



สำนักงานการบินพลเรือนแห่งประเทศไทย
The Civil Aviation Authority of Thailand

Guidance Material for ATS Fatigue Risk Management System

CAAT-GM-ANS-ATSFM

Revision: 01

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Approved by

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Mr. Suttipong Kongpool

Director General of the Civil Aviation Authority of Thailand

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0. Introduction

0.1 Background

Thailand, as a contracting State to the Convention of International Civil Aviation, has an obligation to the international community to ensure that the civil aviation activities under its jurisdiction comply with the Standards and Recommended Practices contained in the Annexes to the Convention.

In accordance with the Air Navigation Act B.E.2497 (Amendment No. 14) B.E.2562, the Civil Aviation Authority of Thailand (hereinafter 'CAAT') has been appointed to carry out tasks aimed at ensuring the safe and efficient operation of Service Providers in Thailand. More specifically, the Requirement of the Civil Aviation Authority of Thailand No. 25 (RCAAT No. 25) on the Application for and Issuance of Air Navigation Services Certificate, Air Navigation Service Providers are required to obtain Certification in order to provide air navigation services in Thailand. The Air Traffic Service Providers (ATSP) shall ensure that any air traffic service that it provides is provided in accordance with standards set out in the Manual of Standards (MOS), ICAO Annexes and documents.

This Guidance Material provides ATSP with essential processes and elements for an effective Fatigue Risk Management Systems (FRMS), as prescribed in subsection 4.2.3 of Manual of standard (CAAT-ANS-MOSATS). The Guidance Material provided as advisory material for Air Traffic Service Providers. It is not legal advice, is not a substitute for individual advice, and may not be applicable to everyone's situation.

Amendments to this Guidance Material will be notified through www.caat.or.th

0.2 Purpose

The 'Guidance Material for ATS Fatigue Risk Management System (ATS FRMS) is issued by the CAAT and contain information about recommendations acceptable to the CAAT.

The purpose of this Guidance Material is to provide general guidance and principles to implement an ATS FRMS to ATSPs and applicants on the certification application process to comply with the provision of the Air Navigation Act and the Regulations.

It should be clearly understood that this document has no legal status. It is intended to provide recommendations and guidance to illustrate a means but not necessarily the only means of complying with the regulations, or to explain certain regulatory requirements by providing interpretative and explanatory material applicability (is subjected to).

0.3 Applicability (is subjected to)

This Guidance Material is applicable to the applicants for the provision of ATS whose certification corresponds to the CAAT in accordance with section 15 chapter 1/2 of the Air Navigation Act B.E. 2497 (Amendment No. 14) B.E.2562, the Requirement of Civil Aviation Authority of Thailand No. 25 (RCAAT No. 25) on the Application for and Issuance of Air Navigation Services Certificate and CAAT Rules on Manual of Standard ATM:ATS B.E.2563 with Manual of Standard Air Traffic Management Services: Air Traffic Services (CAAT-ANS-MOSATS).

0.4 Effective Date

The 'Guidance Material for ATS Fatigue Risk Management System' Revision 01 is effective at 15 December 2022

0.5 Reference (Refer regulation)

- a) Civil Aviation Authority of Thailand Emergency Decree B.E.2558
 - Chapter 1, Part 1, Section 7 and 8, CAAT's functions;
 - Chapter 1, Part 2, Section 37, CAAT's oversight obligations;
- b) Air Navigation Act B.E. 2497 Amendment No. 14 B.E.2562 (ANA (No.14) B.E.2562) Chapter 1/1 and Chapter 1/2;
- c) Requirement of CAAT No.25 on the Application for and Issuance of Air Navigation Services Certificate (RCAAT No. 25);
- d) Notification of CAAT on the Specification of the Juristic Person, Validity and Other Duties of the Air Navigation Service Certification Holder;
- e) Regulation of CAAT No. 17 on Air Traffic Management Services: Air Traffic Services Standards (R2CAAT No. 17);
- f) Rule of CAAT on Manual of Standards of Air Traffic Management Services: Air Traffic Services Standards;
- g) Rule of the CAAT on Operations Manual of Air Traffic Management Services: Air Traffic Services;
- h) ICAO Annex 11 – Air Traffic Services;
- i) ICAO Annex 19 – Safety Management;
- j) ICAO Doc 4444 – Air Traffic Management;
- k) ICAO Doc 9859 – Safety Management Manual; and
- l) ICAO Doc 9966 – Manual for the Oversight of Fatigue Management Approaches.

1. Introduction to Fatigue Risk Management System

1.1 Introduction

1.1.1 FRMS is an optional approach to prescriptive regulations. An ATSP seeking to exceed a limitation in subsection 4.2.2 of MOS-ATS, would do so under CAAT authorization. A FRMS is largely developed as an alternative method of compliance (AltMOC) to prescriptive limitations based upon objective performance standards. An ATSP may be authorized to apply the FRMS to any part or all of its operation, provided that the ATSP demonstrates an effective AltMOC that meets or exceeds

the safety standards afforded by the prescriptive limitations. The FRMS is an AltMOC to prescriptive limitations that the ATSP may implement for fatigue management and mitigation. However, before the ATSP may conduct operations under a CAAT approved FRMS, the ATSP must satisfactorily demonstrate to the CAAT that their proposed FRMS satisfactorily demonstrates that the AltMOC provides an equivalent level of safety to the safety standards set forth in MOS-ATS subsection 4.2.3.

1.1.2 FRMS is a management system for an ATSP to use to mitigate the effects of fatigue in its particular operations. The FRMS is a data-driven system, based largely upon scientific principles and operational knowledge, that allows for continuous monitoring and management of safety risks associated with fatigue-related error. The FRMS is a fatigue mitigation tool that minimizes the acute and chronic sources of fatigue and manages the potential risks associated with fatigue. The FRMS is part of a repetitive performance improvement process that leads to continuous safety enhancements by identifying and addressing fatigue factors across time and changing physiological and operational circumstances. The objective of the FRMS is to manage, monitor, and mitigate the effects of fatigue to improve ATCO alertness and reduce performance errors.

1.1.3 The ATSP's FRMS will be designed to demonstrate that ATCOs are sufficiently alert so they can operate to a satisfactory level of performance. Additionally, the FRMS should be designed to achieve a realistic balance between safety and productivity. It should proactively identify opportunities to improve operational processes and reduce risk, as well as to identify deficiencies after adverse events or reports of excessive fatigue.

1.2 Safety Management System and Fatigue Risk Management System Compared

1.2.1 FRMS has additional requirements to ensure a level of safety that is at least equivalent to that achieved by operating within the prescriptive limitations and considering fatigue as one of the risks to be managed using generic SMS processes. Where an ATSP already has sufficiently mature SMS processes in place, it should not be necessary to develop entirely new processes to implement FRMS. Rather, the ATSP can build upon the organization's existing SMS processes to address the added requirements of a FRMS.

1.3 FRMS Concept

1.3.1 A FRMS consists of organizational processes and procedures to control fatigue risk in aviation operations. It is part of a repeating performance improvement process. This process leads to continuous safety enhancements, by identifying and addressing fatigue factors across time and changing physiological and operational circumstances. Structurally, a FRMS is composed of processes and procedures for measuring, modeling, managing, mitigating, and reassessing fatigue risk in a specific operational setting. The FRMS is an effective fatigue mitigation strategy when the organization bases it on valid scientific principles. The FRMS combines schedule assessment, operational data collection, continuous and systematic analysis, and both proactive and reactive fatigue mitigations, guided by information provided by scientific studies of fatigue. Overall, the FRMS offers a way to more safely provide ATS by offering flexibility not available within regulatory limits. The FRMS complements prescriptive duty and rest period requirements.

- **Operational Demands.** The FRMS addresses the complexity of operational demands and the inherent fatigue-related challenges associated with aviation operations. The FRMS approach is to apply risk management techniques to identify and reduce the risk of fatigue relevant to specific operational circumstances. The FRMS aims to ensure high levels of alertness in personnel to maintain acceptable levels of performance and safety.
- **Adaptability.** The FRMS provides an interactive and collaborative approach to operation performance and safety levels on a case-by-case basis. Therefore, the FRMS permits an ATSP to adapt policies, procedures, and practices to the specific conditions that create fatigue in a particular aviation operation. ATSPs may tailor their FRMS to unique operational demands and focus on mitigations of fatigue that are practical within the specific operational environment.
- **Assessment.** The FRMS relies on assessments to project and confirm the fatigue effects of an operation on ATCO sleep and alertness. This permits continuous assessment of fatigue levels associated with ever-changing operational conditions. The common tool for this assessment is a biomathematical model of fatigue and alertness levels or other algorithms that may be used to predict an individual’s fatigue across a schedule/roster.

Note: Refer to Appendix H- Bio-mathematical model of ICAO Doc 9966 – Manual for the Oversight of Fatigue Management Approaches for more information.

- **Risk Management Process (RMP).** The FRMS applies the RMP to identify fatigue risks through the use of data-driven systems. The FRMS includes documented processes for collecting and analyzing fatigue-related safety data and implementing corrective actions, always allowing for continuous improvement. A “just” or “safety” culture is integral to a successful FRMS, and it requires a shared responsibility among all levels of the organization, as well as the involvement of regulatory agencies.

1.4 Tools for an Effective FRMS.

1.4.1 There are four basic tools for a FRMS to be effective. These basic tools are fatigue-related data, fatigue analysis methods, identification and management of fatigue drivers, and application of fatigue mitigation procedures.

