refers to increasing the FDP so that it exceeds the FDP limit in the operations manual. A reassigned FDP can subsequently be extended under the extension clause if unforeseen operational circumstances are encountered.
- C.7.1.2 There may be occasions when an FCM who has already commenced an FDP needs to be reassigned (e.g. when operational requirements require an FCM to take over another's rostered sectors). There are considerations on how reassignments are managed to mitigate any adverse fatigue risks associated with changing the FCM's duty expectations.

Extension

- C.7.1.3 An operator must have reasonable expectations, based on previous experience and data, that the assigned FDP can be achieved within the limits established in the operations manual. The maximum FDP limits in prescriptive appendices are designed with the expectation that extensions would be rare.
- C.7.1.4 Where the need for extensions is reasonably foreseeable, for example, due to customs delays, seasonal weather or an ATC holding, then schedules and rosters must be modified to provide sufficient allowance for delays. Operators are required to review the use of extensions to adjust schedules accordingly.
- C.7.1.5 Where an operational need for an extension arises prior to a flight commencing, the first consideration is whether all flight crew members are assessed as fit for the extended duty. This consideration can be problematic due to a reduced capability for fatigued crew to assess fitness.
- C.7.1.6 Where unforeseen operational circumstances occur on the final sector of an FDP, the rules permit the flight to continue to its destination or alternate at the discretion of the pilot in command, even if it would cause an FCM to exceed a limit. This is to allow the safe continuation of a flight in the event of an unforeseen operational circumstance, and not to 'force' an aircraft to land should they occur. However, the pilot in command should divert to an alternate if the crew is not fit to continue.

C.7.2 What should be in your operations manual

- C.7.2.1 An operator's operations manual must contain procedures that:
- ensure a reassigned FDP does not exceed the relevant FDP (or flight time) limit
 - provide a tool and training for FCMs to assess their fitness for duty
 - does not permit a reassignment if the FCM does not consider and agree they are fit for the modified FDP
 - does not permit an extension to an FDP unless all FCMs have been consulted by the PIC and have had an opportunity to consider and agree they are fit for the extension

- when extensions occur, the operator collects sufficient information, such as an extension report, to enable further study and fine-tuning of the rostering process to better protect against extensions in the future.

Appendix 1

Reassignment

There are no specific limits on reassignment of an FDP in Appendix 1. An FDP may be reassigned within the FDP limits and no specific procedures are required.

Extensions

The procedures should clearly limit the use of extensions to those circumstances where:

- the FDP has already commenced
- the decision to extend beyond the FDP (or flight training flight time limit) is taken prior to the FDP limit (or flight time limit) being exceeded
- the circumstances that required the extension could reasonably be classed as unforeseen
- the FCM will not exceed a cumulative flight time limit during the extension
- the extension is operationally necessary to complete the planned duty.

If unforeseen circumstances arise after take-off on the final sector of an FDP, the flight may continue to the planned destination or an alternate at the discretion of the PIC, even if any limit in the Appendix is exceeded (a report of the extension must still be made).

Appendices 2, 3, 4 and 6

Reassignment

Procedures should, at a minimum:

- ensure that a reassigned FDP does not exceed maximum operations manual FDP limits (for Appendix 2 or 3 operations, this limit is derived after consideration of the reassigned number of sectors)
- ensure that a reassigned FDP must not cause the FCM to exceed longer term or cumulative limits. Examples are that the reassigned FDP cannot cause the FCM to exceed the longer term minimum ODPs (i.e. 36 consecutive hours off-duty in the 168-hour period before the projected end of the reassigned FDP, or the cumulative flight and duty limits applicable to the appendix under which the FCM is operating)
- ensure that a reassigned FDP must not cause the FCM to exceed the limit on infringing the WOCL. The procedures must require that the limit on infringing the WOCL be considered when determining whether the modified FDP is allowed and whether the reassignment will mean that subsequent rostered FDPs will then exceed the limit on consecutive WOCLs.

Operators are permitted to reassign an FDP to an FCM as an augmented crew member when the FCM was originally assigned to a non-augmented crew and vice versa. Because the FCM will need to utilise in-flight rest, the operator should be aware that there is potential for greater

fatigue risk if the FCMs preparation was not suited to an augmented crew operation. There is also potential for greater fatigue risk if the FCM was expecting an augmented crew FDP with assigned in-flight rest opportunities and is re-assigned to a non-augmented crew FDP. This increased risk should be managed by the operator and may require limitations on the use of this practice be in place.

Extensions

The procedures should clearly limit the use of extensions to those circumstances where:

- the FDP has already commenced
- the decision to extend beyond the FDP and/or flight time limit is taken prior to the FDP or flight time limit being exceeded
- the circumstances that required the extension could reasonably be classed as unforeseen
- the FCM will not exceed a cumulative duty or cumulative flight time limit during the extension
- the extension is necessary to complete the planned duty.

An operator's procedures should also make it clear that an extension cannot be greater than:

- two (2) hours for FDP and one (1) hour flight time for augmented crew operations
- one (1) hour for FDP and 30 minutes flight time for non-augmented multi-pilot operations
- one (1) hour for FDP for single-pilot operations

Note: Flight training may generally only be undertaken during the first seven (7) hours flight time in an FDP. Flight training, with up to a 30-minute extension after the first 7 hours, may be conducted if for unforeseen operational circumstances arise after the commencement of the FDP; and it is operationally necessary in order to complete the duty; and the FCM considers himself or herself fit for the extension - CAO 48.1, paragraph 3.2. Any extension must not result in the pilot exceeding the cumulative flight time limits in clause 5 of CAO 48.1.

For multi-pilot operations, the sectors for the FDP limits may be increased by one more than would otherwise be the case for the FDP.

If unforeseen circumstances arise after take-off on the final sector of an FDP, the flight may continue to the planned destination, or an alternate at the discretion of the PIC, even if any limit in the Appendix is exceeded (a report of the extension must still be made).

It is allowable for an extension to result in an FCM exceeding the longer term off-duty requirement of 36 consecutive hours off-duty in a 168-hour period projected to the end of the assigned FDP.

An extension to an FDP that results in the FDP infringing the WOCL must be considered when determining whether the FCM meets the limit on infringing the WOCL.

Appendix 4A

Reassignment

There are no specific limits on reassignment of an FDP in Appendix 4A; therefore, there is no requirement for procedures in the operations manual that specifically address reassignment of FDPs. The Appendix 4A rules, as a rule set, are considered sufficiently restrictive to absorb changes on the day of operations in assigned FDPs that do not exceed the appendix FDP limits, without representing an unreasonable increase in fatigue risk.

Extension

The procedures should clearly limit the use of extensions to those circumstances where:

- the FDP has already commenced
- the decision to extend beyond the FDP limit is taken prior to the FDP limit being exceeded
- the circumstances that required the extension could reasonably be classed as unforeseen
- the FCM will not exceed a cumulative duty or cumulative flight time limit during the extension
- the extension is necessary to complete the planned duty.

The procedures should also make it clear that an extension to an FDP cannot be greater than one (1) hour.

If unforeseen circumstances arise after take-off on the final sector of an FDP, the flight may continue to the planned destination, or an alternate at the discretion of the PIC, even if any limit in the Appendix is exceeded (a report of the extension must still be made).

Appendix 4B

Reassignment

There are no provisions in Appendix 4B that address reassignments; therefore, it is not specifically prohibited. The requirement in paragraph 14.11, regarding publishing rosters sufficiently in advance of the FDP and standby period to provide the FCM a reasonable opportunity to plan rest before the start time, applies. It is accepted that the activities conducted under this appendix will often, by their nature, result in changes to the FDP on the day of operations. While this is expected, the potential for increased fatigue risk must also be considered and, where unacceptable risk is identified, managed to acceptable levels. Depending on the nature of operations, an identified fatigue risk stemming from consistently or repetitively reassigning FDPs might require procedures to be developed that limit the use of reassignment in response to, or in anticipation of, excessive fatigue risk.

Another consideration is that the Appendix 4B late night operations requirements relate to FDPs that are assigned and conducted; therefore, the limit of four (4) late-night operations in any 168-hour period, applies to late-night operations, regardless of whether the FDPs were assigned prior to the day of operations or modified on the day of operations. The operator should have a

procedure for ensuring reassignments do not result in exceeding the limit of four (4) FDPs involving late-night operations within 168 consecutive hours.

Extensions

The provisions for extensions under Appendix 4B are unique. This is due to the operational flexibility necessitated by medical transport and emergency service operations. Two different extension provisions are provided under Appendix 4B:

- extensions due to unforeseen operational circumstances
- extensions for urgent operations.

For extensions in unforeseen operational circumstances, the procedures should clearly limit the use of extensions to those circumstances where:

- the FDP has already commenced
- the decision to extend beyond the FDP limit is taken prior to the FDP limit being exceeded
- the circumstances that required the extension could reasonably be classed as unforeseen
- the FCM will not exceed a cumulative duty or cumulative flight time limit during the extension
- the extension is necessary to complete the planned duty.

The procedures should also make it clear that an extension to an FDP cannot be greater than two (2) hours for a multi-pilot operation or one (1) hour for a single-pilot operation beyond the FDP limit (or the FDP limit as increased by a split-duty rest period), and an extension to the flight training flight time limit must not be greater than 30 minutes.

