Civil Aviation Safety Authority
of Papua New Guinea

Advisory Circular

AC172-2

Fatigue Management

Initial Issue

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GENERAL

Civil Aviation Safety Authority Advisory Circulars (AC) contain information about standards, practices and procedures that the Director has found to be an Acceptable Means of Compliance (AMC) with the associated rule.

An AMC is not intended to be the only means of compliance with a rule, and consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices or procedures are found to be acceptable, they will be added to the appropriate Advisory Circular.

PURPOSE

This Advisory Circular provides explanatory material (EM) and methods acceptable to the Director for the management of fatigue-related safety risks, in compliance with the prescriptive limitation regulation established in CAR Part 172.

RELATED CAR

This AC relates specifically to Civil Aviation Rule Part 172.55 – **Fatigue Management**.

CHANGE NOTICE

This is the initial issue.

TABLE OF CONTENTS

1.0 Introduction

The aviation industry provides one of the safest modes of transportation in the world. Nevertheless, a safety critical industry must actively manage hazards with the potential to impact safety. Fatigue is now acknowledged as a hazard that predictably degrades various types of human performance, and can contribute to aviation accidents or incidents. Fatigue is inevitable in a 24/7 industry because the human brain and body function optimally with unrestricted sleep at night. Therefore, as fatigue cannot be eliminated, it must be managed.

When complying with prescriptive limitation regulations, ATS Providers are still obliged to use their existing SMS processes to identify and mitigate risks (including those associated with fatigue). There are a number of sources of data already available to an ATS Provider that can be used to identify where fatigue might constitute a hazard. These all involve what ICAO calls 'reactive hazard identification', which means that fatigue is identified after it has occurred. The other types of hazard identification are proactive (monitoring fatigue during operations) and predictive (predicting likely fatigue levels in operations before they occur).

2.0 EM Prescriptive Approach

In a prescriptive approach to fatigue management, the State is responsible for establishing prescriptive limitations and requirements. This approach requires the State to prescribe maxima for work periods, minima for non-work periods and other elements as relevant to the risks associated with a specific the type of work (e.g. limiting consecutive night duties, increasing controls with increasing numbers of time zone crossings). Through their oversight practices, the State ensures that the service provider is managing their fatigue risk to an acceptable level using existing SMS processes within the constraints of the prescriptive limitations and requirements. This means that operational personnel should be sufficiently alert to perform at an adequate level in normal and abnormal situations.

3.0 EM Developing Prescribed Limits and Associated Requirements

This chapter addresses the oversight of the prescriptive approach to fatigue management under the following headings:

1. Developing prescriptive limitations and requirements;
2. Developing regulations for variations;
3. Regulatory oversight of Service Providers using a prescriptive approach to fatigue management; and
4. State Safety Programme (SSP) Considerations.

When establishing prescribed limits and associated requirements for a particular group of aviation professionals, the State necessarily takes into account the variety of types of work, operational contexts and conditions in their region (e.g. climate, geography and infrastructure). The State should also consider its legal, economic and socio-political context to the extent that it may impact on the ability of those professionals to maintain an adequate level of alertness when performing safety-related duties. While States may choose to review other States' prescriptive limits and requirements, it is important that States develop prescriptive limits that specifically address the needs and context of their aviation industry.

Safety issues are not the only drivers for limiting work periods and identifying non-work minima. Industrial agreements and social legislation also limit work periods and may unintentionally impact on fatigue management. Therefore, all limits identified through these different processes need to be assessed for their contribution to safety outcomes. This allows the State to assess the extent to which their current prescriptive limitations need to be reviewed in order to ensure that they provide comprehensive fatigue mitigation.

Fatigue management regulations focus on safety. The State should determine to what extent, if any, limits identified through industrial agreements and social legislation should be incorporated into their fatigue management regulations, so as not to confuse the focus of the limits being identified.

One way to guide the selection of a set of limits and requirements for a specific sector of operational personnel is to develop an assessment of the safety implications to support an objective decision making process. This requires the State to:

a) determine the safety relevance;
b) identify the generic fatigue hazards associated with that sector of operational personnel and assess the
associated risks;
c) propose a set of maxima for work periods and minima for non-work periods that best addresses the most significant risks; and
d) establish any additional requirements necessary to support the prescribed limits.

3.1 EM Determining safety relevance

The role that different operational personnel play in the aviation safety chain determines the extent to which their fatigue-related performance degradation could compromise the overall safety of the system. However, not all tasks carried out by operational personnel are equally safety relevant. It should be noted, though, that undertaking additional non-safety duties also contributes to fatigue.