- a) **Fatigue-Related Data.** An effective FRMS is data-driven, meaning that it relies on the use of reports, studies, etc., rather than on speculation. A FRMS is based on scientific principles and involves continuous monitoring. It is difficult to detect fatigue in operational settings because there are no biomarkers for fatigue or simple tests of how an individual will respond to sleep loss. However, the environmental conditions that promote fatigue are well known and continue to contribute to performance deficits during operations. The challenge is that aviation operators cannot totally eliminate fatigue from 24/7 aviation operations, so ATSP need to apply proactive and

adaptive mitigation for fatigue. Managing fatigue risk depends on two types of operational evidence available to ATSPs:

- (1) The duty schedule directly affects ATCOs' opportunities to obtain restorative recovery sleep. Monitoring duty schedules provides indirect evidence of potential fatigue resulting from inadequate or poorly timed opportunities to obtain sleep.
- (2) A nonpunitive reporting system permits ATCOs and other employees to report subjective fatigue and, from time to time, request relief from duties because of chronic fatigue. These reports contain valuable data, especially when coupled with information about the conditions that contributed to fatigue, such as the work schedule for the week prior to the report. Subjective reports of fatigue can underestimate the true extent of performance impairment, especially when an individual is already suffering from acute or chronic fatigue due to sleep loss or circadian disruption. Therefore, data on procedural errors and duty exceedances, Safety Reporting System reports, and quality assurance data may help an ATSP to objectively document fatigue. ATSPs may couple data sources with scheduling information or other event data reported by ATCOs that implicate the potential for fatigue (e.g., duty delays and irregular operations). A nonpunitive reporting system is essential to encouraging the reporting of fatigue-related events as part of the overall safety system.

- b) **Fatigue Analysis Methods.** The FRMS should be part of the overall risk identification and management approach that employs both proactive and reactive processes to monitor, manage, and mitigate operational risk. The ATSPs can use commercially available computer models to assess average performance capability from sleep/wake history, placement within the circadian cycle, and duty schedule information. The ATSPs can embed models within the FRMS process to help themselves to understand the likely effects on individual performance of sleep obtained before and during duty patterns. Using these models (although it is not required) incorporates the latest scientific research on human circadian systems, sleep, and performance capability, and can be useful for rapidly estimating fatigue levels associated with proposed schedule changes. However, certain assumptions and limitations need to be taken into account. Models are not a substitute for a comprehensive FRMS; they are one useful component of the FRMS.

- (1) **Retrospective (Reactive) Processes for Oversight of Schedules.** The ATSPs can use a science-based fatigue model to assess the estimated fatigue levels associated with current or past schedules and determine which schedules are more vulnerable to increased fatigue levels and reductions in performance. First, ATSPs identify those schedules (both duty sequences and monthly schedules) that have been associated with the greatest levels of fatigue. Next, ATSPs can derive the fatigue factors present and examine the potential for schedule changes to reduce fatigue. Such changes might include additional recovery days, augmented ATCOs to permit sleep opportunities / breaks in time-in-position, or rescheduled block times to avoid critical tasks at times during or near the Window of Circadian Low (WOCL).

Note: *Window of Circadian Low (WOCL) is time in the circadian body clock cycle when subjective fatigue and sleepiness are greatest and people are least able to do mental or physical work. The WOCL occurs around the time of the daily low point in core body temperature - usually around 0200-0600 when a person is fully adapted to the local time zone. However, there is individual variability in the exact timing of the WOCL (Reference from ICAO Doc 9966 'Manual for the Oversight of Fatigue Management Approaches')*

(2) Prospective (Proactive) Processes for Oversight of Schedules. ATSPs also can assess proposed schedules for potential fatigue impact by using the method described above. Duty sequences that have been identified as leading to acute and chronic fatigue can be removed or modified to prevent the accumulation of fatigue across a bid schedule. For scheduled operations, rules may be embedded into the schedule creation process to avoid those conditions that, according to the fatigue model, could lead to excessive fatigue risk.

(3) Identification and Management of Aviation Fatigue Drivers. Many operational drivers of fatigue occur in any aviation environment. Some of the common factors that ATSPs should manage to minimize fatigue risk in aviation operations are:

- duty periods, and rest breaks to reduce fatigue;
- additional duties assigned to ATCOs that further reduce sleep opportunities;
- schedule changes that extend duties beyond the published schedule;
- interval between duty period;
- recovery days, following a duty, that permit sufficient sleep to eliminate any accumulated sleep debt prior to duty or performing additional duties; and
- optimal utilization of available rest opportunities.

c) **Application of Fatigue Mitigation Procedures.** A FRMS is part of a process that requires shared responsibility among management and ATCOs and builds on feedback and nonpunitive reporting within a “just culture.” Developing mitigation strategies and schedule adjustments should be part of a collaborative management process that includes all the stakeholders, such as schedulers, safety, and employee representatives. A FRMS should employ multiple layers of defense to prevent fatigue and fatigue-induced errors from progressing to a level that enables incidents or accidents. Based on an analysis of the factors that lead to fatigue and practical mitigation alternatives, one or more of these mitigations may be applied to reduce fatigue associated with specific schedules or situations. The primary levels of defense and mitigations are:

(1) Viewed together, the duty schedule, additional tasks assigned to ATCOs, and schedule change provide recovery sleep opportunities. It may be necessary to adjust scheduling rules to reduce the occurrence of identified fatigue drivers.

(2) Maximizing use of available sleep opportunities reduces cumulative fatigue. This level of defense is largely the responsibility of the ATCOs. Comprehensive fatigue training, adequate rest facilities at ATS units and efficient transportation to rest facilities aid ATCOs in fulfilling their responsibility.

(3) Implementing error detection and corrective processes can prevent operational consequences of fatigue. Team Resource Management (TRM) is a recognized and widely used process to encourage ATCOs to work together to detect and prevent operational errors.

(4) Conducting comprehensive and objective accident, incident, and error analyses can help in determining when fatigue has been a potential contributing factor, so that those conditions can be avoided in the future.

1.5 Tools for an Effective FRMS.

1.5.1 The stakeholders should regard the roles and responsibilities described here as a starting point. These general roles and responsibilities are not an exhaustive description of the various actions to be taken by each group during the development and execution of the FRMS. Many of the details left to be defined depend on the specifics of each operation.

1.5.2 **ATSP.** For the ATSP, there are five general responsibilities:

- (1) **Initial Commitment.** The ATSP is responsible for taking the initiative to develop, document, and implement the scientifically based FRMS. First, the organization should understand what developing a FRMS entails and should garner the commitment of its leadership to support the process. Second, the organization should be willing to commit the resources of time and money to assign individuals in the organization to develop and sustain the FRMS.
- (2) **Assign FRMS Team.** Once the ATSP identifies a team to develop the FRMS, the ATSP is responsible for tasking the team to develop policies, training, data acquisition processes, analysis methods, and management procedures to implement, audit, and guide the FRMS process.
- (3) **Commitment of Resources.** A FRMS is not a one-time activity; the FRMS is a living system that requires a continuing commitment of resources to support the effectiveness and progressive improvement of the process. The size of the resource commitment will depend on the size and complexity of the operation, but it does not end once the ATSP establishes the FRMS.
- (4) **Collaboration.** An effective FRMS is a collaborative process that involves all the stakeholders in discussion and joint action to be successful. It is the ATSP's responsibility to provide the mechanisms for collaboration/consultation among managers, employees, and the regulator. The ATSP is responsible for creating a "just culture" where managers and employees can share information about fatigue without threat of reprisal or disciplinary action. In keeping with the responsibility of each ATCO to only accept duty when he or she is adequately rested to safely perform his or her duties, it is the responsibility of the organization to develop a nonpunitive policy for responding to legitimate reports of fatigue and providing reserves to replace fatigue-impaired ATCO.
- (5) **Customization.** The ATSP can tailor a FRMS to the size of the organization. For a large organization with an entire department dedicated to each primary function, it will be necessary to have a Fatigue Safety Action Group (FSAG) to coordinate the fatigue-related initiatives across departmental boundaries. Within a smaller organization, it may only require that a single person be assigned the responsibilities to oversee the program. Likewise, within a large organization, there may be multiple sources available to support the data requirements of the FRMS, while, in a small organization, data may be limited to reports of fatigue from ATCO and occasional reports of procedural errors.

1.5.3 Management. Management is primarily responsible for the management and mitigation of fatigue risk because it schedules the work activities of personnel and the distribution of resources in the organization. The FRMS is an organizational system that enables management to meet that responsibility. The accountable executive, when signing the FRMS policy, accepts accountability for the FRMS, either directly or through supervision and management of others, including those to whom the accountable executive has delegated this responsibility. The safety objectives in the FRMS policy must specify what the ATSP wants the FRMS to achieve. To track whether the FRMS is meeting these objectives, its performance needs to be monitored. The FRMS policy needs to be reviewed periodically by the ATSP to ensure that it is adequate to meet changing operational demands. In addition, it will be subject to periodic review by the CAAT.

1.5.4 Fatigue Safety Action Group (FSAG). As a way of meeting the ICAO requirements, it is expected that an ATSP establish a functional group that is responsible for coordinating the fatigue management activities within the organization. The FSAG is a group comprised of representatives of all stakeholder groups (e.g., management, scheduling, and ATCOs and/or their representatives) together with specialist scientific, data analysis, and medical expertise, as required), that is responsible for coordinating all fatigue management activities in the organization. The principle functions of the FSAG are to:

- (1) develop and maintain the FRMS documentation;
- (2) manage the FRM processes;
- (3) contribute to the FRMS Safety Assurance processes;
- (4) be responsible for the FRMS promotion processes; and
- (5) maintain the required documentation.