If unforeseen circumstances arise after take-off on the final sector of an FDP, the flight may continue to the planned destination, or an alternate at the discretion of the PIC, even if any limit in the appendix is exceeded (a report of the extension must still be made).

For extensions for urgent operations, the operator must have procedures that enable the classification of an operation as urgent and should consider the preservation of life, or the potential that a person's health may deteriorate as relevant factors. These procedures should identify not only how the FCM should go about deciding on the extension, but also who should be consulted as part of that decision. In these cases, an FDP may be extended by up to four (4) hours beyond the FDP limit or the FDP limit as increased by a split-duty rest period. However, an extended FDP for an urgent operation must not be greater than 16 hours or exceed a cumulative duty or cumulative flight time limit.

Appendix 5

Reassignment

There are no provisions in Appendix 5 that address reassignments. Therefore, it is not specifically prohibited. The requirement in paragraph 14.11, regarding publishing rosters sufficiently in advance of the FDP and standby period to provide the FCM a reasonable opportunity to plan rest before the start time, applies. It is accepted that the activities conducted

under this appendix will often, by their nature, result in changes to the FDP on the day of operations. While this is expected, the potential for increased fatigue risk must also be considered and, where unacceptable risk is identified, managed to acceptable levels. Depending on the nature of operations, an identified fatigue risk stemming from consistently or repetitively reassigning FDPs might require procedures to be developed to limit the use of reassignment in response to, or in anticipation of, excessive fatigue risk.

Another consideration is that Appendix 5 includes a restriction of four (4) FDPs assigned or conducted between midnight and 0459 in any consecutive 168-hour period. This applies to FDPs regardless of whether the FDPs were assigned prior to the day of operations or modified on the day of operations. The operator should have a procedure for ensuring that reassignments do not result in exceeding the limit of four (4) FDPs that include any time between midnight and 0459 in any consecutive 168-hour period.

Extensions

The procedures should clearly limit the use of extensions to those circumstances where:

- the FDP has already commenced
- the decision to extend beyond the FDP limit is taken prior to the FDP limit being exceeded
- the FCM will not exceed a cumulative flight time limit during the extension
- the extension is necessary to complete the planned duty.

The procedures should also make it clear that an extension to an FDP cannot be greater than two (2) hours. Each 30-minute period of extension (or part thereof) requires the subsequent minimum ODP to be increased by one (1) hour.

If unforeseen circumstances arise after take-off on the final sector of an FDP, the flight may continue to the planned destination, or an alternate at the discretion of the PIC, even if any limit in the Appendix is exceeded (a report of the extension must still be made).

Extensions that result in the FDP (including any time between midnight and 0459) must be taken into account when considering the limit of no more than four (4) FDPs in any consecutive 168-hour period that include any time between midnight and 0459 (local time).

Appendix 5A

Reassignment

There are no specific limits on re-assignment of an FDP in Appendix 5A; therefore, there is no requirement for procedures in the operations manual that specifically address reassignment of FDPs. The Appendix 5A rules, as a rule set, are considered sufficient to absorb changes on the day of operations in assigned FDPs that do not exceed the appendix FDP limits, without representing an unreasonable increase in fatigue risk.

Extensions

The procedures should clearly limit the use of extensions to those circumstances where:

- the FDP has already commenced

- the decision to extend beyond the FDP limit is taken prior to the FDP limit being exceeded
- the FCM will not exceed a cumulative flight time limit during the extension
- the extension is necessary to complete the planned duty.

The procedures should also make it clear that an extension to an FDP cannot be:

- greater than one (1) hour for FDP or 30 minutes flight time (for the flight training limit)
- extended beyond the end of evening civil twilight.

An FDP may be extended beyond the end of evening civil twilight only if it is necessary to complete the duties associated with the last daylight flight.

C.8 Standby limits and standby-like arrangements

C.8.1 Introduction

- C.8.1.1 Standby may be undertaken at home or at another place where suitable sleeping accommodation is provided. There are both advantages and disadvantages in conducting standby at the airport, at home or another location away from the airport. For example, if standby is undertaken at the airport, then it may be more likely for an FCM to be in a state of readiness while undertaking no actual work, even if there is access to suitable sleeping accommodation. This heightened state of readiness can introduce stress, which may increase fatigue and decrease alertness levels faster than at home or another location away from the airport. On the other hand, standby conducted at the airport negates the need for the pilot to drive to the airport upon call-out which, depending on the time taken to travel, weather and the traffic conditions, might impact negatively on fatigue levels prior to the commencement of the FDP. It is the operator's responsibilities to monitor these potential hazards and make decisions on the location of standby that manage the risk appropriately.
- C.8.1.2 Some operators may assign what they call 'airport standby'. Although no duties are assigned, typically access to suitable sleeping accommodation is not available. In these instances, this 'standby-like arrangement' must be considered as duty and not standby. This is because it is not considered possible for an FCM to use this period for genuine rest or sleep in preparation for an FDP.
- C.8.1.3 An important risk management strategy for any operator using standby periods is to maximise the effectiveness of any rest/sleep opportunities that the FCM might have while being on standby. This means reducing contact to a minimum and, where possible, not including the FCM in operational deliberations and decision making prior to the start of the FDP.
- C.8.1.4 Operators should note that, for different FCMs, there can be different ways to manage any additional stress, which may be present as a result of maintaining a higher level of alertness during standby. A strategy that FCMs might employ involves doing aviation-related activities while still on standby. Should an FCM decide to perform aviation-related tasks while on standby (entirely of their own volition), then this time is not to be considered duty time. Operators should not take inappropriate advantage of this method

for managing stress by not allocating enough time to perform required duties in the subsequent FDP.

C.8.2 What should be in your operations manual

C.8.2.1 Operations manual procedures must:

- include a means for making reliable assessments of suitable sleeping accommodation (at base and away from base) that is proposed for use in a standby period. These assessments should be ongoing to ensure the accommodation remains fit for purpose
- ensure FCMs are not disturbed by company contact during the standby period, except to call the FCM out for an FDP or duty.

Note: Stress and fatigue can be accelerated if the FCM is required to undertake duties (e.g. office duties) while on standby, and therefore any time conducting duties cannot be deemed standby.

C.8.2.2 If standby-like arrangements are employed (i.e. where an FCM is required to hold themselves available for duties, but access to suitable sleeping accommodation is not provided), this time counts as duty time.

Appendix 1

Although it is not specifically prohibited, there are no provisions in Appendix 1 that address standby. If an operator wishes to hold the FCM on standby then, in accordance with paragraph 14.11 of CAO 48.1, they need to be rostered for that standby period in such a way that the FCM is provided a reasonable opportunity to plan adequate rest for the possible FDP.

In addition to this, Appendix 1 has the requirement for prior sleep opportunity that is always associated with the actual assigned FDP. If an operator wishes to use standby, they are required to have procedures in place that are acceptable to CASA and that accurately demonstrate how the prior sleep opportunity is achieved for FDP start times that occur during rostered standby periods.

Any interruption or disturbance during the prior sleep opportunity period initiated by the operator could infringe the prior sleep opportunity requirements.

Appendices 2, 3, 4 and 6

The procedures must ensure:

- the FCM will not be held on standby for greater than a 14-hour period
- that if the FCM is called out from standby after a four-hour period on standby, the maximum FDP limit that applies to that FCM is reduced by the length of time they are on standby in excess of four (4) hours
- that if the FCM is called out from standby, the maximum combined duration of standby plus the subsequent FDP is 16 hours (except which the subsequent FDP is an augmented crew operation or includes a split-duty rest period at suitable sleeping accommodation) of at least four (4) consecutive hours (only relevant under Appendix 2 and 3)
- that if the FCM is not called-out from standby, the FCM completes a minimum ODP of at least 10 hours.

Example:

Under Appendix 2, if the FCM is called out at 2000 hours after six (6) hours of standby for a three-sector FDP, the applicable maximum FDP of 10 hours must be reduced to eight (8) hours. This is because the FCM was on standby for two (2) hours after the four-hour mark.

Appendix 4A

Although it is not specifically prohibited, there are no provisions in Appendix 4A that address standby. If an operator wishes to hold the FCM on standby then, in accordance with paragraph 14.11 of CAO 48.1, they need to be rostered for that standby period in such a way that the FCM is provided a reasonable opportunity to plan adequate rest for the possible FDP.

In addition to this, Appendix 4A has the requirement for prior sleep opportunity that is always associated with the actual assigned FDP. If an operator wishes to use standby, they are required to have procedures in place that are acceptable to CASA and that accurately demonstrate how the prior sleep opportunity is achieved for FDP start times that occur during rostered standby periods. Any interruption or disturbance during the prior sleep opportunity period initiated by the operator could infringe the prior sleep opportunity requirements.

Appendix 4B and 5

If no call-out occurs, there is no specific limit on the length of a continuous period of standby; therefore, continuous 24-hour periods of standby are possible. However, the FCM must meet the required longer term ODP requirements, and these will ultimately require the FCM to end a continuous period of standby.

Commencing an FDP marks the end of a standby period, and the FCM cannot return to standby until the required minimum ODP has been undertaken.

Standby cannot be used as a means of separating FDPs. Where an FDP takes place, followed by a break or rest period, once the minimum requirements of the split-duty provisions are met, then a split-duty rest period should be used if a further period of flying duty is required.