EXAMPLES

1. Transferring non-operating crew members from one place to another, as required by the Service Provider, is a task that might have an impact on fatigue but is not directly relevant to operational safety.
2. Assessing procedures in a simulator may have an impact on fatigue but unless it is followed by a duty period, it is not directly relevant to operational safety.

To develop limitations and requirements that address high-risk areas while allowing the positive development of a State's aviation industry, it is important to identify which activities undertaken by the different groups of aviation professionals have the greatest impact on safety outcomes.

3.2 EM Assessing fatigue risks

The overall risk for a specific group of operational personnel is the combination of the consequences (see safety relevance above) and the likelihood of all fatigue-related hazards for all tasks undertaken by those personnel. A list of generic fatigue hazards and mitigation alternatives associated with a particular operational context may be developed based on consideration of the scientific principles and relevant research findings from studies, including operationallybased studies.

However, while careful consideration of research findings provides an important basis for establishing a set of prescriptive limitations, no single study will provide the complete solution that will necessarily be the best fit in the specific context to which they will be applied.

Taking into consideration the associated risks, the State has to draw informed boundaries, designed to maintain an acceptable level of safety performance in the majority of situations across an industry sector. For example, research on the fatigue hazards associated with pilots on short-haul operations in a particular region may identify common fatigue-related hazards such as frequent early starts and high workload associated with multiple stops.

It should be noted that such a high-level fatigue risk assessment is, by its very nature, much broader than that required by Service Providers to assess their risks within an FRMS.

More information on the assessment of a Service Provider's fatigue risk assessment is provided in Chapter 5 of ICAO Doc 9966

Existing limits and work practices used by various Service Providers can be reviewed to assess mitigation options identified from relevant research, scientific principles and operational knowledge. Operational knowledge may relate to such elements as:

a) additional scheduling policies to address likely disruption on the day;

b) mitigations used to address seasonal weather conditions;

c) mitigations used to address known fatiguing combinations of working patterns; and

d) practices for allocating unscheduled duties.

Other mitigations or defences include such things as the level of support available through reliable technology. The dayto-day operational reality of a specific operating environment plays an important role, particularly when determining appropriate mitigations for workload related fatigue hazards.

Existing limits and requirements should then be assessed to determine to what extent such mitigating measures are covered.

Example; A State might advise adjusting limits for time in position if technology that a controller normally uses to undertake his tasks is unavailable, for example short-term conflict detection tools.

Existing limits and requirements should then be assessed to determine to what extent such mitigating measures are covered.

3.3 EM Identifying limits

States must base their prescriptive limitations and requirements on scientific principles. In general, this means they:

a) provide adequate sleep opportunities prior to duty periods;
b) limit the duration of work periods and identify minima for non-work periods to allow for adequate recovery;
c) limit consecutive and total work periods over defined periods of time, in order to prevent cumulative fatigue;
d) consider the impact of commencing duties at different times of the day;
e) consider whether the duty is being undertaken by a single operational person or a team;
f) consider the impact of workload during the work period; and
g) avoid extended periods of being awake when assigning unscheduled duties (e.g. standby).

Identifying limits based on scientific principles and knowledge is therefore more than simply identifying a maximum work duty period and a minimum rest period.

For example, in the case of air traffic controllers, limits may differ according to the duration and number of consecutive early start duty periods and consecutive night duty periods as well as the number of standby duties during non-duty periods within a specific period of time.

While different types of operational personnel will require different sets of prescriptive limits, in all cases their development will require consideration of the operational relevance, and where necessary the appropriate way to address, the following areas:

a) Breaks taken during duty periods;
b) Stability of work patterns;
c) Assignment of unscheduled duties (including those associated with managing operational disruptions on-theday);
d) Recovery value associated with non-work periods; and
e) Meeting other physiological needs.
f) These are discussed further below.

3.3.1 Breaks Taken During Duty Periods

Within different disciplines, breaks taken during duty periods are intended to fulfil different recuperative purposes:

a) Breaks to limit a period of continuous wakefulness; and
b) Breaks to provide relief from periods of intense workload which have high potential for workload-fatigue-related performance degradation.

Requiring specified breaks to provide relief from periods of intense workload are generally associated with air traffic controllers (e.g. breaks between periods of time-in-position within a duty period). When identifying limits and associated requirements for this type of break, the State should consider:

- The nature and amount of work to be done (including time on task, task difficulty and complexity, and work intensity).