Note: *The size and composition of the FSAG will vary for different ATSPs, but should be related to the size and complexity of the operations covered by the FRMS, and to the level of fatigue risk in those operations.*

1.5.5 Employees/ATCO. For the employees/ ATCO there are three main responsibilities:

- (1) **Get Enough Sleep.** The only remedy for sleep deprivation is sleep and it is the employee's responsibility to use the facilities and sleep opportunities to obtain rest, sleep, and meals. Each person has a unique requirement for sleep and only the individual can decide how much sleep is adequate to maintain alertness and performance. As a general guide, the average person is thought to require about 8 hours of sleep per day, although individual differences exist in sleep need, ranging from 7-9 hours. In general, it is the employee's responsibility to get as much sleep as they need and to take additional sleep when they feel fatigued or unfit for duty.
- (2) **Plan Sleep Ahead of Time.** Getting adequate sleep requires planning with future duty times in mind. For example, if duty will require an early morning awakening, then the employee should plan to go to bed early the night before so as to be fully rested for the next duty. If the next duty will commence in the evening, the employee is responsible for taking an afternoon or evening nap so that he or she does not start work with eight or more hours of continuous wakefulness before the start of duty.
- (3) **Report Fatigue.** If circumstances preclude sufficient sleep for the employee to be adequately alert and rested and to perform duty, whether they are the result of the schedule, delays, illness, life events, or personal actions, it is the employee's responsibility to report his or her state of fatigue to the ATSP. The employee should not accept the responsibilities of duty when fatigued or feeling unfit to perform assigned duties to the extent that the safety may be jeopardized.

2. Components of a FRMS

2.1 Components of a FRMS

2.1.1 FRMS is a safety management approach dealing with the risks imposed by fatigue, so there are similarities between the components of an SMS and FRMS.

2.1.2 The FRMS is more than a collection of tools, it is a management process built on organizational policies and procedures that implement a systems approach to fatigue management. A “systems approach” means that FRMS is an integrated network of people and other resources performing activities designed to minimize fatigue in the operational environment. Below is a list of the four components, two of which are operationally focused and two which are organizationally focused.

- | | |
|-------------------------------------|--------------------|
| (1) FRMS policy and documentation | (Organizationally) |
| (2) FRMS processes | (Operationally) |
| (3) FRMS safety assurance processes | (Operationally) |
| (4) FRMS promotion processes | (Organizationally) |

2.1.3 They will vary in complexity based on the size and diversity of the operational environment. At a minimum, the ATSP’s proposed FRMS should include the following elements:

- a) a Fatigue Risk Management (FRM) policy,
- b) an education and awareness training program,
- c) a fatigue reporting system,
- d) a system for monitoring ATCO fatigue,
- e) an incident reporting process, and
- f) a performance evaluation.

3. FRMS Policy and Documentation

3.1 FRMS Policy

3.1.4 The FRMS policy and documentation are instrumental in defining the organizational measures to support the core operational activities of the FRMS. While FRMS policy specifies the ATSP's commitment and approach to the management of fatigue risk, the FRMS policy should also require that the scope of the ATSP's FRMS operations be clearly defined in their FRMS manual, this means that the policy should define to whom and to what type of operation it applies (e.g. air traffic controllers in the control tower versus the approach unit or area control centre). Additionally, the ATSP's FRMS policy should be distinguishable from the general safety policy to allow for a separate review.

3.1.5 However, because a policy statement is typically a short and stable document, it does not have to detail the specific routes or specific work places operating under the FRMS. It does have to identify where these are detailed (e.g. the Operations Manual). This means that any changes in scope, which are all subject to the CAAT's approval, do not require a rewrite of the initial FRMS policy statement.

3.1.6 A FRMS builds on an operator's SMS. In some cases, it may be appropriate for the Service Provider to incorporate its FRMS policy with its SMS policy. However, SMS and FRMS require two separate approval processes. The service Provider is required to have a FRMS policy that is easily identifiable, is clearly distinguishable from other safety policy statements, and is able to be reviewed in its entirety.

3.1.7 Minimum requirements for the FRMS policy should:

- (1) Reflect the shared responsibility of management, the individuals covered under the FRMS Policy, and others involved in the functions of the FRMS;
- (2) Clearly state the safety objectives of the FRMS;
Note: *The safety objectives in the FRMS policy specify the standards that the ATSP and the CAAT have agreed must be achieved by the FRMS. The FRMS policy also needs to identify safety performance indicators and targets that will be used to measure how well the FRMS is meeting its safety objectives. (Examples of safety performance indicators can be found in Section 5.2 Monitoring FRMS Safety Performance).*
- (3) Be signed by the accountable executive of the organization;
- (4) Be communicated, with visible endorsement, to all the relevant areas and levels of the organization;
- (5) Declare management's commitment to effective safety reporting;
- (6) Declare management's commitment to providing adequate resources for the FRMS;
- (7) Declare management's commitment to continuous improvement of the FRMS;
- (8) Require that clear lines of accountability for management, ATCOs, and all other involved personnel are identified; and
- (9) Require periodic reviews of the FRMS policy to ensure that it remains applicable and appropriate.

3.2 FRMS Documentation

3.2.1 The FRMS documentation describes all the components and elements of the entire FRMS and provides a record of FRMS activities and any changes to the FRMS. Documentation shall be kept of all FRMS activities. Additionally, the use of FRMS documentation makes it possible to audit the effectiveness of the FRMS (internally and externally) to verify that it is meeting the safety objectives defined in the FRMS policy. The documentation can be centralized in a FRMS manual. However, it needs to be accessible to all personnel who may need to refer to it and to the CAAT for auditing purposes. The ATSP shall develop and keep current FRMS documentation that describes and records:

- a) FRMS policy and objectives;
- b) FRMS processes and procedures;
- c) Accountabilities, responsibilities and authorities for these processes and procedures;
- d) Mechanisms for ongoing involvement of management, ATCO, and all other involved personnel;
- e) FRMS training programs, training requirements, and attendance records;
- f) Scheduled and actual duty periods, and rest periods with significant deviations and reasons for deviations noted;
- g) FRMS outputs including findings from collected data, recommendations, and actions taken; and
- h) FSAG terms of reference

4. Fatigue Risk Management (FRM) Processes

4.1 Fatigue Risk Management (FRM) processes are one part of the day-to-day operations of the FRMS. They enable the Service Provider to achieve the safety objectives defined in its FRMS Policy and involve:

- (1) ongoing monitoring of fatigue levels;
- (2) identification of situations where fatigue may constitute a hazard;
- (3) risk assessment; and
- (4) introduction of additional risk mitigations when needed.

4.2 Together with the safety assurance processes, the FRM processes constitute the operational FRMS activities. These are summarized in Figure 4-1.

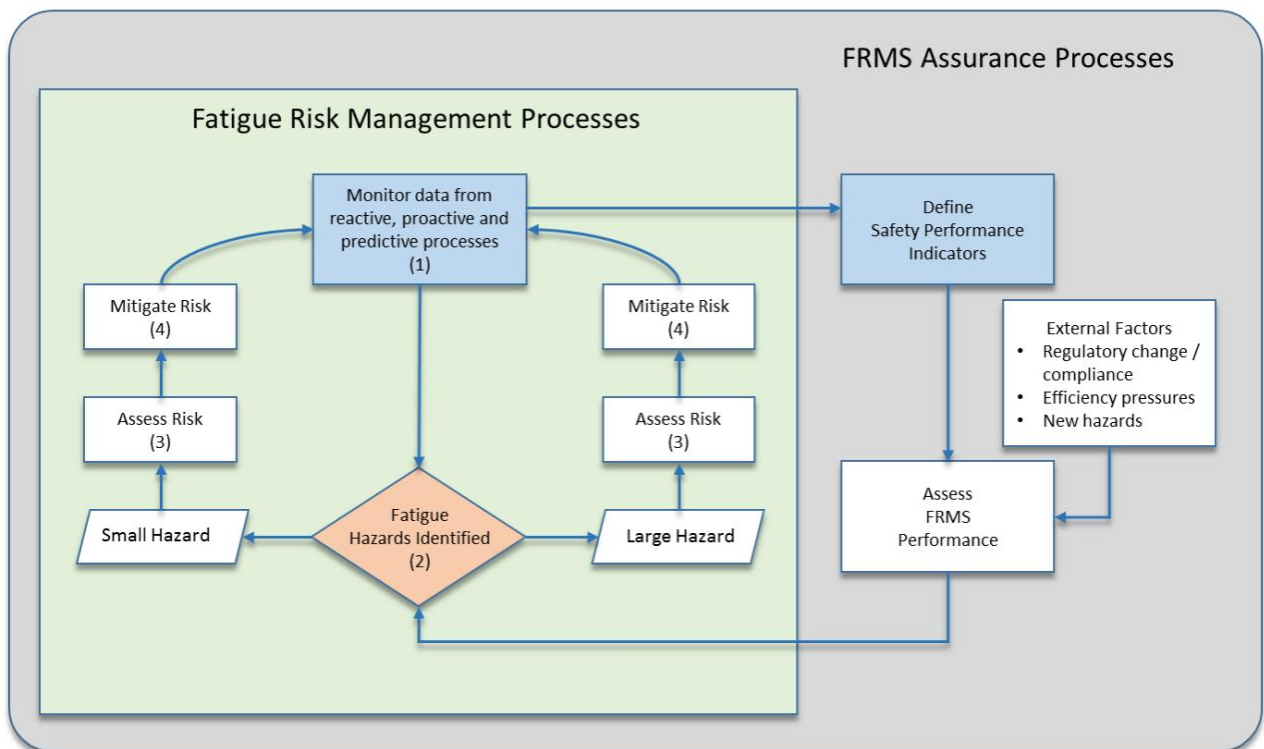


Figure 4-1 Operational activities of a FRMS and safety assurance processes.

As shown in Figure 4-1, the FRM processes form a closed loop with:

- 1) ongoing monitoring of fatigue levels;
- 2) identification of situations where fatigue may constitute a hazard;
- 3) risk assessment; and
- 4) introduction of additional risk mitigations when needed; and back to step 1.