It is permissible for an FCM to return to standby after a period of duty in which no flight occurs; however, the maximum FDP limits following that period of duty are to be reduced by the amount of time spent on duty or 30 minutes (whichever is greater), while any part of that duty was performed within eight (8) hours of the subsequent commencement time of an FDP.

C.9 Positioning

C.9.1 Introduction

C.9.1.1 Positioning involves transporting an FCM between locations when the FCM is a passenger. Transport to suitable accommodation is not positioning; this is part of the off-duty period. Utilising crew rest facilities as part of augmented crew is not positioning; this is part of the FDP. Positioning after the last flight in an FDP does not pose a fatigue risk to the positioning flight and is not part of the FDP; however, it is duty and impacts

subsequent ODP. Positioning prior to a subsequent flight as crew adds to fatigue and is considered part of the FDP.

C.9.1.2 When calculating displacement time for determination of acclimatisation, an operator must also take any time zones crossed during the FCM's positioning period into consideration. Subsection 7 of CAO 48.1 (which deals with the determination of acclimatisation) relates solely to the location where an ODP or FDP commences, regardless of the manner or role FCMs played in getting there.

C.9.1.3 When calculating cumulative duty, any time spent positioning must be included as positioning is a task that is associated with the business of the operator.

C.9.2 What should be in your operations manual

C.9.2.1 If an operator intends to position an FCM at the completion of an FDP, there should be procedures to ensure:

- the period spent positioning is considered when determining the subsequent minimum ODP
- the period spent positioning is considered in the determination of cumulative duty time
- the FCM does not participate as part of an operating crew during the period of positioning.

C.9.2.2 If an operator intends to position an FCM before a flight or series of flights, there should be procedures to ensure:

- the time spent positioning counts as FDP
- the displacement time is considered when determining the subsequent minimum ODP
- the period spent positioning is considered in the determination of cumulative duty time
- the FCM does not participate as part of an operating crew during the period of positioning.

C.9.2.3 The positioning 'sector' does not need to be considered a 'sector' when the number of sectors is a factor in determining the maximum allowable duration of an FDP.

C.10 Off-duty period (ODP) limits

C.10.1 Introduction

C.10.1.1 An ODP is a period free of all duties and standby associated with employment. This means FCMs cannot simply switch to other non-flying duties in their required ODPs, and they cannot be assigned another FDP until the minimum ODP requirements have been met.

C.10.1.2 ODPs can help mitigate fatigue risk in three broad areas:

- acute fatigue (i.e. the requirement for an ODP following an FDP)
- cumulative fatigue (i.e. the requirement for 36 hour off-duty period every 7 days and 6 days off duty every 28 days)

- acclimatise an FCM to the local time (adaptation period).

Addressing acute fatigue (off-duty period following an FDP)

C.10.1.3 Assigned ODPs must be sufficiently long enough to provide for:

- the required sleep opportunity (8 hours)
- sufficient time for the FCM's requirements of bodily functioning (i.e. eating, drinking, washing and dressing)
- enough time to travel to and from the suitable sleeping accommodation.

C.10.1.4 In some situations, particularly when there is a long commute time, the minimum ODP, as set out in the appendices, will not be adequate to meet all these requirements and must be extended to ensure the eight-hour sleep opportunity is preserved after meeting other requirements. It is primarily the responsibility of an operator to ensure that enough time is available in the ODPs (both at home base and away from home base); however, it is also the responsibility of the FCM to ensure the time available is used effectively and that any issues or impediments are communicated to the operator.

C.10.1.5 The effectiveness of an ODP is also impacted by the location and quality of the accommodation that is provided, or that is available to the FCM when they are away from home base.

Example:

If the accommodation is next to a noisy road or work site, it will reduce the quality of any sleep the FCM can achieve. The more sleep is fragmented by waking up, the less restorative value sleep has in terms of how people feel and function the next day.

C.10.1.6 Section 5.4 includes considerations for selecting suitable sleeping accommodation.

Addressing cumulative fatigue (off-duty periods for cumulative fatigue recovery)

C.10.1.7 The off-duty limits that relate to cumulative fatigue are the requirements for 36 hours off-duty (including two (2) local nights) in any consecutive 168-hour period, as well as the requirement for a number of full days off-duty in any consecutive 28-day period.

Note: Appendices 4B and 5 have a variation on this requirement.

Day in 'days off-duty' means the period between local midnight at home base and the subsequent local midnight at home base.

C.10.1.8 The time of commencing duty following a fatigue recovery period impacts the effectiveness of the recovery period. Duty commencing at 0500 following a local night significantly reduces effectiveness of the prior sleep opportunity. Operators should consider starting duties later in the day where possible.

C.10.1.9 To start an FDP, an FCM must meet these off-duty requirements at the projected end of the assigned FDP. This requires an operator to calculate the requirements based on the end of duty. FDP ending after midnight should be considered for their impact on cumulative days off-duty requirements:

Addressing time-zone related fatigue

- C.10.1.10 For Appendices 2 and 4, crossing more than two (2) time-zones travelling east, or three (3) time-zones travelling west, increases the minimum ODP required following the FDP. A similar approach should be considered by operators implementing other appendices if they include time-zone changes.
- C.10.1.11 Once an FCM crosses two or more time-zones in an FDP from a location to which they were acclimatised, their body clock is assumed to migrate away from local time at that location. After 36 hours have elapsed, they are no longer sufficiently aligned to the original time zone and are considered to be in an unknown state of acclimatisation. FCMs require an adaptation period to become acclimatised to a location. FCMs in an unknown state of acclimatisation have reduced maximum FDPs to account for the additional fatigue, commonly referred to as jet lag. FCMs must not be assigned more than four (4) consecutive FDPs in an unknown state of acclimatisation before being provided with an opportunity for adaptation.

C.10.2 What should be in your operations manual

- C.10.2.1 Each appendix has subtle differences in ODP requirements and, therefore, the operations manual requirements for each appendix are set out individually in this section.

Appendix 1

An operator must have documented procedures to ensure that:

- to address acute fatigue—the FCM has a minimum off-duty period of 12 consecutive hours within any consecutive 24-hour period.
- to address cumulative fatigue—before commencing an FDP, an FCM has had:
 - at least 36 consecutive hours off-duty, including two (2) local nights, in the 168 hours before the projected end time of the assigned FDP, and
 - at least six (6) days off-duty in the 28 consecutive days before the FDP commences

Appendix 2

Off-duty period following an FDP

An operator's operations manual must document the minimum ODPs that the operator will apply to their FCMs. These periods must not be less than those required by CAO 48.1 and may be longer where circumstances require a greater ODP to achieve an eight-hour sleep opportunity.

The documented procedures must ensure that, following an FDP, an FCM has an off-duty period of at least the duration as determined by the relevant calculation below:

If the FCM is acclimatised (to any location) and the FDP and any duty time is ≤ 12 hours:

- If at home base:
 - 12 hours +
 - one (1) hour for each time zone crossed in excess of two (2) east and three (3) west

- If away from home base:
 - 10 hours +
 - one (1) hour for each time zone crossed in excess of two (2) east and three (3) west

If the FCM is acclimatised (to any location) and the FDP and any duty time is > 12 hours:

- 12 hours +
- 1.5 times the amount the FDP and the duty period exceeded 12 hours +
- one (1) hour for each time zone crossed in excess of two (2) east and three (3) west

If the FCM is in an unknown state of acclimatisation:

- 14 hours +
- 1.5 times the amount the FDP exceeded 12 hours +
- one (1) hour for each time zone crossed.

Home base (acclimatised)	12	
Away (acclimatised)	10	
Unknown acclimatisation	14	
If FDP and duty > 12	$(\text{FDP} + \text{duty} - 12) \times 1.5$	
Acclimatised Number of time zones travelled	East (-2)	
	West (-3)	
Unknown acclimatisation Number of time zones travelled		
Required ODP		

If the calculation above results in an ODP requirement of more than 14 hours, the ODP may be reduced to not less than 14 hours if all of the following conditions are met:

- the reduced ODP is undertaken away from home base
- the first FDP was not extended past the FDP limit as provided for under the operator's operations manual
- no other duties were undertaken following the first FDP before the ODP commences
- the FCM commences the second FDP in an acclimatised state
- the ODP following the second FDP is a recovery period of at least 36 consecutive hours including two (2) local nights.

FDP 1	Reduced ODP 1	FDP 2	ODP2
Required ODP > 14 hours No extension	≥ 14 hours Away base	acclimatised	36 hours Two (2) local nights

A reduced ODP is permitted to provide a short turnaround at away base where appropriate conditions are met.

Where an FCM's FDP (the last FDP) does not exceed 10 hours, their following ODP (ODP 2) may be reduced to no less than nine (9) hours, provided that:

- the ODP undertaken immediately before the last FDP (ODP 1) was at least 12 hours (including a local night)
- the FCM is acclimatised at the start of the ODP 2
- the ODP 2 is undertaken over a local night
- the ODP 2 is not undertaken at home base
- the ODP following the FDP after ODP 2 is at least 12 hours, including a local night.

Note: If an operator takes advantage of this nine-hour reduction provision, the procedures must reflect the requirement for the FCM's eight-hour sleep opportunity prior to the FDP after the reduced ODP. The FCM must still have enough time to travel to and from the suitable sleeping accommodation, meet the reasonable requirements of bodily functioning (i.e. eating, drinking, washing and dressing) and get a minimum of eight (8) hours sleep opportunity.