This is a particularly difficult limit to prescribe for a whole industry sector as there are many individual factors which would also effect workload such as:

a) Time constraints (including whether timing is driven by task demands, external factors, or by the individual).
b) Factors relating to the performance capacity of an individual (for example experience, skill level, effort, sleep history, and circadian phase).

Therefore, States may require that a Service Provider propose their own breaks to provide relief from periods of intense workload.

3.3.2 Stability Of Work Patterns

Changes within patterns of work for operational personnel may have an impact on fatigue. An example of this would be rapid changes between work periods during the day and during the night.

States should consider how they require their Service Providers to demonstrate their management of changes to patterns of work and irregular duty period start and finish times especially where they infringe or overlap the WOCL.

3.3.3 Assignment Of Unscheduled Duties

Within the prescribed limits, assignment of unscheduled duties to meet unpredictable operational needs is commonly managed through different approaches, e.g. on-call periods, standby, reserve and last-minute roster changes. For the purposes of this section, the term “on-call” will be used to cover all of these approaches.

The specific challenges associated with unscheduled duties relate to their inherent unpredictability and the likelihood of being assigned unscheduled duties. In many cases controlling the likelihood of being called in to

undertake an unscheduled duty may be impossible. Therefore, requirements for the assignment of unscheduled duties should aim to ensure that the operational person is adequately rested to undertake unscheduled duties. Such requirements may include State-identified limits and associated requirements or simply the requirement for the Service Provider to develop procedures.

Regardless of which approach a State takes, the following elements can guide the development of this area of the regulations:

a) the need for protected sleep opportunities prior to and after unscheduled duties;
b) adjusting the length of the standby period in relation to the length of the notification period (e.g. airport standby versus long call reserve);
c) duty length may need to be adjusted in relation to the time spent on call or standby depending on the length of the notification period; and
d) consideration of the extent to which an on-call period is counted as a work period is related to the degree to which it induces fatigue.

As for any other duty period, the operational person needs an opportunity to plan their rest to enable them to perform to a satisfactory level. Key to this is the length of time given from notification of the duty to the time of commencement of that duty. Longer notification periods can afford the individual the opportunity to rest in preparation for the duty, allowing them to remain available to be assigned an unscheduled duty for longer. Short notification periods require operational personnel to be fully rested and immediately ready to undertake the duty. Therefore, the length of the period on-call should be directly related to the length of the notification period.

It follows that where operational personnel are required to report immediately on notification, the ability for the individual to be fully rested declines over time. Therefore, States should consider how the time elapsed from commencement of the on-call period impacts on the length of the duty the operational person can be assigned. This is particularly so in the case of last-minute duty extensions to manage unexpected operational disruptions. This topic is discussed further in *Section 4.2.1 Variations to Meet Unexpected Operational Circumstances and risks.*

In making the judgement on the extent to which an on-call period counts as work, the following considerations may be useful, considering that sleep during on-call periods may be less restorative:

a) the location of the on-call period (e.g. at home vs. at the workplace vs. at a hotel);
b) the length of the notification period (e.g. does it afford an opportunity to sleep prior to reporting?)
c) the inclusion of protected periods during which the operational person will not be disturbed;
d) the possibility for the operational person to sleep during the on-call period (e.g. at home during either of the windows of circadian low).

3.3.4 Recovery Value Of Non-Work Periods

The recovery value of non-work periods is also dependent on when they take place in relation to the WOCL and the facilities that promote sleep e.g. a quiet, dark environment at an appropriate temperature. There are some instances where the Service Provider may be responsible for providing sleeping facilities during the non-work period, e.g. crew members away from homebase. To ensure that adequate sleep can be obtained, the State may develop regulations to explicitly outline requirements on the quality of the sleep facilities or may simply include the requirement for the Service Provider to demonstrate that the facilities they provide allow adequate sleep to be obtained.

3.3.5 Meeting Other Physiological Needs

In order to avoid any detriment to individuals’ performance, opportunities to eat, drink and meet biological needs should also be provided. The State should require that Service Providers have work practices that allow for these basic needs to be met.