4.2.1 Fatigue Monitoring

- (1) FRM processes are data driven. The fatigue monitoring data required as part of the FRM process are more comprehensive than what is required for managing fatigue in operations that comply with the prescriptive limits and are managed under an ATSP's SMS. Conceptually, this is similar to the fatigue analysis and reporting system component, but this component focuses on individual ATCO reports of fatigue. These reports provide feedback to the ATSP about conditions perceived to contribute to fatigue.
- (2) A range of types of data can be useful, and the key is choosing the right combination of measures for each operation covered by the FRMS, both for routine monitoring

and when additional information is required about a potential hazard that has been identified.

Note: A list of tools used to provide different types of data is provided in Appendix B. of ICAO Doc 9966 'Manual for the Oversight of Fatigue Management Approaches' and CANSO/ICAO/IFATCA Fatigue Management Guide for Air Traffic Service Providers.

4.2.2 Fatigue Hazard Identification

- (1) One of the main sources for identifying hazards is the fatigue reporting system which is the system for reporting of adverse events that may be attributable wholly or in part to fatigue are similar to ATCO reports, and can serve as a mechanism for obtaining all relevant information regarding fatigue contributions to the incident. Ideally, corporate policy would define how an adverse event is evaluated for potential fatigue involvement and also define a methodology for conducting a detailed Root Cause Analysis (RCA). At a minimum, the incident investigation and reporting process must obtain all the necessary information to trace the root cause of the incident, especially the potential level of fatigue and the conditions that contributed to the fatigue-related event. The FRMS policy must provide for protection of privacy and methods to protect the employee from adverse actions that would discourage reporting events and conditions surrounding the events.
- (2) To maximize the utility of such reports, procedures should be arranged to capture all relevant information, such as the schedule leading up to the fatigue report, the actions of the employee to obtain rest, subjective and objective evidence of fatigue, environmental conditions that may have exaggerated or contributed to fatigue, relevant health or medical conditions, specific actions (commissions and/or omissions) related to the incident, and communications prior to and during the event. Corporate policy shall provide protection of privacy and methods to protect the employee from adverse actions that would discourage reports of fatigue.
- (3) Technologies developed to monitor sleep and performance in ATCO can be used to supplement self-reports of fatigue. While it may not be practical to apply these technologies continuously, periodic studies of actual sleep (using actigraphs or logbooks) and fatigue (using performance measures and subjective ratings) can be highly valuable for objectively measuring the extent of fatigue across different kinds of operations and isolating key fatigue drivers. The ATSP can use the results of these assessments to inform the analysis and forecasting functions of the FRMS to better assess potential fatigue in future operations (e.g., in a proposed new schedule).
- (4) The ATSP will need to identify their fatigue hazards using all of these methods to ensure availability of the various kinds of information and data needed by a FRMS to continuously monitor the levels of fatigue risk. They enable data-driven decisions based on scientifically valid principles and measurements. A FRMS necessarily involves three types of hazard identification:
 - Predictive processes;
 - Proactive processes; and
 - Reactive processes.
- (5) **Predictive processes** are designed to identify likely fatigue hazards before they occur. Three possible methods to predict fatigue levels associated with planned work schedules (rosters). These involve the use of:
 - previous experience (of the ATSPs or others in the industry);
 - evidence-based scheduling practices; and
 - bio-mathematical models.
- (6) **Proactive processes** are designed to identify fatigue hazards by measuring fatigue levels in current operations. The success of proactive processes (and of the FRMS)

depends on the willingness of individuals to continue participating in data collection. This makes it important to consider the demands placed on individuals by different types of fatigue measurement. Five possible methods of proactive fatigue hazard identification:

- self-reporting of fatigue risks;
- fatigue surveys;
- relevant performance data;
- available safety databases and scientific studies; and
- analysis of planned versus actual time worked.

(7) **Reactive processes** are designed to identify the contribution of an individual's fatigue to safety reports and events that have occurred. The aim is to identify how the effects of fatigue could have been mitigated, to reduce the likelihood of similar occurrences in the future. The following lists examples of triggers for reactive processes:

- fatigue reports;
- confidential safety reports;
- audit reports; and
- incidents.

(8) Depending on the severity of the event, a fatigue analysis could be undertaken by the FSAG, the ATSP's safety department, or an external fatigue expert or accident investigation agency. The findings of any fatigue investigation should be recorded as part of the FRMS documentation. There is no simple test (such as a blood test) for fatigue-related impairment. To establish that fatigue was a contributing factor in an event, it has to be shown that;

- the person or team was probably in a fatigued state; and
- the person or team took particular actions or decisions that were causal in what went wrong; and
- those actions or decisions are consistent with the type of behavior expected of a fatigued person or team.

4.2.3 **Fatigue Risk Assessment**

- (1) Once a fatigue hazard has been identified, the level of risk that it poses has to be assessed and a decision made about whether or not that risk needs to be mitigated. For ATSPs managing fatigue risk within prescribed limits through their SMS, existing SMS risk assessment methodologies may be sufficient. Using a FRMS requires more effort on fatigue-specific risk assessment.
- (2) Typically, safety risk is defined as the projected likelihood and severity of the consequence or outcome from an existing hazard or situation. A likelihood and severity matrix is commonly used by many ATSPs to assess all types of risk and assist them to decide whether it is necessary to invest resources in mitigation. The level of the risk associated with a hazard and whether that risk level is "tolerable" is determined by plotting its position on the matrix.
- (3) To assess different types of fatigue risks using a matrix, different severity classifications are needed to better reflect the variety of possible consequences of fatigue-affected performance. Likelihood classifications will depend on the type of fatigue severity classification used. Therefore, when using risk assessment matrices in a FRMS, it is necessary for fatigue subject matter experts to customise their matrices by carefully selecting how severity and likelihood are classified.

4.2.4 Mitigation

- (1) The risk assessment process determines whether or not a fatigue hazard requires mitigation. The most important thing to consider in choosing fatigue mitigations is the estimated level of associated fatigue risk. All mitigations require resources (effort, time, costs). Limited resources need to be prioritized where mitigations are most needed to effectively control fatigue risk.
- (2) The identification of fatigue mitigations requires a broad understanding of scientific knowledge, operational experience and applicable regulations. While an ATSP's safety management structure will influence who makes the decision about whether or not a fatigue hazard requires mitigation, it is recommended that the FSAG identify the appropriate mitigations and be consulted in all fatigue mitigation decisions.
- (3) Data monitored in the FRM process loop can be used to generate fatigue safety performance indicators (SPIs). SPIs provide a metric to monitor the effectiveness of fatigue controls and mitigations. If trends in SPIs indicate that current mitigations are not adequate and that a fatigue hazard remains, then a detailed risk assessment of the issue should be conducted in line with the ATSP's processes and new mitigations proposed where necessary. SPIs are also a critical source of information for the FRMS safety assurance processes.
- (4) If the mitigations perform to an acceptable standard (i.e. the relevant SPIs reach their pre-defined acceptable values or targets), they become part of normal operations. If the controls and mitigations do not reduce the fatigue hazard to an acceptable level, it will be necessary to re-enter the FRM processes at the appropriate step. This could require: gathering of additional information and data, re-evaluation of the safety risks associated with the hazard, and/or implementing and evaluating new controls and mitigations.

4.2.5 **Performance Evaluation.** A FRMS is a self-correcting process that includes evaluating the results of prior monitoring, analysis, training, and mitigation. Policies and procedures, based on the evaluation of results and the effectiveness of the FRMS in reducing fatigue, provide feedback to the system for continuous performance improvement.

- (1) The Continual Improvement Process (CIP) includes the following:
 - a system for evaluating and reporting the effectiveness of the FRMS, including reporting that is available to CAAT when requested.
 - a process whereby the results of evaluations provide guidance to the FRMS program for self-correction and improvement.
 - a system for periodic independent review of the FRMS for its effectiveness in managing fatigue-related risk.
- (2) While not required, it may be desirable to have a process for capturing economic benefits and costs of the program.

5. FRMS Safety Assurance Processes

5.1 Introduction

5.1.1 Using SPIs monitored in the FRM processes along with information and expertise from other sources, the FRMS Safety Assurance processes have three main functions:

- a) To monitor that the FRMS is delivering an acceptable level of fatigue risk that meets the safety objectives defined in the FRMS policy and any other regulatory requirements.
- b) To monitor changes in the operational environment and the organization that could affect fatigue risk in the operations covered by the FRMS, and to identify ways in which FRMS performance can be maintained or enhanced prior to the introduction of changes.
- c) To provide ongoing feedback that drives continuous improvement of the FRM processes and other FRMS components.

5.1.2 Within an organization, responsibility for FRMS safety assurance activities may be distributed differently, depending on the number and complexity of operations covered by the FRMS and the size of the Service Provider. Typically, FRMS safety assurance processes would be the responsibility of the SMS team. Some of the FRMS safety assurance processes may be undertaken by the FSAG. However, some Safety Assurance activities, such as internal audits of the FRM processes, should be undertaken by a different organizational unit than that responsible for administering it.

5.2 Monitoring FRMS Safety Performance

5.2.1 Performance of the FRMS should be examined through FRMS SPIs that are identified through a variety of different sources, including:

- a) trends in indicators from the FRM processes and the ATSP's SMS;
- b) hazard reporting and investigations;
- c) audits and surveys; and
- d) reviews and fatigue studies.

5.2.2 When FRMS SPIs are not at an acceptable level, the controls and mitigations in use may need to be modified via the FRM processes. A review of relevant fatigue studies might provide new ideas. Investigation of how hazard reports are followed up or examination of trends in fatigue-related hazards or incidents may be required. Audit findings may need to be reviewed, checks may need to be made to determine whether FSAG recommendations are followed, whether fatigue-related training is being delivered as expected, or whether the FSAG is functioning according to its terms of reference, to find out why the FRMS is not working as intended. It may also be appropriate to review the SPIs to ensure that they are still appropriate measures of the safety performance of the FRMS.