ODP1	FDP1	ODP2	FDP2	ODP3
12 hours including local night	Less than 10 hours FDP + DP	≥ nine (9) hours Local night - away base Acclimatised & sleep opportunity	No restriction	12 hours including local night

Off-duty periods for cumulative fatigue recovery

An operator must have documented procedures to ensure that, in order to address cumulative fatigue, before commencing an FDP or standby period, an FCM has had:

- at least 36 consecutive hours off-duty, including two (2) local nights, in the 168 hours before the projected end time of the assigned FDP; and
- at least six (6) days off-duty in the 28 consecutive days before the FDP commences.

Time zone adaptation periods

Appendix D provides additional information to determine when an FCM is considered acclimatised. Once an FCM is in an unknown state of acclimatisation, FDPs are reduced until they are acclimatised again following an adaptation period. An FCM must not undertake more than four (4) consecutive FDPs in an unknown state of acclimatisation. An adaptation period must be provided before the FCM can undertake another FDP.

Table 7.1 in CAO 48.1 specifies the minimum duration for an adaptation period to become acclimatised to the new location. In applying this table to arrive at an adaptation period, the operations manual procedures should:

- determine the time zone displacement between:
 - the location where the FCM was last acclimatised (the original location)
 - each location where an FDP or ODP was commenced since last acclimatised (later locations)
- determine the time zone displacement between the original location and whichever of the later locations gives the greatest time zone displacement
- determine the time zone change in the table that corresponds to the greatest time zone displacement
- determine the direction (east or west) in which the FCM travelled and, therefore, the greatest time zone displacement occurred
- determine the number of hours east or west (as the case requires) that corresponds to the time zone change.

The FCM is acclimatised to the new location following an adaptation period in accordance with Table 4.

Note: The adaptation period is a continuous off-duty period.

At away bases, the required adaptation period can be reduced by 12 hours for each off-duty period at a location that is less than two-hour time zone displacement for the adaptation location and includes a local night at that location.

Table 4 - Adaptation period to become acclimatised (extracted from Table 7.1 of CAO 48.1)

Time zone change (measured in time zones)	Adaptation period to become acclimatised to new location (hours)	
	West	East
Note: See definition of time zone		
2	24	30
3	36	45
4	48	60
5	48	60
6	48	60
7	72	90
8	72	90
9	72	90
10 or more	96	120

Note: An adaptation period may commence before the time when an FCM comes to be in an unknown state of acclimatisation.

For guidance in determining acclimatisation, including examples of how an FCM becomes reacclimatised, operators and FCMs should refer to Appendix D to this CAAP.

There is ongoing debate within the scientific community about whether it is preferential for FCMs to have an extended period off-duty at an overseas location after long trans-meridian flights, or to commence the return to home base after a shorter ODP, thereby reducing the impact of being in a location where the time zone is substantially different from that at home base.

Both options are currently available under Appendix 2 and procedures for either or both are acceptable. Where an operator seeks to minimise the time spent in a different time zone, they should try to keep FCMs on a schedule that is based on their home base sleep pattern.

Appendix 3

Off-duty period following an FDP

An operator's operations manual must document the minimum ODPs that they will apply to their FCMs. These periods must not be less than those required by CAO 48.1 and may well be greater due to the possibilities that the circumstances require a greater ODP in order to meet all obligations and still achieve an eight-hour sleep opportunity.

The documented procedures must ensure that, following an FDP, an FCM has an ODP of at least the duration as determined by the relevant calculation below:

- If at home base:
 - 12 hours +
 - 1.5 times the amount the FDP exceeded 12 hours
- If away from home base:
 - 10 hours +
 - 1.5 times the amount the FDP exceeded 12 hours.

If the calculation above results in an ODP requirement of more than 14 hours, the ODP may be reduced to not less than 14 hours, provided that:

- the reduced ODP is undertaken away from home base
- the first FDP was not extended past the FDP limit as provided for under the operator's operations manual
- no other duties were undertaken following the first FDP before the ODP commences
- the ODP following the second FDP is of at least 36 consecutive hours and includes two (2) local nights.

Where an FCM's FDP (the last FDP) does not exceed 10 hours, their following ODP (ODP 2) may be reduced to no less than nine (9) hours, provided that:

- the ODP undertaken immediately before the last FDP (ODP 1) was at least 12 hours (including a local night)
- the ODP 2 is undertaken over a local night
- the ODP 2 is not undertaken at home base
- the ODP following the FDP after ODP 2 is at least 12 hours, including a local night.

Note: If an operator takes advantage of this nine-hour reduction provision, the procedures must reflect the requirement for the FCM's eight-hour sleep opportunity prior to the FDP after the reduced ODP. The FCM must still have enough time to travel to and from the suitable sleeping accommodation, meet the reasonable requirements of bodily functioning (i.e. eating, drinking, washing and dressing) and get a minimum of eight (8) hours sleep opportunity.

Off-duty periods for cumulative fatigue recovery

An operator must have documented procedures to ensure that, to address cumulative fatigue, before commencing an FDP or standby period, an FCM has had:

- at least 36 consecutive hours off-duty, including two (2) local nights, in the 168 hours before the projected end time of the assigned FDP
- at least six (6) days off-duty in the 28 consecutive days before the FDP commences.

Appendix 4

Off-duty period following an FDP

An operator's operations manual must document the minimum ODPs that they will apply to their FCMs. These periods must not be less than those required by CAO 48.1 and may well be greater due to the possibilities that the circumstances require a greater ODP to meet all obligations and still achieve an eight-hour sleep opportunity.

The documented procedures must ensure that, following an FDP, an FCM has an ODP of at least the duration as determined by the relevant calculation below:

- If at home base:
 - 12 hours +
 - 1.5 times the amount the FDP exceeded 12 hours +
 - one (1) hour for each time zone crossed in excess of two (2) east and three (3) west.
- If away from home base:
 - 10 hours +
 - 1.5 times the amount the FDP exceeded 12 hours +
 - one (1) hour for each time zone crossed in excess of two (2) east and three (3) west.

If the calculation above results in an ODP requirement of more than 14 hours, the ODP may be reduced to not less than 14 hours, provided that:

- the reduced ODP is undertaken away from home base
- the first FDP was not extended past the FDP limit as provided for under the operator's operations manual
- no other duties were undertaken following the first FDP before the ODP commences
- the ODP following the second FDP is of at least 36 consecutive hours and includes two (2) local nights.

Where an FCM's FDP (the last FDP) does not exceed 10 hours, their following ODP (ODP 2) may be reduced to no less than nine (9) hours, provided that:

- the ODP undertaken immediately before the last FDP (ODP 1) was at least 12 hours (including a local night)
- the ODP 2 is undertaken over a local night
- the ODP 2 is not undertaken at home base
- the ODP following the FDP after ODP 2 is at least 12 hours, including a local night.

Note: If an operator takes advantage of this nine-hour reduction provision, the procedures must reflect the requirement for the FCM's eight-hour sleep opportunity to be met in the 10 hours prior to the FDP that starts after the reduced ODP. The FCM must still have enough time to travel to and from the suitable sleeping accommodation, meet the reasonable requirements of bodily functioning (i.e. eating, drinking, washing and dressing) and get a minimum of eight (8) hours sleep opportunity.

Off-duty periods for cumulative fatigue recovery

An operator must have documented procedures to ensure that, to address cumulative fatigue, before commencing an FDP or standby period, an FCM has had:

- at least 36 consecutive hours off-duty, including two (2) local nights, in the 168 hours before the projected end time of the assigned FDP, and
- at least six (6) days off-duty in the 28 consecutive days before the FDP commences.

Appendix 4A

An operator's operations manual must document the minimum ODPs that the operator will apply to their FCMs. These periods must not be less than those required by CAO 48.1 and may well be greater due to the possibilities that the circumstances require a greater ODP to meet all obligations and still achieve an eight-hour sleep opportunity.

The documented procedures must ensure that, following an FDP, an FCM has an ODP of at least 10 hours.

However, an FCM may take 2 ODPs of not less than four (4) consecutive hours each, with an intervening duty period of not more than two (2) hours, provided the total duration of the 2 ODPs is not less than 13 hours.

Procedures must be in place to ensure that, before beginning an FDP or standby period, the longer-term cumulative fatigue requirements will be met. These procedures must ensure that the FCM has had at least two (2) full days (consecutively or otherwise) off-duty in the 14 consecutive days before the projected end time of the assigned FDP.

Appendix 4B

Off-duty period following an FDP

The documented procedures must ensure that, following an FDP, an FCM has an ODP of at least the following duration:

- if the ODP includes the period between 2300 and 0559 hours local time — eight (8), plus the number of hours of time zone displacement (if any)
- if the ODP does not include the period between 2300 and 0559 hours local time—10, plus the number of hours of time zone displacement (if any).

The documented procedures must ensure that the ODP above must consist of at least eight (8)

consecutive hours, of which there must be access to suitable sleeping accommodation.

If the operator relies on the minimum ODP being eight (8) consecutive hours at suitable sleeping accommodation (including the hours of 2300 and 0529), the FCM will be afforded sufficient time to get to and from the suitable sleeping accommodation, and still get an eight-hour period at suitable sleeping accommodation.

The documented procedures must ensure that any extension to an FDP results in the required increase to the minimum ODP by one (1) hour for every 30 minutes (or part thereof) that the FDP is extended.