3.4 EM Establishing additional requirements associated with prescribed limits

Other than prescribing limits, additional regulations may be needed to ensure that the Service Provider demonstrates the effective management of fatigue risks within the constraints of the prescribed limits. Such requirements may address:

1. Construction of schedules (rosters) using scientific principles and operational knowledge through:

    a) Comparison of actual work and non-work periods with what was originally planned, to identify times in a schedule when fatigue levels might be higher than expected;
    b) Adjustment of limits and schedules to accommodate any unique factor(s) associated with higher fatigue risks (e.g. duties or tasks that could significantly increase fatigue)

2. The use of existing SMS processes to identify and mitigate fatigue risks, such as:

    a) Processes for reporting fatigue-related issues including non-fitness for duty because of fatigue;
    b) Processes for keeping records on working and non-working times and the analysis of such data;
    c) Processes for reporting and recording the use of flexibility provisions within the prescribed limits;

3. Inclusion of fatigue management-related topics within the Service Provider's awareness and/or training programmes to an appropriate level. Topics should cover:

    a) The underlying scientific principles; and
    b) Personal strategies for the mitigation of fatigue.

4.0 EM Developing Regulations for Variations to a Prescribed Limit

While regulation through variation is undesirable, ICAO fatigue management SARPs allow for States to offer some limited flexibility to the service providers complying with the prescribed limits by way of variations. Variations may be necessary to meet operational needs and risks in:

a) Unexpected circumstances beyond the control of the Service Provider; and
b) Expected but exceptional circumstances.

4.1 EM Variations to meet unexpected operational circumstances and risks

Unexpected operational circumstances refer to those that do not occur on a regular basis or cannot be reasonably predicted to occur, based on past experience. If they are able to be reasonably predicted (e.g. known seasonal conditions that increase flight times or require additional air traffic control resources), the Service Provider should be expected to schedule accordingly. The service provider should use mitigations, e.g. schedule "buffer periods" (scheduling additional time to allow for operational variability) or provide additional resources within the prescribed limits, and not rely on the use of variations.

However, it is recognized that unexpected operational circumstances can occur to which a Service Provider must respond immediately, which can necessitate extending beyond prescribed limits. To enable such on-the-day extensions, the State may establish regulations which:

a) prescribe outer limits and the circumstances in which they can be used;33 or
b) permit a Service Provider flexibility to manage on-the-day disruptions by requiring them to develop their own on-the-day response protocol.

Whether identified by the State or proposed by a Service Provider, the following will need to be identified:

a) the circumstances in which the variations may be used;
b) the operations to which the variations may be applied;
c) the necessary mitigations to address the increased fatigue risks; and
d) the variation limits.

The variation limits are dependent upon the operational circumstances and the operational person making an

assessment of their fitness for duty.

4.2 EM Variations to meet expected operational needs and risks

A State may permit *minor* variations to the prescribed limits to meet expected operational needs and risks in exceptional circumstances, without the need for the Service Provider to develop a full FRMS. Examples of expected, but exceptional, operational circumstances include ensuring the provision of adequate services for the duration of a short-term event, or to meet a specific operational need requiring very minimal variations for extended periods of time.

The State should have an application and approval process for variations to prescribed limits to ensure that each Service Provider demonstrates how they will actively manage their specific fatigue risks when the variations are in place. This requires the Service Provider to provide a safety case (risk assessment) that demonstrates a level of safety equivalent to, or better than, the prescriptive fatigue management regulations. It also requires the State to have personnel with the knowledge and experience to be able to assess such safety cases. Without them, a State should not approve variations. A framework to support the assessment of such safety cases is discussed below.

Note: A State needs to have personnel with the knowledge and experience to assess safety cases before they can approve variations.

4.3 EM Assessing safety cases to support variations

A safety case required to support a Service Provider's proposed fatigue management approach consists of more than just the argument that 'we have always done it this way'. It must document what the Service Provider wants to do, what has been done to assess the risk, the supporting documentation for why it offers an acceptable level of risk, and what mitigations will be used.

Before assessing a safety case, the State evaluates the Service Provider's capability and willingness to manage safety, based on previous oversight experience. In the case of an application for a variation to prescribed work limits, the State needs to be confident that the variation will be managed safely.

The effort expected of the Service Provider in developing a safety case (or risk assessment) should reflect the safety riskit aims to address. Safety cases to support minor and temporary variations to prescribed limits should be proportionate to the risk and not make the same demands as the establishment of an FRMS. In some cases the capability of the Service Provider making the change and the low safety impact of the change may mean that the information provided in the safety case is quite brief.

While not all safety cases require the same level of preparation, they can all be evaluated using the following

interrelated steps:

1. Assessing the nature, scope and impact of the proposed variation;
2. Assessing the applied risk assessment methodology;
3. Evaluating how the risk assessment is used and how the decision to accept risk has been made;
4. Assessing the appropriateness of the risk mitigation measures;
5. Assessing whether the claims, arguments and evidence made in the risk assessment are valid;
6. Assessing plans for continued monitoring of the safety impact of the changes.