5.2.3 Trends in Safety Performance Indicators from the FRM Processes and the SMS

- a) SPIs to measure the overall safety performance of FRMS will include some indicators identified by the FSAG as part of the FRM processes to monitor the efficacy of controls and mitigations. The nature of these will differ for different industry sectors. They may also include indicators that capture wider aspects of the safety performance of the FRMS, for example safety performance metrics within the operator's SMS. Examples include: number of fatigue reports in relation to other voluntary hazard reports;
 - frequencies of fatigue reports associated with a specific duty or pattern of duty;
 - frequency of exceedance of Service Provider-identified buffers;
 - frequency of exceedance of the agreed outer boundaries of the approved FRMS.

- b) Acceptable values or targets need to be set for SPIs, and these must always be within the tolerable region defined in the ATSP's risk assessment process. For example, a Service Provider could set a FRMS safety performance target of no more than 10 duty day exceedances per month.
- c) Trends in the ATSP's ability to maintain acceptable values or achieve targets over time can then be used to assess FRMS performance. Trends may be identified: over individual duties; patterns of work; shorter periods of time (e.g. weekly trends); longer periods of time (e.g. seasonal trends, yearly trends); and in relation to specific locations, types of operations or groups of workers.
- d) As the FRMS matures, and as part of the continuous review requirements, more sophisticated performance indicators and targets may need to be identified to better monitor the performance of the FRMS.

5.2.4 Hazard Reporting and Investigations

- a) The FSAG should record all fatigue hazards identified in the FRM processes, together with any actions taken to mitigate those hazards, in the FRMS documentation. The fatigue hazard register should be regularly evaluated to ensure that it contains current, valid fatigue hazards and appropriate mitigation measures, as part of the FRMS safety assurance processes.
- b) Trends in voluntary fatigue reports by individuals can also be monitored as indicators of the effectiveness of the FRMS. Safety events in which an individual's fatigue has been identified as a contributing factor will be less common than fatigue reports. However, regular review of these events may also highlight areas where functioning of the FRMS could be improved. The value of both these sources of information depends on using appropriate methods for analyzing the role of fatigue.

5.2.5 Audits and Surveys

- a) Audits and surveys can provide measures of the effectiveness of the FRMS without having to rely on fatigue levels being high enough to trigger fatigue reports or fatigue-related safety events (both of which may be relatively rare events).
- b) Audits can be used to periodically assess the effectiveness of the FRMS. They should address questions such as:
 - Are all relevant departments implementing the recommendations of the FSAG?
 - Are all the targeted operational personnel using mitigation strategies as recommended by the FSAG?
 - Is the FRMS training programme effective?
 - Is the FSAG maintaining the required documentation of its activities?
- c) Internal audits need to be conducted by a unit in the Service Provider's organization that is external to the FSAG. Feedback from regulatory audits can provide useful information for FRMS safety performance monitoring. Another type of audit that can be used in this context is to have an independent scientific review panel that periodically reviews the activities of the FSAG and the scientific validity of their decisions. A scientific review panel can also provide the FSAG with periodic update.
- d) Surveys can provide a "snapshot" of the effectiveness of the FRMS. For example, they can document how schedules and work patterns are affecting individuals, either by asking about their recent experiences (retrospective) or tracking them across time (prospective). Surveys for this purpose should include validated measures, such as standard rating scales for fatigue and sleepiness, and standard measures of sleep timing and quality. Note that a high response rate (ideally more than 70%) is needed

for survey results to be considered representative of the entire group, and response rates tend to decline when people are surveyed too frequently ('participant fatigue').

5.2.6 Reviews and Fatigue Studies

- a) A safety review would be carried out to evaluate whether the FRMS is likely to be adequate to deal with a change, for example the introduction of a new type of operation or a significant change to an existing operation covered by the FRMS. The review evaluates the likely effects of the change on fatigue risk and the appropriateness and effectiveness of the FRM processes to manage those effects.
- b) In FRMS safety assurance processes, fatigue studies are mainly used as a source of broader information from external sources about common issues in FRMS (whereas in the FRM processes they are carried out to evaluate specific fatigue hazards). They are undertaken when a Service Provider is either concerned about a broad fatigue-related issue for which it is appropriate to look at external sources of information or where a new operation is being introduced where there is no other specific information. Sources of information can include the experience of other operators, industry-wide or State-wide studies, or scientific studies. Such information can be particularly valuable in situations where the Service Provider needs to build a safety case but has limited experience and knowledge.

5.3 Maintaining FRMS Performance in the Face of Change.

5.3.1 The aviation environment is very dynamic and changes are a normal part of the industry. They may be driven by external factors (for example, new regulatory requirements, or changing security requirements) or by internal factors (for example, management changes, new routes, equipment, or procedures). Changes, whether externally or internally driven, can reduce the effectiveness of the controls and mitigations that have been implemented to manage existing fatigue hazards; and introduce new fatigue hazards into an operation, which need to be managed. Because FRMS safety assurance processes assess the overall performance of a FRMS, they provide a means for recognising emerging fatigue risks and managing planned changes.

5.3.2 Recognising emerging fatigue risks

- a) Analysis of trends in safety performance indicators may indicate the emergence of fatigue hazards that have not previously been recognized. For example, changes in one part of the organization may increase workload and fatigue risk in another part of the organization. Identifying emerging fatigue risks is an important function of FRMS safety performance processes, which take a broader system perspective than purely FRM processes. Any newly identified fatigue risk, or combination of existing risks for which current controls are ineffective, should be referred back to the FSAG for evaluation and management using FRM processes (risk assessment, design and implementation of effective controls and mitigations)

5.3.3 Managing planned change

- a) A Service Provider's FRMS safety assurance processes should provide a formal process for the management of change that provides for:
 - identification of changes in the operational environment that may introduce fatigue risks;
 - identification of changes within the organization that may introduce fatigue risks; and
 - consideration of available tools which could be used to maintain or improve FRMS performance prior to implementing changes.

- b) During the period of implementation of the change, FRMS safety assurance monitoring provides periodic feedback that the FRMS is functioning as intended in the new conditions. Examples include having validation period for
- a new route, during which additional monitoring of ATCO fatigue is undertaken, together with more frequent assessment of SPIs as part of the FRMS safety assurance processes;
 - an extension in duty hours within a particular pattern of work, during which additional monitoring of ATCO fatigue is undertaken, together with more frequent assessment of SPIs as part of the FRMS safety assurance processes.

5.4 Continued Improvement

5.4.1 As the safety assurance processes provide a means to monitor the overall performance of a FRMS, they not only offer the means to ensure that adequate fatigue management is maintained but also the means for continued improvement of the FRMS.

5.4.2 FRMS safety assurance processes provide for the continuous improvement of the FRMS through:

- a) the elimination and/or modification of risk controls have had unintended consequences or that are no longer needed due to changes in the operational or organizational environment;
- b) routine evaluations of facilities, equipment, documentation and procedures; and
- c) identifying the need to introduce new processes and procedures to mitigate emerging fatigue-related risks.

5.4.3 It is important that changes made to the FRMS are documented so that they are available for internal and regulatory audit

6. Promotion Processes

6.1 Introduction

6.1.1 Promotion processes are an essential component of a FRMS because FRMS, like SMS, relies on effective communication throughout the organization. This section outlines the FRMS promotion processes, which includes training programs, a communication plan, and the links between the FRMS promotion processes and other FRMS components. Along with the FRMS policy and documentation, the FRMS promotion processes support the core operational activities of the FRMS.

6.1.2 Depending on the structure of the organization, this may come from the FSAG, the SMS, or from an accountable executive responsible for the FRMS communication plan. On the other hand, the operational personnel concerned and other stakeholders need to communicate promptly and clearly concerns about fatigue hazards to the Fatigue Safety Action Group or other relevant management. In all cases, all stakeholders need to have an appropriate understanding of fatigue and their role within the FRMS.

6.1.3 In addressing the need for effective communication, FRMS promotion processes require the implementation of:

- a) Fatigue-related training programmes; and
- b) an effective FRMS communication plan.

6.1.4 Comprehensive education and awareness training programs applicable to the ATSP's FRMS are essential in providing a foundation and understanding for managing and mitigating fatigue associated with operations where the FRMS authorization is applied. The ATSP should develop their education and training program to focus on the specifics of the FRMS authorization and applicable ATCO FRMS operation procedures. Each FRMS authorization will be different; therefore, the education and awareness training program for that FRMS will be specific to that FRMS authorization. If the ATSP is issued multiple FRMS authorizations, the ATSP should identify the training items associated with that authorization for specific guidance in developing an education and awareness training program.

6.2 Training

6.2.1 The objective of the ATSP's FRMS Education and Awareness Training program is to ensure that all involved personnel are trained and competent to undertake their responsibilities relevant to the ATSP's FRMS. In addition to the FRMS training program, the training completion standards for both initial and recurrent training should be specified in the FRMS documentation. The frequency of the recurrent FRMS training should be every 12 calendar-months.

6.2.2 The ATSP shall maintain records of their FRMS training programme in accordance with Chapter 11 of MOS-ATS and monitor its effectiveness.

6.2.3 The FRMS training program should emphasize the key principles of fatigue science, management of sleep, and understanding the effects of the circadian body clock to illustrate the relevancy not only to individual's roles in the FRMS but also to their lives outside of work. Thus, FRMS training covers issues that everyone can identify with personally and promotes the concept of shared responsibility in a FRMS.

6.2.4 Training Programs should be established and implemented by the ATSP as part of its FRMS to ensure competency commensurate with the roles and responsibilities of management, ATCO, and all other involved personnel under the planned FRMS.