Off-duty periods for cumulative fatigue recovery

Procedures must be in place to ensure that, before beginning an FDP or standby period, the longer-term cumulative fatigue requirements will be met. These procedures must ensure that the FCM has had at least one of the following:

- in the consecutive 336-hour (14 day) period before the projected end of the assigned FDP or standby—one (1) ODP of at least 36 consecutive hours including two (2) local nights
- or
- in the consecutive 504-hour (21 day) period before the projected end of the assigned FDP or assigned standby—one (1) ODP of at least 72 consecutive hours including three (3) local nights.

Appendix 5

Off-duty period following an FDP

The documented procedures must ensure that, following an FDP, an FCM has an ODP of at least the following duration:

- if the ODP includes the period between 2300 and 0559 hours local time—eight (8) hours
- if the ODP does not include the period between 2300 and 0559 hours local time—10 hours.

The documented procedures must ensure that the ODP above must consist of at least eight (8) consecutive hours, of which there must be access to suitable sleeping accommodation.

If the operator relies on the minimum ODP being eight (8) consecutive hours at suitable sleeping accommodation (including the hours of 2300 and 0529), the FCM will be afforded sufficient time to get to and from the suitable sleeping accommodation, while still getting an eight-hour period at suitable sleeping accommodation.

The documented procedures must ensure that any extension to an FDP results in the required increase to the minimum ODP by one (1) hour for every 30 minutes (or part thereof) that the FDP is extended.

Off-duty periods for cumulative fatigue recovery

Procedures must be in place to ensure that, before beginning an FDP or standby period, the longer-term cumulative fatigue requirements will be met. These procedures must ensure that the FCM has had at least one of the following:

- in the consecutive 336-hour (14 day) period before the projected end of the assigned FDP or standby—one (1) ODP of at least 36 consecutive hours including two (2) local nights
or
- in the consecutive 504-hour (21 day) period before the projected end of the assigned FDP or assigned standby—one (1) ODP of at least 72 consecutive hours including three (3) local nights.

Appendix 5A

An operator's operations manual must document the minimum ODPs that they will apply to their FCMs. These periods must not be less than those required by CAO 48.1 and may well be greater due to the possibilities that the circumstances require a greater ODP to meet all obligations and still achieve an eight-hour sleep opportunity.

The documented procedures must ensure that, following an FDP, an FCM has an ODP of at least 10 hours.

Procedures must be in place to ensure that, before beginning an FDP or standby period, the longer-term cumulative fatigue requirements will be met. These procedures must ensure that the FCM has had at least, in any consecutive 384-hour period, a period of at least two (2) consecutive days off-duty.

Appendix 6

Off-duty period following an FDP

An operator's operations manual must document the minimum ODPs that they will apply to their FCMs. These periods must not be less than those required by CAO 48.1 and may well be greater due to the possibilities that the circumstances require a greater ODP to meet all obligations and still achieve an eight-hour sleep opportunity.

The documented procedures must ensure that, following an FDP, an FCM has an ODP of at least 12 hours, plus 1.5 times the amount the FDP exceeded 12 hours.

Off-duty periods for cumulative fatigue recovery

An operator must have documented procedures to ensure that, to address cumulative fatigue, before commencing an FDP or standby period, an FCM has had:

- at least 36 consecutive hours off-duty, including two (2) local nights, in the 168 hours before the projected end time of the assigned FDP, and
- at least six (6) days off-duty in the 28 consecutive days before the FDP commences.

C.11 Limit on cumulative flight time

C.11.1 Introduction

C.11.1.1 Limiting cumulative flight time over medium and long time periods is a means of managing cumulative fatigue prescriptively by acting to reduce the capacity of an operator to assign an FCM in an intensive manner for a sustained period.

Note: CASA intends to eventually transition to medium and long-term duty time limits.

C.11.1.2 Cumulative flight time for an FCM means the progressive total of flight time accrued by the FCM when acting as a crew member but excluding flight time accrued during recreational private operations.

C.11.1.3 For an operator to manage cumulative flight time, they must track both the flight time the FCMs record when flying in their operations over the period in question, and the flight time that FCMs accrue during non-recreational flying over the period in question.

Note: Recreational flying is flying conducted by an FCM in a personal capacity, and at the FCM's leisure. A flight conducted by an FCM as a private operation is not a recreational private operation if it is conducted for, or on behalf of an entity, regardless of whether the entity is an AOC holder or Part 141 certificate holder.

C.11.1.4 For this limit to be accurately applied, an operator must be recording flight time, in accordance with the definition of flight time provided earlier in the CAAP:

C.11.1.5 All appendices (other than Appendix 4A, 5 and 5A) have the same cumulative flight time limits:

- a maximum of 100 flying hours in any consecutive 28-day period
- a maximum of 1000 flying hours in any consecutive 365-day period.

C.11.1.6 Appendix 4A has a more tailored approach to managing fatigue for ballooning pilots and has a limit of 50 flying hours in any consecutive 28-day period.

C.11.1.7 Appendix 5 and 5A have a more complex approach with higher limits and a means for resetting the limits.

C.11.2 What should be in your operations manual

C.11.2.1 An operator's operations manual must include:

- rostering procedures and guidelines that require tracking and consideration of each FCM's cumulative flight time
- a means for monitoring the number of hours of flight time for each FCM, thereby ensuring no FCM exceeds the applicable limits
- guidelines that are in a form that is clear and readily available to the operator's employees who are involved in rostering activities, as well as affected FCMs.

C.11.2.2 There may need to be procedures for FCMs who fly for another operator. If an FCM has flown for another operator, procedures will be required for taking these flying hours into account when assessing whether the FCM is within cumulative flight time limits.

C.11.2.3 There may need to be procedures for FCMs to include in their accumulated flying record any private flying in non-recreational activities.

Appendices 1, 2, 3, 4, 4B and 6

An operator's operations manual must not permit an FCM to exceed the following cumulative flight time limits:

- 100 hours in any consecutive 28-day period
- 1000 hours in any consecutive 365-day period.

Appendix 4A

An operator's operations manual must not permit an FCM to exceed 50 hours cumulative flight time in any consecutive 28-day period.

Appendix 5

An operator's operations manual must not permit an FCM to exceed the following cumulative flight time limits:

- 50 hours in any consecutive 168-hour (7 day) period
- 170 hours in any consecutive 28-day period
- 450 hours in any consecutive 90-day period
- 1200 hours in any consecutive 365-day period.

For those sections of the aerial work industry that require high yearly cumulative flight times, there is a provision within Appendix 5 whereby, after a significant break, FCMs will be able to 'reset' their cumulative flight times. For these unique provisions to be effective, FCMs require freedom from all duty, rather than just from flying duties. Achieving the reset clauses may require adequate planning as the FCM will be unavailable over the period until the reset provision has been achieved.

The 28-day and 90-day limits may be reset to zero if the FCM achieves a period of five (5) consecutive days off-duty.

The 365-day limit may be reset to zero if the FCM achieves a period of 28 consecutive days off-duty.

An operator's operations manual should clearly stipulate that FCMs are not permitted to conduct any non-recreational flying during ODPs to reset cumulative time limits. If these requirements cannot be adhered to, then the cumulative limits cannot be reset.

Appendix 5A

An operator's operations manual must not permit an FCM to exceed the following cumulative flight time limits:

- if an FCM has less than 500 hours experience in mustering operations (as PIC or pilot under supervision)—100 hours in any consecutive 30-day period
- 100 hours in any 384-hour (16 day) period
- 1200 hours in any consecutive 365-day period.

As with the provisions of Appendix 5 described previously, the 365-day limit may be reset to zero if the FCM achieves a period of 28 consecutive days off-duty.

C.12 Limit on cumulative duty time

C.12.1 Introduction

C.12.1.1 Limiting cumulative duty time is a means for managing the risk of excessive cumulative fatigue by limiting the total possible duty over the mid and long term.

C.12.1.2 Cumulative duty means the progressive sum of duty periods and is intended to capture any duty (including positioning) that the FCM performs for the operator.

C.12.1.3 While Appendix 5 and 5A have no direct limit on cumulative duty, operators need a process for tracking Appendix 5 and 5A duty if the operator wishes to use the FCM for operations in another appendix.

C.12.2 What should be in your operations manual

C.12.2.1 Except for operators who exclusively operate under Appendix 5 or 5A, an operator's operations manual must include:

- rostering procedures and guidelines that clearly require tracking and consideration of each FCM's cumulative duty time
- a means for monitoring the number of hours of duty time for each FCM ensuring no FCM exceeds the applicable limits
- guidelines that are in a form that is clear and readily available to the operator's employees who are involved in rostering activities, as well as affected FCMs.

C.12.2.2 There may need to be procedures for FCMs who works for another operator. If an FCM works for another operator, procedures must consider this duty time when calculating cumulative duty.

Appendix 1

Appendix 1 provides basic limits with simplified management. There are no limits on cumulative duty under Appendix 1.

Appendices 2, 3, 4, and 6

An operator's operations manual must not permit an FCM to exceed the following cumulative duty limits:

- 60 hours in any consecutive 168-hour (7 day) period
- 100 hours in any consecutive 334-hour (14 day) period.

Appendix 4A

An operator's operations manual must not permit an FCM to exceed the following cumulative duty limits:

- 45 hours in any consecutive 168-hour (7 day) period
- 84 hours in any consecutive 334-hour (14 day) period.