The steps for assessing safety cases are discussed below in relation to applications for variations to prescribed limits.

4.3.1 Assessing The Nature, Scope And Impact Of The Proposed Variations

Objective
The State is assured that the Service Provider understands the change it is proposing including the direct or indirect impact of the change on the fatigue levels of those who will work to the new limits.
Methods • Submitted documentation clearly identifies which element(s) of the prescriptive regulations that it is seeking to vary, the proposed changes, and the operations to which they are intended to apply. • Other areas of regulation that are affected by the proposal are identified. • Submitted documentation demonstrates that the Service Provider has considered any direct or • indirect impacts the proposed variations will have on those operations and other services.

4.3.2 Assessing Hazard And Consequence Identification

Objective
The State is assured that a hazard identification process has been carried out with regard to the proposed variation and that the consequences of the hazards have been documented.

Methods
- Review the method used to identify and assess the fatigue hazards and their consequences for the proposed variation.
- Review any other direct or indirect hazards identified in relation to the variation and their consequences.
- Transitional risks to the operation associated with the variation are considered.

4.3.3 Evaluating The Way The Risk Has Been Assessed And Accepted

Objective

The State is assured that the level of risk associated with the proposed variation is acceptable

Methods
- Examine the record of the risk assessment .
- Assess if the risk assessment appears reasonable both before and after mitigations have been applied using personal experience and judgement.
- Evidence is provided that existing fatigue controls and mitigations are effective.
- Confirm that an appropriately authorized person has accepted the remaining risk level and that this has been recorded.

4.3.4 Assessing The Risk Mitigation Measures

Objective
The State is assured that the mitigations identified are sufficient to manage the fatigue risk expected when operating up to the fullest extent of the variation to the fatigue management limitations being proposed.

Methods
- Determine who was involved in the process of identifying and establishing the mitigations to ensure that this was conducted at the correct level within the organizational structure of the Service Provider and with the involvement of the relevant people.
- Carefully examine the proposed fatigue mitigations using knowledge of the Service Provider proposing the variations and of other Service Providers in similar situations to establish if the mitigations are appropriate and likely to be effective.
- Review the Service Provider's processes and procedures to evaluate the appropriateness of their plan for risk management, and training.
- Consider other aspects of human performance that may be affected by the mitigations.
- Ensure that the Service Provider is not relying only on training to mitigate fatigue risks.

4.3.5 Assessing That The Claims, Arguments And Evidence Made In The Risk Assessment Are Valid

Objective

The State is assured that the claims and arguments are robust and supporting evidence is accurate and correctly interpreted.

Methods
- Review the safety arguments to confirm that a justification for the continuation of an acceptable level of safety performance has been demonstrated.
- Safety arguments are supported by well-validated research or best practices.
- Transitional risks are mitigated.
- Clear conclusions are included in the risk assessment
- Proposed mitigations have considered all the legal requirements applicable to the worker (national, international, safety, social). Ensure they have been captured and addressed.

4.3.6 Assessing Plans For Continued Monitoring Of The Safety Impact Of The Variations

Objective The State is assured that the hazards associated with the variations have been correctly identified and the mitigations are performing as expected.
Methods • The service provider has processes in place and demonstrated the capability to allow continued monitoring through existing SMS activities. • Specific safety performance indicators related to the variation are established. • A review process is identified to assess the impact of organizational changes Service Provider changes to the operating environment.

As for all safety cases, the State needs to develop a process to record all elements of this assessment. This should include what evidence (documentation) was reviewed, any safety concerns that were not acceptably addressed and the rationale for the decision to accept or reject the variation, as well as the period of time that the variation remains applicable. This process should also include scheduling a review of the variation once it is operational within the State's oversight programme.

5.0 EM Regulatory Oversight

Through their oversight practices, States must ensure compliance with all the prescriptive limitations regulations and variation requirements, as well as the management of fatigue risk through SMS processes and training obligations. Oversight also includes the establishment of appropriate corrective action mechanisms and enforcement strategies that can be enacted should a service provider (or individual) exhibit non-compliance.

The following sections describe how compliance should be demonstrated by a Service Provider with regards to requirements for:

a) prescriptive limitations;
b) variation processes;
c) meeting SMS obligations; and
d) training.

5.1 EM Compliance with prescribed limits and associated requirements

States must assess a service provider's compliance with prescribed limits and associated requirements. The nature and extent of this assessment will depend on:

a) the level of granularity/complexity of their prescriptive rule set;
b) the maturity of the service provider's SMS; and
c) the extent to which the service provider's uses the full range of the prescriptive limitations.