6.2.5 The content of training programs should be adapted according to the knowledge and skills required for each group to play their part effectively in the FRMS. All groups require basic education about the dynamics of sleep loss and recovery, the effects of the daily cycle of the circadian body clock, the influence of workload, and the ways in which these factors interact with operational demands to produce fatigue. In addition, it is useful for all groups to have information on how to manage their personal fatigue and sleep issues. Schedulers should have a comprehensive understanding in the use and limitations of any scheduling tools and biomathematical models or other algorithms that may be used to predict the levels of ATCO fatigue across schedules and rosters.

6.2.6 The FRMS training curriculum should provide a full understanding of all FRMS components and elements: policy and documentation; processes for hazard identification, risk assessment, mitigation, and monitoring; SA processes for monitoring FRMS performance, managing change, and continuously improving the FRMS; and FRMS promotion processes, including training and communication. The training should provide a robust understanding of how scheduling affects sleep opportunities and interacts with the circadian biological clock cycle, the fatigue risk that this creates, and how it can be mitigated through scheduling. The training should provide an in-depth understanding of the ATSP's ATCO FRMS operating procedures. Lastly, the training program should highlight the processes and procedures for implementing scheduling changes recommended by the FSAG.

6.3 Communication

6.3.1 A FRMS relies on effective communication throughout the ATSP's organization. On the one hand, there needs to be regular communication about the activities and safety performance of the FRMS to all stakeholders. Depending on the structure of the organization, this may come from the FSAG or an accountable executive responsible for the FRMS communication plan. On the other hand, ATCOs and other stakeholders need to communicate promptly and clearly about fatigue hazards to the FSAG or other relevant management.

6.3.2 The FRMS training programs are clearly an important part of the communication plan. Since training intervals are annual, ongoing communication to stakeholders is required. Various media channels may be used to report the activities and safety performance of the FRMS, to sustain interest in fatigue-related matters, and to encourage the continuing commitment of all stakeholders to the FRMS processes. A variety of types of communication can be used, including electronic media (Web sites, online forums, email), newsletters, bulletins, seminars, periodic poster campaigns in strategic locations, and the like.

6.3.3 Communication plan should be established and implemented by the ATSP. An effective FRMS communication plan that:

- (1) Explains FRMS policies, procedures, and responsibilities to all relevant stakeholders; and
- (2) Describes communication channels used to gather and disseminate FRMS-related information.

6.3.4 ATCO Feedback. Communications from ATCOs are vital for fatigue hazard identification, for feedback on the effectiveness of controls and mitigations, and in providing information for FRMS safety performance indicators (e.g., by participating in surveys and fatigue-monitoring studies). For these communications to be open and honest, all FRMS stakeholders need to have a clear understanding of the policies governing data confidentiality and the ethical use of information provided by ATCOs. There also should be clarity about the thresholds that separate nonculpable fatigue-related safety events from deliberate violations that could result in penalties. Timely feedback to ATCOs who submit fatigue reports is vital. Feedback does not require completion of a full investigation. Every ATCO should receive a timely response to their report with some indication of the planned follow-up activity, such as: “This report has been forwarded to the FSAG, which is currently investigating an adverse trend in fatigue reports associated with this duty and is evaluating a number of potential mitigation strategies.

7. Fatigue Reporting System

7.1 A fatigue reporting system is an integral component of the FRMS, as it supports the evaluation of the ATSP's FRMS and provides data points from fatigue-related occurrences. However, to be effective, the fatigue reporting policy should be based upon open communications encouraging employees to report fatigue-related occurrences without fear of reprisal. Voluntary disclosure has proven to be an excellent vehicle for conveying safety information to those individuals having the authority to effect and change policy. The ATCO's fatigue reporting system should support this concept. In return, the ATSP is afforded the opportunity to collect valuable safety information and effect changes in policies, as appropriate, and continue to build upon their safety culture.

- (1) This component defines the processes needed to detect, report, and investigate cases of fatigue risk from internal and external sources. It includes objective operational data and methods that enable the ATSP to develop and evaluate reactive and proactive methods to reduce and manage fatigue risk, including scheduling (rostering) and rest periods.
- (2) There are analysis methods, such as biomathematical models of fatigue, which can be used to evaluate the fatigue implications of duty period and monthly duty. This system includes two components: an analysis of the risk of fatigue associated with the schedule and an analysis of the potential consequences of that fatigue risk. Based on this risk and consequence analysis, proactive corrective action can be taken to mitigate the risk. In addition, the fatigue reporting system may suggest that certain schedules are causing fatigue, and corrective steps can be taken to analyze the source of the fatigue and prevent a similar set of circumstances in the future.

8. The Continuous FRMS Process

8.1 The Continuous FRMS Process

8.1.1 Fatigue Risk Management System Process means that it consists of a series of actions that build on corporate policies, organizations, and procedures. The FRMS is not just a written set of rules, but a living system that envisions ATSPs detecting and adapting to fatigue impact on their operation and employees carrying out specific actions that implement the policies and procedures within an established organization. The specific actions that comprise the FRMS process break down into four general steps that repeat, leading to continuous performance improvement and reductions in fatigue-related risk. Each step in the process relies on one or more of the fatigue management tools.

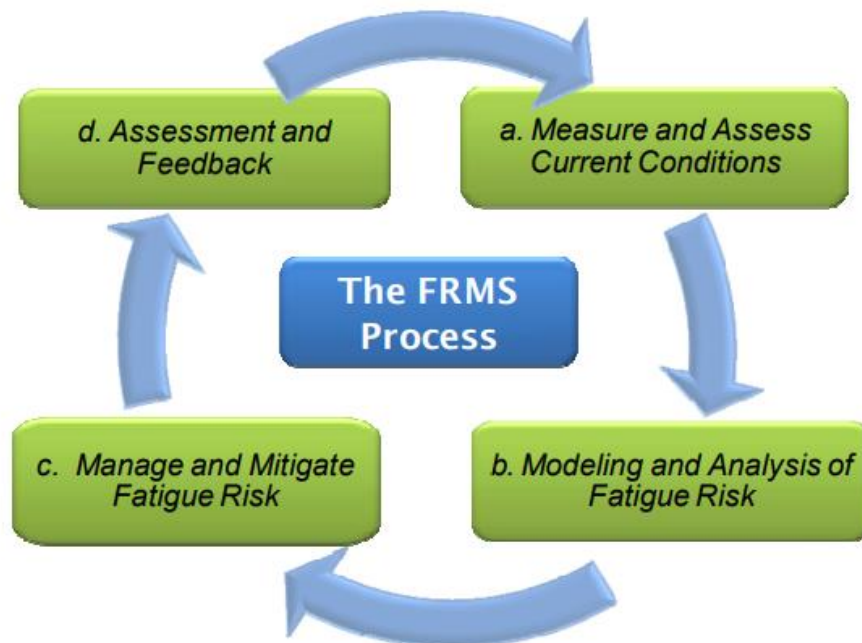


Figure 8-1 The fatigue risk management system process.

- a) **Measurement and Assessment of Current Conditions.** The first step is to measure and assess the level of fatigue risk associated with current schedules and operations by collecting information on ATCO reports of fatigue or fatigue-related errors and incidents, and information on the schedules that led up to these reported fatigue-related errors and incidents. Understanding the current conditions within the organization is critical for the development of a valid mitigation plan.
- b) **Modeling and Analysis.** This second step helps to determine the root cause of fatigue by modeling the work schedules and analyzing fatigue risk associated with them. This step is crucial to the process because it uses scientific principles about fatigue, perhaps aided by computer modeling, to find the specific operational and ATCO factors that could contribute to significant performance changes due to fatigue. Managing and mitigating fatigue depends on this step because fatigue risk needs to be measured and connected to the conditions (fatigue drivers) that contribute to the risk. Analysis of the fatigue risk can be broken down into two components: likelihood of occurrence of a particular level of fatigue and the severity of the consequence of fatigue, should it occur. For example, duty period that occurs between 0130 and 0529 will inevitably include the period identified as the WOCL. This low point in performance should be evaluated in relation to the duties to be performed at that

time; an expected raised level of fatigue is of greater concern if it coincides with critical flight maneuvers.

- c) **Management and Mitigation of the Fatigue Risk.** This third step is based on the measurement and analysis of the fatigue-causing conditions. It requires explicit and regular management activity to consider the information from the first two steps and engage all the stakeholders in a collaborative process to develop solutions to address the fatigue-causing factors.
- d) **Assessment and Feedback.** The fourth step in the process is collection of evidence of success in the form of improved schedules, additional sleep opportunities, enhanced training, and revised policies combined with objective data that demonstrate that these changes have effectively reduced fatigue. Evidence of reduced fatigue includes fewer reports of fatigue and/or errors due to fatigue, evidence of increased sleep, or modeling of schedules that predicts improved performance and reductions in fatigue related risk. This step is important and essential for continuous process improvement. Some measures may not prove to be as effective in reducing fatigue as anticipated, leading to a need for further adjustments. Additionally, changes in schedules, turnover in the workforce, added demands for service, and the addition of new routes can lead to emerging pressures that contribute to increased fatigue risk. This step allows for further adjustments to improve current operations and correct for changes in future operations.

9. An Approval Process

9.1 Introduction

9.1.1 An ATSP necessarily implements a FRMS, and the CAAT will need to review and accept each phase before the next one can begin. The phases are:

- (1) Preparation
- (2) Trial
- (3) Launch
- (4) Maintain and improve

		ATSP	CAAT
Approval process	Phase 1. Preparation	Developing FRMS capability	Assessment of feasibility
	Phase 2. Trial	Validation of FRMS capability	Assessment of FRMS capability
	Phase 3. Launch	Getting approval	Approval of FRMS
Continued oversight	Phase 4. Maintain and Improve	Embedding FRMS into normal operations	Embedding FRMS into normal regulatory oversight

Table 9-1 Aims of State and Service Provider during different phases of FRMS implementation.