Appendix 4B

The cumulative duty time limits under Appendix 4B depend on whether an FCM has at least one (1) ODP of at least 36 hours, including two (2) local nights, during a consecutive 168-hour period.

If an FCM does not have an ODP of at least 36 hours, including two (2) local nights, during the consecutive 168-hour period, the FCM is limited to 40 hours of duty during that period.

If an FCM does have an ODP of at least 36 hours, including two (2) local nights, during the consecutive 168-hour period, the FCM is limited to 60 hours of duty during that period.

C.13 Limits on infringing the WOCL and early starts

C.13.1 Introduction

C.13.1.1 There is extensive research showing decrements in performance and safety concerns while performing duty periods that infringe the WOCL (0200 to 0559 hours). Specifically, fatigue-related incidents were found to increase in a linear fashion across four (4) consecutive night shifts. Subsequent to the initial night, risk increased approximately 6% on the second night, 17% on the third night, and 36% on the fourth night. Biomathematical modelling of consecutive WOCL infringing duties yields similar results. Limiting exposure to three (3) consecutive WOCL infringing duties aims to prevent fatigue from escalating in subsequent duties.

C.13.1.2 Early starts (0500-0659) impact the ability to get a restorative night's sleep which can cause accumulation of sleep debt. WOCL infringing duties and early starts are two of the most commonly reported fatigue problems in pilot surveys. Reducing the maximum FDP for the fourth and fifth consecutive early start aims to minimise the cumulative fatigue impact.

C.13.1.3 Appendix 4A has no restriction on WOCL infringements as the FDP and cumulative duty time limitations, along with prior sleep opportunity and off-duty requirements, are tailored to ballooning operations.

C.13.1.4 Appendix 4B contains a special clause on 'late-night operations' rather than restricting infringements of the WOCL or early starts. A late-night operation is any FDP that includes more than 30 minutes between the hours of 2330 and 0529 local time.

C.13.1.5 Under Appendix 5A, the restriction on operating solely within daylight hours mitigates operations within an FCM's WOCL.

C.13.2 What should be in your operations manual

Appendix 1

Operations that take place at a time later than 2200 hours are dealt with differently under Appendix 1. No more than three (3) FDPs that take place at a time later than 2200 hours may be undertaken in any 168 consecutive hours (these are referred to as 'late FDPs'). FDPs that commence prior to 0600 hours are also restricted to a maximum of eight (8) hours. These restrictions are dealt with in section C.3 of this Appendix.

Appendices 2, 3, 4, and 6

For the purposes of CAO 48.1, an FCM's window of circadian low is between 0200 and 0559. An 'early start' is an FDP that commences between 0500 and 0659.

In Appendix 2, the definitions of 'WOCL' and 'early start' depend on the FCM's state of acclimatisation. If the FCM is in an acclimatised state, the FCM's WOCL is based on the local time at the location where they are acclimatised. If the FCM is in an unknown state of acclimatisation, the WOCL is based on the local time at the location where they were last acclimatised. This same concept is applied to determining whether an FDP is an 'early start'.

In Appendix 3, 4 and 6, the definitions of 'WOCL' and 'early start' are based on the local time at the location where an FCM commences an FDP (not where the FDP concludes).

There will be occasions where an FDP will be captured by the definitions of both 'WOCL' and 'early start'. Such FDPs need to be considered as both an infringement of the WOCL and an early start.

An operator's operations manual must include procedures to ensure that an FCM is restricted to:

- three (3) consecutive early start FDPs, and
- three (3) consecutive infringements of the WOCL.

However, the operations manual may permit up to five (5) consecutive early starts provided the duration of the 4th and 5th consecutive early starts are reduced. The normal FDP limit for the 4th consecutive early start must be reduced by two (2) hours, and the FDP limit for the 5th consecutive early start must be reduced by four (4) hours. Reducing the maximum FDP for the 4th and 5th consecutive early starts aim to minimise the cumulative fatigue impact.

Example:

An operator complying with Appendix 4 has procedures that permit rostering an FCM on a series of five (5) FDPs commencing at 0600 hours local time. The first three (3) FDPs may be assigned up to the normal limit (10 hours, or less if the operations manual requires); however, the 4th FDP would need to be reduced to a maximum of eight (8) hours, and the 5th FDP reduced to a maximum of six (6) hours.

To avoid these restrictions, an operator could consider rostering the FCM on a non-early start (an FDP that commences at or after 0700). This would permit the FCM to obtain more effective rest in preparation for a longer FDP.

An operator must develop rostering procedures and guidelines that track infringements of the WOCL and early starts. These procedures must also identify and track those FDPs that infringe the WOCL due to a reassignment or extension.

Appendix 4B

Rather than restricting infringements of the WOCL and early starts, Appendix 4B contains a special clause around 'late-night operations'. A late-night operation is any FDP that includes more than 30 minutes between the hours of 2300 and 0530 local time (effectively any FDP that is undertaken between 2330 and 0500 local time).

The operations manual must contain procedures limiting the number of late-night operations that are assigned or conducted to a maximum of four (4) in any consecutive 168-hour period.

In addition, the operations manual must have procedures to ensure that if, during any consecutive 168-hour period, an FCM conducts three (3) or more late-night operations, the FCM is limited to 40 hours cumulative duty during that period.

Appendix 5

The operations manual must contain procedures limiting the number of FDPs that are assigned or conducted that include any time between midnight and 0459 to a maximum of four (4) in any consecutive 168-hour period. These restrictions are dealt with in section C.3 of this Appendix.

Appendix D

Determination of acclimatisation

D.1 General

- D.1.1 FCMs and operators should refer to subsection 7 of CAO 48.1, which states the determination of acclimatisation. The following scenarios are examples of how these determinations apply.
- D.1.2 These scenarios are hypothetical. The ODPs are examples, not necessarily the minimum ODP required, which is determined by the relevant appendix of CAO 48.1. The scenarios do not consider cumulative duty time limits.

D.2 Scenario 1

- D.2.1 An FCM commences an FDP in an acclimatised state in Perth (the original location). The FDP is 10 hours in duration and finishes in Auckland (four (4) hours' time difference displaced east from the original location) where an ODP of 16 hours commences before the start of the next FDP. At the commencement of the ODP, less than 36 hours has passed since the start of the FDP and, therefore, the FCM remains acclimatised to Perth (refer to paragraph 7.2 of CAO 48.1).
- D.2.2 At the commencement of the next FDP in Auckland, only 26 hours has passed since the start of the last FDP, where the FCM was acclimatised (in Perth). The FCM is considered, under paragraph 7.2 of CAO 48.1, to remain acclimatised to Perth.
- D.2.3 The next FDP is 12 hours duration and finishes in Bangkok (one (1) hour time difference displaced west from the original location) where an ODP commences. At the commencement of the ODP, the difference in local time between the location (Bangkok) and the location where last acclimatised (Perth) is less than two (2) hours, and the FCM has remained in an acclimatised state each time acclimatisation was tested throughout the tour. So, according to paragraph 7.1 of CAO 48.1, the FCM is considered acclimatised to Bangkok.

	Activity	BKK (+7)	PER (+8)	AKL (+12)	Acclimatised location	Actual Location	DT	ET
Start FDP	PER-AKL		0800		PER	PER	0	0
Start ODP	REST		1800	2200	PER	AKL	4E	10
Start FDP	AKL-BKK		1000	1400	PER	AKL	4E	26
Start ODP	REST	2100	2200	0200	BKK	BKK	0	0

D.3 Scenario 2

- D.3.1 An FCM commences an FDP in an acclimatised state in Bangkok (the original location). The FDP is 10 hours duration and finishes in Hong Kong (one (1) hour time difference displaced east from the original location) where an ODP of 12 hours commences before the start of the next FDP. As the time difference is less than two (2) hours from the location where the FCM was last acclimatised (Bangkok), according to paragraph 7.1, the FCM is considered acclimatised to Hong Kong. For the purposes of determining acclimatisation, Hong Kong now becomes the 'original location'.

- D.3.2 The FCM now commences an FDP in Hong Kong in an acclimatised state. The FDP is 18 hours in duration and finishes in New York (11 hours' time difference displaced east from the original location) where an ODP of 33 hours commences before the start of the next FDP. At the commencement of the ODP, less than 36 hours has passed since the start of the FDP; therefore, the FCM remains acclimatised to Hong Kong (refer to paragraph 7.2 of CAO 48.1).
- D.3.3 At the commencement of the next FDP in New York, more than 36 hours has passed since the FCM was acclimatised to the original location, and the greatest time zone displacement from the original location was more than two (2) hours. So, according to paragraph 7.3 of CAO 48.1, the FCM is now in an unknown state of acclimatisation. The next FDP will therefore be conducted in an unknown state of acclimatisation, unless the ODP prior to the FDP is increased.
- D.3.4 The FCM now commences the FDP in New York in an unknown state of acclimatisation. The FDP is eight (8) hours in duration and finishes in London (16 hours' time difference displaced east from the original location – Hong Kong). The next FDP will be conducted in an unknown state of acclimatisation, unless an adaptation period prior to the FDP is undertaken, in accordance with Table 7.1 of CAO 48.1.
- D.3.5 To determine the adaptation period required to become reacclimatised, the greatest time zone displacement from the original location needs to be determined. In this case, the greatest displacement is 16 hours east; therefore, according to Table 7.1 of CAO 48.1, a total of 120 hours off-duty is required to become reacclimatised in London. However, if the FCM does not have that adaptation period and commences another FDP, this FDP will be conducted in an unknown state of acclimatisation. The FCM has a 20-hour ODP in London.
- D.3.6 The FCM commences the FDP in London in an unknown state of acclimatisation. The FDP is eight (8) hours in duration and finishes in New York (11 hours' time difference displaced east from the original location –Hong Kong). The next FDP will be conducted in an unknown state of acclimatisation, unless an adaptation period prior to the FDP is undertaken, in accordance with Table 7.1 of CAO 48.1.
- D.3.7 To determine the adaptation period required to become reacclimatised, the greatest time zone displacement from the original location needs to be determined. In this case, the greatest displacement is 16 hours east (when the FCM had the ODP in London). Therefore, according to Table 7.1 of CAO 48.1, a 120-hour adaptation period is required to become reacclimatised in New York. Because the ODP in London was in a location more than two (2) hours different to New York, there is no reduction in the required adaptation period.