States should ensure that a service provider has documented work and non-work period practices, based on scientific principles, which comply with the prescriptive limitations and associated requirements set by the State.

States should also require service providers to retain records of work and non-work periods. This should include planned and actual work and non-work periods, with significant deviations from prescribed limits and minima noted. Significant deviations are those that exceed the outer limits or reduced minima of any flexibility provisions (refer 2.1).

Analysis of such records, including trending the use of any flexibility provisions by the service provider, allows the State to monitor compliance. Further, analysis of these records, coupled with fatigue reports, may help to identify fatigue risk associated with a service provider's rostering practices. These records must remain auditable for a period of time as determined by the State.

Service Providers may choose to use a bio-mathematical model to assist in preparing schedules with fatigue management principles in mind. Such models provide a means for predicting the relative fatigue levels associated with one work pattern compared to another. However, model predictions should not be used without reference to operational knowledge, when making decisions about work pattern design. Personnel overseeing a Service Provider who utilizes a bio-mathematical model in their rostering process should ensure they understand the capabilities and limitations of the model used by the Service Provider and what the output metrics represent.

It is important that the State is satisfied that the Service Provider publishes an individual's work schedules sufficiently in advance to allow planning for work and rest periods. While late changes to an individual's work

schedule are sometime unavoidable, it is important that the Service Provider take steps to keep changes at short notice to a minimum and minimize their impact.

If a Service Provider allows individuals to engage in 'shift swapping', specific procedures should exist for this to ensure:

a) prescriptive limitations are not exceeded at the time of the shift swap or at a later time during the work schedule; and
b) shift swapping is monitored to avoid conflict with scheduling principles or practices developed by the Service Provider.

The State should also require that the assignment of unscheduled duties is actively managed by operational processes and procedures which contain elements such as:

a) minimizing the extent of disruption to the timing of a planned duty;
b) providing protected sleep opportunities (prior to, during and after unscheduled duties);
c) identifying minimal notification periods for changes to planned duties; and
d) limiting the number of consecutive days that they may be subject to being assigned unscheduled duties.

5.2 EM Compliance with variation process requirements

Compliance with approved processes for extending work periods in sudden unforeseen operational circumstances should be monitored to ensure that such extensions are used only as appropriate. Such monitoring can be achieved through:

a) analysis of the proportion of duties which necessitated such extensions; and

b) examination of reports which the State should require to be generated each time such extensions are used. These reports should contain sufficient information to identify the reason for the use of the extension, the effectiveness of any fatigue mitigations employed and subsequent changes to the schedule to ensure realignment with prescribed limits.

Where variations have been approved to meet expected operational circumstances, compliance with the associated mitigations, processes and procedures also needs to be monitored. Such monitoring can be achieved through:

a) including the assessment of the use of the variations as part of regular oversight visits;

b) reviewing the safety performance indicators that were agreed within the variation approval;

c) reviewing any safety reports (either mandatory or voluntary) associated with the agreed variation.

5.3 EM Compliance with sms requirements

Complying with the prescriptive limitations does not relieve the Service Provider of the responsibility to manage its risks, including fatigue-related risks, using its SMS. However, they are less onerous and have fewer specific obligations for fatigue-related risk management than with FRMS, particularly with regards to collecting data. Despite this, States should still be satisfied that the evidence of SMS processes applied to fatigue-related risks is sufficiently robust to manage the fatigue risk expected when operating up to the fullest extent of the prescriptive limitations.

Minimum expectations for managing fatigue risk using existing SMS processes are provided below:

5.3.1 Identifying Fatigue Risks

For operations that remain within the prescriptive flight and duty time limits, there are a number of sources of data already available to a Service Provider that can be used to identify where fatigue might constitute a hazard. Most, but not all, involve 'reactive hazard identification', which means that fatigue is identified after it has occurred. Depending on the size of a service provider and the maturity of its SMS processes, some or all of the following examples might be acceptable for use:

a) gathering information from previous accidents and incidents (internal and external);
b) considering hazard reports that may be associated with fatigue;
c) considering fatigue-related results of internally or externally conducted safety assessments/audits;
d) considering fatigue-related safety information from external sources, i.e. similar Service Providers, media, accident investigation bodies, audit reports etc.;
e) considering results from generic fatigue hazard checklists; and
f) active participation with the service provider's Safety Committee or having a small group of suitably experienced members of the service provider meet to consider the service provider's operations and identify possible fatigue hazards in this manner.