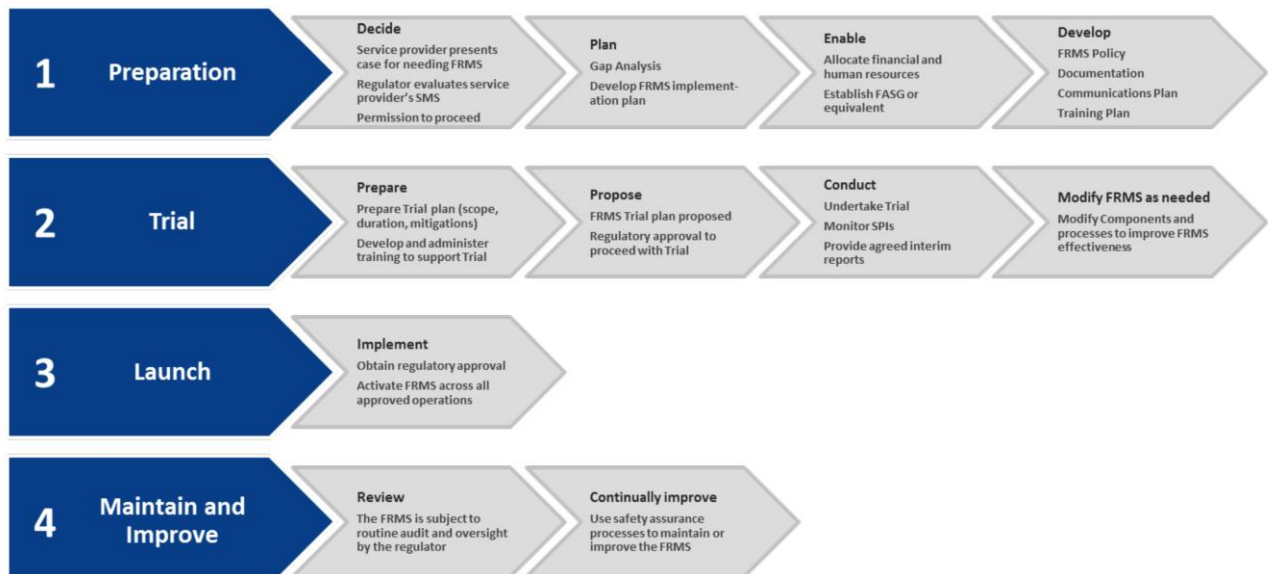


Figure 9-1 Implementation steps undertaken by Service Providers within each of these phases.

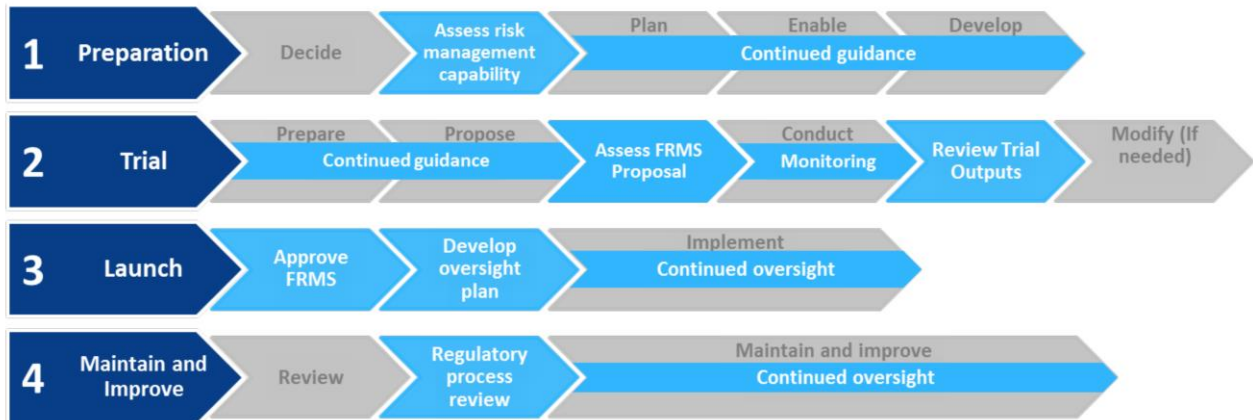


Figure 9-2 Integrated steps undertaken by Service Providers (grey) and States (blue) in the implementation of a FRMS.

9.2 Phase 1: Preparation

9.2.1 Before preparing to implement a FRMS, an ATSP should inform the CAAT of its intentions. Such early interaction helps establish an open and informed working relationship between the CAAT and the ATSP. One way the CAAT can encourage early contact with an ATSP planning to develop a FRMS is to require written notification of intent.

9.2.2 At this stage, the CAAT may discuss with the ATSP how the trial will demonstrate an equivalent (or reduced) level of fatigue risk on operations under the FRMS compared to operations that remain within the prescriptive limits. This will require the regulator and the Service Provider to identify and agree to measures (SPIs) of the level of safety under the prescriptive limits.

9.2.3 Gap Analysis

- a) To support FRMS planning, the Service Provider should conduct a gap analysis to:
 - identify elements of the FRMS that are already available in existing systems and process;
 - identify existing systems and processes that could be modified to meet the needs of FRMS (to minimize “re-inventing the wheel”); and
 - identify where new systems and processes need to be developed for the FRMS.
- b) The ATSP should use tools (in appendix of this Guidance Material) to assist with a gap analysis. The results of the gap analysis are used as the basis for the development of the Service Provider’s FRMS implementation plan.
- c) To conduct the gap analysis, an ATSP will need personnel who are able to:
 - assess the fatigue training needs;
 - provide rostering expertise and have detailed knowledge of the rostering system;
 - provide detailed knowledge of the general operational context including the operations envisaged to be covered by the FRMS; and
 - provide knowledge of the legal and regulatory requirements associated with fatigue management.

Therefore, an important part of the Service Provider’s planning will include the identification of key personnel. Some or all of these key personnel may be included in the FSAG (or equivalent).

9.2.4 Identifying the method for establishing the baseline for the equivalent level of safety.

- a) In order to agree on meaningful SPIs, it is necessary to establish a baseline of safety. The baseline of safety is identified through fatigue-related metrics associated with the prescriptive limitation regulations under the Service Provider’s SMS processes in

specific operational circumstance (e.g. average sleep obtained in a normal non-work period in relation to average alertness and performance at the end of the safety related work period).

- b) The CAAT and the ATSP will need to agree to the method used by the ATSP to demonstrate an equivalent level of safety for the proposed FRMS trial operation. This will allow comparison of baseline measures of safety to those expected under the proposed FRMS limits. Possible SPIs include the average sleep achieved in the 24 hours before a work period (in the case of air traffic controllers).
- c) During Phase 1, the FSAG or equivalent (perhaps with the assistance of a consultant depending on the complexity of the intended FRMS), will be tasked with:
 - developing the FRMS policy and documentation;
 - identifying their own and the Service Providers' training needs; and
 - developing the FRMS promotion and communication plan.

9.2.5 Review of FRMS Policy and Documentation

- a) To determine whether the Service Provider should be allowed to progress to Phase 2 and start preparing a trial proposal, the State should be satisfied that the Service Provider (through the work of the FSAG or equivalent) has completed and provided:
 - a gap analysis;
 - a FRMS Policy Statement signed by the accountable executive. Developing the policy at the beginning of the FRMS implementation process will assist in defining the scope of the FRMS;
 - an appropriate allocation of financial and human resources. The accountable executive for the FRMS needs to have the authority and control to ensure that this happens;
 - A FRMS implementation plan;
 - A FRMS documentation plan. This can be expected to evolve as the FRMS becomes operational.
 - A FRMS communication plan. This can be expected to evolve as the FRMS becomes operational.
 - Training programme ready for all personnel who will be involved in the FRMS trial in Phase 2
 - An established Fatigue Safety Action Group (FSAG or equivalent) able to undertake Phase 2.

Note: *Since preparation of these documents and processes requires substantial time and resources, it is advised that the Service Provider presents evidence of their progress throughout this phase.*

- b) Using the FRMS evaluation form (mentioned under The Service Provider's gap analysis; see Appendix), the CAAT will conduct a desktop review of the policy and documentation to determine whether the Service Provider's initial preparation adequately addresses the regulatory requirements. This will include evaluating:
 - policy content;
 - the organizational structure adequately addresses the risks specific to the FRMS;
 - the deviation recording process that will document the extent and reason for significant exceedances of scheduled work periods, significant reductions of rest periods and the number of uses of individuals' agreement to extend a work period beyond the prescriptive limitations;
 - the proposed fatigue risk assessment process;

- the proposed safety assurance processes including methods for monitoring and managing changes to the FRMS;
 - integration of FRMS processes with the day-to-day functions of the Service Provider;
 - quality control audit procedures;
 - initial training plan and procedures (including fatigue reporting);
 - terms of reference for the Fatigue Safety Action Group; and
 - details of the safety promotion activities.
- c) At the end of Phase 1, the CAAT has established open communication lines with the Service Provider and is confident that the Service Provider has the basic FRMS processes in place, has allocated appropriate resources to develop a FRMS, and will be ready to activate those processes and resources in the FRMS trial in Phase 2.

9.3 Phase 2: Trial

9.3.1 The purpose of this phase is the Service Provider's demonstration their FRMS capability through a trial period. This will involve preparing a detailed plan for a trial of the FRMS in the specific operations for which it is being sought. The proposed plan shall be acceptable to the State and include agreed safety performance indicators (SPIs) that will be monitored to evaluate the trial. Once the FRMS trial proposal has been accepted, the trial is conducted with the CAAT evaluating the trial outputs and changes made to the FRMS trial as necessary.

9.3.2 In the Phase 2 (trial) phase, the regulatory focus is related to:

- a) Guidance during the preparation of the trial proposal;
- b) Assessing the trial proposal;
- c) Monitoring the trial; and
- d) Reviewing the trial outputs.