	Activity	BKK (+7)	HKK (+8)	NYC (5)	LON (0)	Acclimatised location	Actual Location	DT	ET
Start FDP	BKK- HKK	0800				BKK	BKK	0	0
Start ODP	REST	1800	1900			HKK	HKK	0	0
Start	BKK-		0700			HKK	HKK	0	0

	Activity	BKK (+7)	HKK (+8)	NYC (5)	LON (0)	Acclimatised location	Actual Location	DT	ET
FDP	NYC								
Start ODP	REST		0100	1200		HKK	NYC	11E	18
Start FDP	NYC- LON			2100 (+1d)		UNK	NYC	11E	51
Start ODP	REST			0500	1000	UNK	LON	16E	59
Start FDP	LON- NYC			0100	0600	UNK	LON	16E	79
Start ODP	REST			0900	1400	UNK	NYC	16E	87

D.4 Scenario 3

- D.4.1 An FCM commences an FDP in an acclimatised state in Sydney (the original location). The FDP is 16 hours in duration and finishes in Dubai (six (6) hours' time difference displaced west from the original location) where an ODP of 30 hours commences before the start of the next FDP. At the commencement of the ODP, less than 36 hours has passed since the start of the FDP; therefore, the FCM remains acclimatised to Sydney (refer to paragraph 7.2 of CAO 48.1).
- D.4.2 At the commencement of the next FDP in Dubai, more than 36 hours has passed since the FCM was acclimatised to the original location, and the greatest time zone displacement from the original location was more than two (2) hours. According to paragraph 7.3 of CAO 48.1, the FCM is now in an unknown state of acclimatisation. The next FDP will therefore be conducted in an unknown state of acclimatisation, unless the ODP prior to the next FDP is increased.
- D.4.3 The FCM commences an FDP in Dubai in an unknown state of acclimatisation. The FDP is 11 hours in duration and finishes in Paris (nine (9) hours' time difference displaced west from the original location (Sydney)). The FCM undertakes an ODP of 26 hours (including one (1) local night in Paris).
- D.4.4 The FCM then undertakes three (3) FDPs in an unknown state of acclimatisation during daylight hours alternating ODP between London and Paris, remaining within the same time zone (Coordinated Universal Time [UTC]+1), or one time zone to the west (UTC). The ODPs between FDPs are all undertaken over local nights. Therefore, under subparagraph 7.4 (b) of CAO 48.1, a credit of 12 hours for each local night is available to reduce the required adaptation period specified in Table 7.1 of CAO 48.1.
- D.4.5 To determine the adaptation period required to become reacclimatised, the greatest time zone displacement from the original location needs to be determined. In this case, the greatest displacement is 10 hours west (when the FCM had the ODP in London). According to Table 7.1 of CAO 48.1, a 96-hour adaptation is required to become reacclimatised; however, since the FCM has spent three (3) local nights within two (2)

time zones, a total of 36 hours may be deducted from this adaptation period. Meaning, that, to become acclimatised, an adaptation period of 60 hours is required.

	Activity	SYD (+10)	DBX (+4)	CDG (+1)	LON (0)	Acclimatised location	Actual Location	DT	ET	CR
Start FDP	SYD-DBX	0800				SYD	SYD	0	0	0
Start ODP	REST	0000	1800			SYD	DXB	6W	16	0
Start FDP	DBX-CDG	0600	0000 (+1d)	1900		UNK	DXB	6W	46	0
Start ODP	REST		1100	0600		UNK	CDG	9W	57	0
Start FDP	CDG-LON			0700 (+1d)		UNK	CDG	9W	82	12
Start ODP	REST			1700	1600	UNK	LON	10W	92	12
Start FDP	LON-CDG			0800	0700	UNK	LON	10W	107	24
Start ODP	REST			1800	1700	UNK	CDG	10W	117	24
Start FDP	CDG-LON			0700	0600	UNK	LON	10W	128	36
Start ODP	REST			1700	1600	UNK	LON	10W	138	36

D.5 Scenario 4

D.5.1 The original location is Adelaide. Perth is one (1) hour and 30 minutes (during non-daylight savings period) earlier than Adelaide; therefore, on arrival in Perth, an FCM is acclimatised to Perth. If the FCM departs Perth for Urimqi in Western China, the FCM arrives acclimatised because Urimqi is the same time as Perth (due to China being a single time zone, although, at 87.5E, Urimqi would normally be at least two (2) hours different from Perth).

D.5.2 If the FCM then flies 2820 NM to Narita, the time is only one (1) hour's difference from Urimqi, and the FCM remains acclimatised. If the FCM then returns to Perth or Adelaide, they are acclimatised to Adelaide.

	Activity	URC (+8)	PER (+8)	NRT (+9)	ADL (+9.5)	Acclimatised location	Actual Location	DT	ET
Start FDP	ADL-PER				0730	ADL	ADL		
Start ODP	REST		1600		1730	PER	PER		

	Activity	URC (+8)	PER (+8)	NRT (+9)	ADL (+9.5)	Acclimatised location	Actual Location	DT	ET
Start FDP	PER-URC		0700			PER	PER		
Start ODP	REST	1700	1700			URC	URC		
Start FDP	URC-NRT	0700				URC	URC		
Start ODP	REST	1700		1800		NRT	NRT		
Start FDP	NRT-ADL			0800		NRT	NRT		
Start ODP	REST			1800	1830	ADL	ADL		

D.5.3 The same schedule has different implications when Adelaide is in daylight savings. Perth becomes two (2) hours and 30 minutes earlier than Adelaide (during daylight savings period) and the 36-hour period to an unknown state of acclimatisation begins at the start of the FDP in Adelaide. The FDP from Urimqi to Narita commences more than 36 hours after the FDP from Adelaide commenced, and the FCM is in an unknown state of acclimatisation. The FCM remains in an unknown state of acclimatisation upon return to Adelaide. According to Table 7.1 of CAO 48.1, a 36-hour adaptation period is required for the greatest displacement of two (2) to five (5) hours. However, the ODP in Narita was within two (2) time zones of Adelaide. So, the required adaptation period can be reduced to 24 hours.

	Activity	URC (+8)	PER (+8)	NRT (+9)	ADL (+10.5)	Acclimatised location	Actual Location	DT	ET	CR
Start FDP	ADL-PER				0830	ADL	ADL	0	0	0
Start ODP	REST		1600		1830	ADL	PER	2.5W	10	0
Start FDP	PER-URC		0700			ADL	PER	2.5W	25	0
Start ODP	REST	1700	1700			ADL	URC	2.5W	35	0
Start FDP	URC-NRT	0700				UNK	URC	2.5W	49	0
Start ODP	REST	1700		1800		UNK	NRT	2.5W	59	0
Start FDP	NRT-ADL			0800		UNK	NRT	2.5W	73	12
Start ODP	REST			1800	1930	ADL	ADL	2.5W	83	12

Appendix E

Example fatigue occurrence report

Fatigue Report Form

IF CONFIDENTIALITY REQUIRED TICK HERE <input type="checkbox"/>			
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			
<input type="checkbox"/> 1	Fully alert, wide awake	<input type="checkbox"/> 5	Moderately let down, tired
<input type="checkbox"/> 2	Very lively, somewhat responsive, but not at peak	<input type="checkbox"/> 6	Extremely tired, very difficult to concentrate
<input type="checkbox"/> 3	OK, somewhat fresh	<input type="checkbox"/> 7	Completely exhausted
<input type="checkbox"/> 4	A little tired, less than fresh		
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	How much sleep did you have in the <u>24 hrs</u> before the event?	hrs mins
Home	Yes / No	How much sleep did you have in the <u>72 hrs</u> before the event?	hrs mins
Duty itself	Yes / No	flight deck nap? Yes / No if yes, when	start end
In-flight rest	Yes / No		
Disrupt	Yes / No		
Personal	Yes / No		
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			

Fatigue report form

Appendix F

Enhanced fatigue management obligations - Hazard identification and associated procedures

- F.1.1 ICAO's Document 9859 – *The Safety Management Manual (SMM)* 4th edition highlights the importance of distinguishing between hazards as a condition or an object with the potential to cause death, injuries to personnel, damage to equipment or structures, loss of material, or reduction of the ability to perform a prescribed function (the potential to cause harm) and risk likelihood and severity of the consequence or outcome from an existing hazard or situation (the likelihood of the harm occurring and the potential severity). Applying these criteria to fatigue is a means of minimising or eliminating its influence on pilot performance.
- F.1.2 CASA has designed a set of prescriptive limitations that are designed to broadly manage the risk of fatigue due to sleep loss, time awake, time on duty and the time of day effects. However, there are many operational factors which are known to contribute to fatigue. These factors are specific to the operational environment and may include, but are not limited to:
- night flying
 - time critical operations
 - cockpit temperature and pressurization
 - environmental degradation
 - lack of automation
 - route variations
 - aerodrome unfamiliarity
 - high noise or vibration levels.
- CASA has only provided minimal consideration of these influences within the limitations, for example, the number of sectors flown.
- F.1.3 Operators should consider their own circumstances using prior company experience or discussions with other operators and groups so that operationally specific fatigue hazards may be identified within their operations manual.
- F.1.4 The following table is an illustration of what CASA considers a reasonable approach to fatigue hazard identification for an operator without an established risk assessment process. Operators are reminded that it may be possible to reduce the identified hazard through means other than limiting flight or duty times.
- These are a sample of fatigue hazards which may exist for some operators. This list is not specific to any particular operation type but is intended to inform operators with little experience in SMS-type processes about how hazards may be mitigated to comply with the enhanced fatigue management obligations for Appendices 2-6. If an operator has an approved SMS, the processes within the SMS could, and should, be used for the purposes of complying with those obligations.