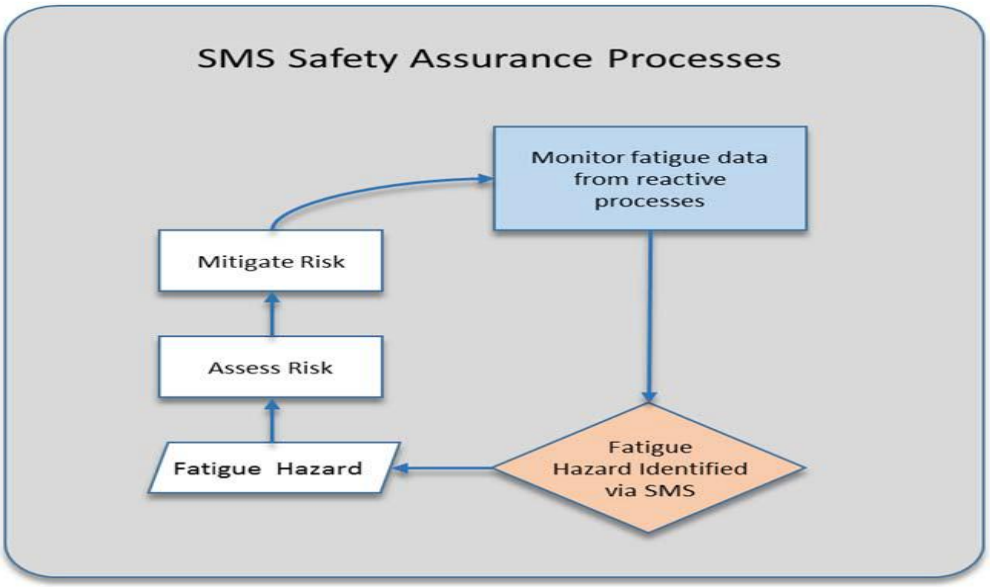

Figure 1 summarizes the use of data (obtained through mainly reactive processes) for identifying fatigue hazards as part of a Service Provider's SMS, for operations that comply with the prescriptive limitation regulations. Responsibility for risk assessment of fatigue hazards and mitigation resides with the SMS team. Section 5.3.3 in the Manual for the Oversight of Fatigue Management Approaches describes fatigue risk assessment processes in more detail.

5.3.2 Mitigating Fatigue Risks

Where a fatigue risk is identified while complying with prescribed limits, the Service Provider will put in place a safety action plan identifying appropriate mitigations and controls according to its current safety management practices.

Fatigue risk can only be managed in part by States limiting the hours of duty and commensurately providing for sufficient non-duty periods. There may still remain a need for a Service Provider to control fatigue risk by further limiting prescriptive limitations promulgated by the State due to their unique operating environment and workload considerations, or other factors.

As well as working to more restrictive limits than those prescribed, other typical risk mitigations which may also be considered by a Service Provider include the adjustment of scheduling practices and policies, provision of controlled napping opportunities, provision of protected sleep opportunities, or augmenting staffing levels (discussed in Chapter 2).

SMS processes should require that such risk mitigations are regularly reviewed and assessed to ensure their desired outcome continues.

5.3.3 Training

As part of their SMS, Service Providers are responsible for maintaining a safety training programme that ensures that personnel are trained and competent to perform their SMS duties (Annex 19, Appendix 2). While most Annexes with Fatigue Management SARPs also include a specific requirement for fatigue management-related training, the preexisting SMS training Standard already requires that Service Providers offer awareness and training programmes over and above those that are part of approved training programmes for licensing purposes. SMS therefore places an expectation on Service Providers to incorporate basic fatigue management topics in their awareness and training programmes. This is discussed further in 3.4 below.

5.4 EM Compliance with training requirements

It will be necessary for the State to ensure that fatigue management-related topics are included in a Service Provider's training programme and on safety information circulars, as appropriate. All individuals who are implicated in the realm of fatigue management, including the organization's management personnel, rostering personnel and the individuals at the front-line, need training and information related to fatigue management.

The fatigue management-related content in training programmes for these individuals should be appropriate to their role in managing fatigue within the service provider's SMS activities. It should comprise basic scientific principles related to fatigue management and general sleep hygiene as well as content specific to the Service Provider's type of service and unique operational characteristics. This will include information on options for personal mitigation strategies and familiarization with service provider procedures for activities such as 'shift

swapping', reporting on people "not fit for duties" due to fatigue, or assigning unscheduled duties. Suggestions for fatigue management training topics can be found in Appendix J of ICAO Doc 9966..