9.3.3 Regulatory guidance during the preparation of the trial proposal

- a) The increased level of regulatory guidance and support established during Phase 1 should continue to the point where the Service Provider submits a trial FRMS proposal. This is particularly important as the Service Provider develops their safety case as part of the trial proposal. The FRMS evaluation form again may be a useful tool for the Service Provider during this step.
- b) Essential elements of the trial proposal should include identification of:
 - the scope, outer limits; and an assessment of the likely additional risk and how that likely additional risk will be monitored and mitigated.
 - a time limit for the trial period. While adequate time needs to be given to allow the Service Provider to demonstrate that all components of a FRMS (including the safety assurance processes) are functioning, a Service Provider cannot be allowed to operate outside of the prescriptive limits for an indefinite period. Protracted trial periods diminish the value of having an approved FRMS. A Service Provider cannot continue using a "FRMS in progress" that is not actively trying to achieve all the approval requirements.

9.3.4 Assessing the trial proposal

- a) The FRMS trial proposal should include a safety case. However, in the case of assessing a FRMS safety case proposal, the assessment will be conducted in greater

depth and will necessarily include oversight and audit visits to the organization. These steps are:

- Assessing the nature, scope and impact of the proposed change;
 - Assessing hazard and consequence identification;
 - Evaluating the fatigue risk assessment methodology and how the decision to accept risk has been made;
 - Assessing the appropriateness of the risk mitigation measures;
 - Assessing whether the claims, arguments and evidence made in the safety case are valid;
 - Assessing plans for continued monitoring of the safety impact of the proposed limits, work schedules and mitigations;
 - Assessing the previous safety behaviours demonstrated throughout the organization (including safety reporting policies and practices).
- b) Once the trial proposal has been agreed to, the Service Provider may then commence the trial in accordance with the agreed timeline.

9.3.5 Monitoring the trial

- a) The CAAT will need to closely monitor the progress of the trial throughout the agreed timeline through:
- frequent feedback (e.g. e-mail updates, following trial outputs);
 - undertaking desktop reviews of the agreed operational SPIs for the trial;
 - examination of progress reports at set times of the trial period;
 - evaluation of the development of the full suite of the Service Provider's FRMS process and procedure documentation;
 - evaluation of FRMS training programme and its effectiveness;
 - conducting on-site visits (e.g. attending FSAG meetings, discussions with operational staff, interviews of key personnel, discussion with internal and external subject matter experts); and
 - direct inspection of the trial operation.
- b) Agreed SPIs will be monitored throughout the trial by the CAAT. If, during the monitoring of the trial, a Service Provider observes data or reports of excessive deviations from expectations, the CAAT should be notified and immediately conduct a review of the FRMS operation for potential unintended consequences not previously anticipated.
- c) Having a variety of SPIs is expected to give a more reliable indication of fatigue levels and of the performance of the FRMS. Common types of fatigue SPIs include:
- operational SPIs that monitor the duty-related causes of fatigue
 - SPIs based on reactive fatigue data (e.g. numbers of fatigue reports on a particular work pattern);
 - SPIs based on proactive monitoring of actual levels of fatigue levels of targeted operational personnel (e.g. high levels of subjective sleepiness at the end of a work period).

9.3.6 Reviewing trial outputs

- a) Before proceeding, the Service Provider must show that the trial is delivering the required safety outcomes. This may be demonstrated through a final report on the trial that includes an analysis of the agreed SPIs and any associated compulsory safety reports. The CAAT should also check if there have been any operational and organizational changes during the trial period that might have impacted the trial findings. Further, the CAAT may review any other relevant information, e.g. through

State audits of the Service Provider in other areas, or findings of studies on similar operations.

- b) The result of the CAAT's review will determine whether there is a need for adjustment of any of the trial's limits or requirements, including enhancements to mitigations. Aspects of the trial may need to be redone according to the nature and severity of the CAAT's concerns.

9.4 Phase 3: Launch

9.4.1 Once the CAAT is satisfied that the trial FRMS is fully functioning and delivering an acceptable level of safety performance, the CAAT approves the FRMS and Phase 3 begins.

9.4.2 Approving a FRMS

- a) Giving approval for the FRMS means that the Service Provider can now activate the FRMS across all the specified operations and may now embed the approved FRMS as part of its normal operations. If the Service Provider wishes to extend the scope of the FRMS to cover additional operations, they will be required to present an additional or modified safety case and may be required to conduct a further Trial to demonstrate the effectiveness of the FRMS for managing fatigue risk in these additional operations, i.e., return to Phase 2.

9.4.3 Developing a FRMS oversight plan

- a) The CAAT will develop a FRMS oversight plan that will ensure appropriate continued oversight. This will include scheduling of formal audits, general inspections, desk-top reviews and periodic updates on SPIs. Allowance for ad hoc visits and increased oversight demands during any changes in scope to the FRMS will also be considered when developing the oversight plan.
- b) During Phase 3, the level of regulatory oversight will typically be lower than during the Trial but must be sufficient to assure the CAAT that the FRMS is functioning as intended in all the operations to which it applies. However, immediately post-approval the CAAT may wish to maintain an initial increased level of oversight than for routine regulatory oversight to ensure that the Service Provider continues to manage their FRMS appropriately.

9.5 Phase 4: Maintain and improve

9.5.1 During Phase 4, the CAAT will need to embed the oversight of the Service Provider's approved FRMS as part of their normal oversight programme. Regulatory oversight demands are reduced to routine levels. As in Phase 3, any extensions to the scope of the FRMS will require the Service Provider to present an additional or modified safety case and may require a new trial, i.e., return to Phase 2.

9.5.2 Regulatory process review

- a) At a predetermined time after the initial implementation of an approved FRMS, the CAAT may wish to conduct a review of their oversight processes and procedures with a view to improvement based on lessons learned over the Service Provider's FRMS implementation process thus far.
- b) The terms of reference for the review will address as a minimum:
 - the continued fitness for purpose of the four components of the FRMS, i.e. are fatigue risks being appropriately controlled,
 - compliance with system demands, and
 - the effectiveness of training, promotion and assurance mechanisms

- c) Recommendations to improve oversight processes and procedures will be made to assure that these are subject to continual improvement.

9.5.3 Continued FRMS Oversight

- a) In overseeing the Service Provider's FRMS, the CAAT is seeking to ensure that all of the FRMS processes are functioning in a cohesive manner with regard to the specific operations to which they have been applied and that an acceptable level of safety performance is maintained.
- b) In overseeing the Service Provider's FRMS, the CAAT will examine evidence of the Service Provider's FRMS safety assurance functions by assessing any trends in the SPIs and reviewing the agreed FRMS safety performance targets. It will need to be confirmed that the Service Provider is, where necessary, identifying potentially adverse trends and managing them appropriately as part of the risk assessment functions. Such evidence can be gained through assessing:
 - any corrections or additions that have been made post-approval;
 - adjustments to outer limits and mitigations in response to data;
 - any organizational and operational changes that may have an impact on the FRMS;
 - the current training package and training practices, including all staff training records and
 - the standard of internal auditing of the FRMS processes.
- c) As part of normal oversight, the CAAT will conduct interviews with a variety of people involved with the FRMS and monitor changes of key FRMS personnel. Where key personnel have changed, the CAAT should seek to ensure the new personnel are included in a list of interviewees. Occasionally, a CAAT might also ask to attend a Service Provider's Fatigue Safety Action Group meeting to gain better insight in its FRMS processes, although the CAAT cannot be part of the Fatigue Safety Action Group activities. The CAAT may also choose to audit some of the primary sources of input into the system (for example, fatigue reports, records of planned and actual work periods). The content and effectiveness of FRMS training and education programmes should be periodically evaluated by the CAAT.
- d) In the same way that normal oversight audit functions are recorded, the CAAT will need to ensure that it has an adequate FRMS record-keeping process. Such records will store the outcomes, findings and rectification notifications of the approval process and ongoing oversight.

9.5.4 Withdrawing FRMS privileges

- a) The withdrawal of privileges by the CAAT should be commensurate to the level of risk resulting from the deficiency. These actions may range from administrative changes or FRMS operational changes, to a withdrawal of FRMS approval. The three alternatives in increasing severity are:
 - **Service provider on notice to improve FRMS processes**
 Where the CAAT's oversight produces concerns that the Service Provider's FRMS may not meet regulatory requirements, then the Service Provider should first be given an opportunity to improve the specific aspects of its FRMS so that it does meet regulatory requirements. Based on the findings of the audit process, the CAAT will need to provide advice to the Service Provider and identify a mutually-agreed corrective action plan.

- **State-mandated lowering of maximum values (and/or increasing minimum values)**

Where the CAAT's oversight produces concerns that an element of a Service Provider's FRMS may be ineffective, the CAAT may need to revise Service Provider's maximum and minimum values. These CAAT-set limits should remain in place until the Service Provider can provide evidence that its FRMS processes are effective and the State has regained regulatory confidence in the Service Provider.

- **Withdrawal of FRMS approval**

Where there is a significant safety concern that has not been addressed by the above enforcement alternatives, it is the CAAT's obligation to withdraw the FRMS approval and require the Service Provider to operate within prescriptive limitation regulations. While complying with the prescribed limits, the Service Provider may attempt to improve its FRMS processes, in order to re-establish regulatory confidence and re-apply for FRMS approval. Should the CAAT consider that the Service Provider's FRMS meets its requirements at this point, the CAAT may approve the FRMS on restricted conditions (for example, decreased maximum values for duty periods and minimum values for rest periods) until such time as it is confident of the maturity and effectiveness of the system.

10. Forms

10.1 ATS FRMS Evaluation Checklist (CAAT-ANS-TM-109)

For submission ATS FRMS for approval, a completed statement of compliance in ATS FRMS Evaluation Checklist (CAAT-ANS-TM-109) must be submitted by the ATSP. The referenced checklist is available in CAAT website.