FATIGUE MANAGEMENT FOR FLIGHT CREW MEMBERS

Identified Fatigued Hazard (date recorded)	Existing Controls	Hazard still present Yes/No/Diminished?	Additional mitigations	Hazard still present Yes/No/Diminished?	Responsible Person and Policies and Practice Considerations
Insufficient or disrupted sleep prior to duty period	Report fatigued Fatigue Training	Yes	Controlled rest Caffeine	Diminished.	Operations Manager to monitor fatigue reports. FCM survey to be conducted 6 months after the additional mitigations are introduced.
Extreme temperatures / humidity	Cockpit climate control Fatigue Training	Diminished	Rest intervals between sectors conducted in air-conditioned rest facilities Encourage regular hydration with electrolyte drinks	Diminished to acceptable levels. Hazard for operations in high temperatures does not exist for operations between April and November (base specific)	Head of Maintenance to monitor levels of aircraft climate control unserviceability's.
High Noise levels	Mandatory use headsets (Ops manual ref XXXX)	Diminished	Upgrade headsets to be noise cancelling	No – noise reduced to normal range	Chief Pilot – amend Ops manual policy
Flight within Instrument meteorological conditions (IMC) or at night.	CAR 217 training and checking Part 61 IF recency requirements.	Diminished	Autopilot must be serviceable or two crew Increase IF recency requirements to XX hours every XX days	Diminished to acceptable levels	Head of Maintenance to monitor levels of autopilot unserviceability's. Chief Pilot to make system

FATIGUE MANAGEMENT FOR FLIGHT CREW MEMBERS

Identified Fatigued Hazard (date recorded)	Existing Controls	Hazard still present Yes/No/Diminished?	Additional mitigations	Hazard still present Yes/No/Diminished?	Responsible Person and Policies and Practice Considerations
					changes to monitor new recency recording
Automation not available. For example: No Autopilot.	Appropriate training	Diminished	Increased rest intervals between sectors. Reduce night flying to less than XXX per FDP	Diminished to acceptable levels	Head of Maintenance to monitor levels of autopilot unserviceability's.
Consecutive WOCL duties causing fatigue	Limit of 3 Consecutive WOCL duties per 7 days Fatigue Training	Yes	Max Limit of two consecutive WOCL duties per 7 days Increased ODP Controlled rest Caffeine Sleep monitoring	Diminished to acceptable levels	Operations Manager

Appendix G

Data collection procedures

G.1 General

- G.1.1 Monitoring and evaluation processes within the enhanced fatigue management obligations would readily be met through the collection and analysis of fatigue related data gathered under operational circumstances. The collection of fatigue data may improve an organisation's performance across a number of domains. For example, the addition of data will help inform the organisation of the effectiveness of mitigation efforts, such as training and scheduling.
- G.1.2 Data could be collected from a variety of sources including subjective and objective measures of alertness, performance and sleep. These data are critical to form a baseline to establish the fatigue risk associated with operations. 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.
- G.1.3 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 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 through the use of recording devices, 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*.

G.2 Data collection methods

G.2.1 Fatigue surveys

- G.2.2 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, 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. An example of a brief fatigue survey is presented below.

G.3 Fatigue Survey

Age:			
Gender:		Male <input type="checkbox"/>	Female <input type="checkbox"/>
Position:		(i.e., CAPT /FO /SO)	
Years in current role:			
Aircraft type			
Haul type	Short <input type="checkbox"/>	Long <input type="checkbox"/>	Short & Long <input type="checkbox"/>
This Form was completed by:	Pre-duty <input type="checkbox"/>	Post-duty <input type="checkbox"/>	Day-off <input type="checkbox"/>

Samn-Perelli crew status check

Title	Title
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

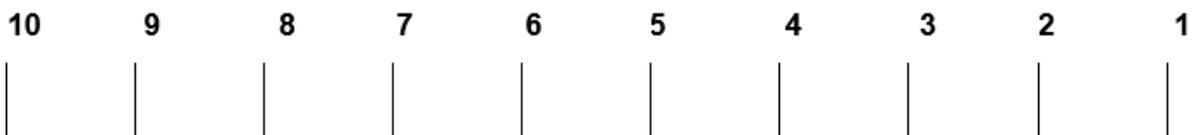
During the past 7 days (start with today and go back 7 days - how many hours or number in an activity):

	Title			Title			
	Sat	Sun	Mon	Tues	Wed	Thr	Fri
FDP Length							
Time awake at end of FDP							
Sectors Flown							
Flying Time							
Time Slept							

Title				Title			
Time Napping							
Commuting							

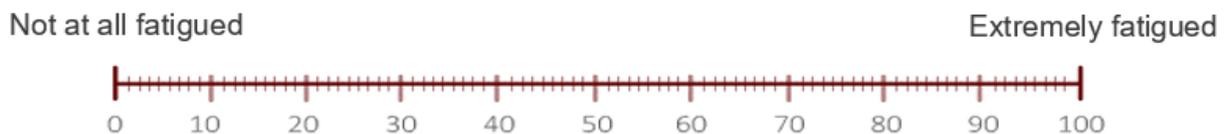
During the past week rate your overall sleep quality. Consider how many hours, how easily you fell asleep, how often you woke up during the night, how often you woke up earlier than you had to, and how refreshing your sleep was.

Quality	Overall sleep quality (using scale below)
Very good	
Good	
Average/Fair	
Poor	
Very poor	



Fatigue scale

Right now, how do you feel?



G.3.1 Sleepiness and alertness ratings

Sleepiness and alertness ratings are subjective tools which can be used to assess sleepiness and alertness levels of FCMs. Ratings can be administered as a paper and pencil survey or electronically on a mobile device. The Karolinska Sleepiness Scale (KSS) and the Samn-Perelli Fatigue Scale are two assessment tools been used extensively in aviation data collection protocols.

While these tools are sensitive to sleep loss and changes in alertness levels, there is no standardise 'cut-off' score to delineate a state of impairment from fatigue. Nevertheless, the scales can be used by operators to assess their FCMs base line levels of fatigue and compare these to operations that are likely to exhibit fatigue for the purpose of monitoring and evaluating scheduling practice and mitigating fatigue.

<i>Subjective alertness assessments</i>	
Karolinska Sleepiness Scale (KSS; 1-9)	<p>Is a 9-point scale that measures the subjective level of sleepiness at a selected time during the day. Scores on the KSS increase with longer periods of wakefulness and it strongly correlates with the time of the day. A value of 7 or higher on the KSS is associated with intrusions of sleep and an increased risk of impaired performance.</p> <p>1 = extremely alert 2 = very alert 3 = alert, 4 = rather alert 5 = neither alert nor sleepy 6 = some signs of sleepiness 7 = sleepy – but no difficulty remaining awake 8 = sleepy but some effort to keep awake 9 = very sleepy, great effort to keep awake, fighting sleep</p>
Samn-Perelli fatigue rating scale (SPS)	<p>The SPS is a 7-point scale that subjectively measures an individual’s level of fatigue at a selected time during the day. This scale was originally developed to assess levels of fatigue and alertness in pilots before take-off. Typically, a mean value of 5 or greater on the Samn-Perelli scale would raise some concern about the suitability of that particular roster.</p> <p>1. Fully alert, wide awake. 2. Very lively, responsive, but not at peak. 3. Okay, somewhat fresh. 4. A little tired, less than fresh. 5. Moderately tired, let down. 6. Extremely tired, very difficult to concentrate. 7. Completely exhausted, unable to function effectively</p>

G.3.2 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 a period of time. Sleep/activity and duty logs typically consist of

questions about sleep and wake times, sleep quality, naps, duty time, environmental stress, diet and physical exertion. Sleep data measured from consumer wearable devices could also be incorporated into these logs.

An example form is presented below:

Sample Sleep / Activity and Duty Log

	Name:						
	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							

G.4 Data presentation

Operational fatigue related data should be presented in a format that demonstrates the adequacy of the operators' fatigue mitigation strategies in addressing fatigue risks, while observing the requirements of the Privacy Act.