Service provider fatigue management training should be conducted on an initial and recurrent basis. The interval between training should be determined by the service provider given their operational characteristics and training needs analysis driven by the SMS processes. This means that the State should ensure that the training programme, and the way in which the service provider assesses the effectiveness of its training programme, is commensurate and sufficient for its needs.

Effective coverage of fatigue topics may be confirmed through reviewing trends in fatigue reporting rates and the quality of information provided in fatigue reports. This information could provide insights into how well fatigue concepts have been understood, is the appropriateness of fatigue mitigations used.

Appendix A – EM Prescriptive Limitation Parameters for Air Traffic Controllers

This Appendix should be read in association with the overarching requirements published above which describes the areas to be considered when developing prescriptive regulations in general. The following material comprises a set of parameters that may be considered in the development of prescriptive limitations for ATCOs. This is only one example of how prescriptive limitations for fatigue management may be defined.

A1. The Service Provider's Responsibilities

- Duty rosters should be prepared and published sufficiently in advance to provide ATCOs the opportunity to plan adequate rest. Consideration should be given to the cumulative effects of undertaking long duty hours interspersed with minimum non-work periods, and of avoiding rosters that result in the serious disruption of an established pattern of working and sleeping. Rosters should cover a period of at least (14) days.
- Minimum non-work periods need to provide adequate rest such that the ATCO can achieve a suitable sleep period, as well as allowing for consideration of other physiological requirements and any associated travelling or commuting time.
- In order to avoid any detriment to an ATCO's performance, opportunities to consume a meal must be arranged when the duty period exceeds (7) hours.
- The Service Provider should not require an ATCO to undertake any safety related task if it is known or suspected that the ATCO is fatigued to the extent that safety may be adversely affected.
- To provide evidence of compliance with prescriptive limits, records will be kept for (24) months – rule 172.115(h)(2)) of the duties performed and non-duty periods achieved so as to facilitate inspection by the service's authorized personnel and the regulator.

A2. Air Traffic Controllers' Responsibilities

- An ATCO should not perform any safety relevant tasks when he or she knows that he or she is fatigued or feels unfit to the extent that safety may be adversely affected.
- ATCOs should make best use of the facilities and opportunities that are provided for rest and for the consumption of meals. They should plan and use rest periods to ensure that they are fully rested.

A 3. Duty Limitation Parameters

A3.1 Duty Period – (Car 172.55 And Ats Administration Manual Capter 1-100)

- The duty period may not exceed10 hours
- The aggregate of duty period hours may not exceed 90 hours within a period of 14 consecutive days
- There must be at least 8 hours between the end of one duty period and the beginning of the next
- No more than 7 consecutive days of duty shall be worked
- If the maximum number of consecutive days of duty is rostered, there shall be a minimum interval of 48 hours between the end of one consecutive period of duty days and the next.

Scientific and operational factors for consideration: There may be variable limits of duty period throughout the day which reflect task complexity and workload requirements as well as time of day and circadian disruption. There must be sufficient time between duty periods for suitable sleep. The cumulative effects of fatigue over a period of days should be considered.

A3.2 Operational Duty

- No operational duty shall exceed10 hours without there being a break taken during or at the end of that period
- A break should total not less than15 minutes.

Scientific and operational factors for consideration: Time in the controlling position should be limited based on complexity of task and workload. Breaks should provide sufficient time away from tasks to allow individuals to resume work with a sufficient level of performance. Breaks could be structured to allow napping or sleeping opportunities if appropriate.

A3.3. Night Duties

- A period of night duty shall be defined as starting at 0000 local and ending at 0700 local
- A duty which covers all or part of the period of night duty shall not exceed10 hours
- No more than 3 consecutive duties shall be worked which cover all or part of the period of night duty.
- A minimum period of 12 hours shall occur between the end of duties which cover all or part of the period of night duty and the commencement of the next period of duty.

Scientific and operational factors for consideration: A night duty shall be wholly or partly between the window of circadian low. Consideration should be given to the research with regard to shift length and night work. Recovery time from night duties should allow recovery from any sleep debt accumulated and reversion to normal sleep cycle rhythms.

A3.4. On Call Duties

- No more than 1 on-call duties shall be worked in a 7-day period
- The maximum length of on call period of duty where the ATCO does not attend the place of work shall be 8 hours.

Scientific and operational factors for consideration: Continuous hours of wakefulness and opportunities available to take sleep during the on-call period.