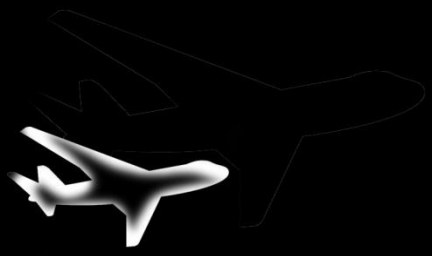

Fatigue Risk Management

A fit-for-purpose regulatory framework

Public discussion document

NOV 2016

CIVIL AVIATION AUTHORITY OF NEW ZEALAND

AVIATION SECURITY SERVICE NEW ZEALAND

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Summary

The Civil Aviation Authority (CAA) is considering what improvements can be made to ensure the regulatory system is fit for purpose and enables aviation participants to effectively manage the risks associated with fatigue.

We are interested in learning your views on fatigue risk management across the civil aviation system.

New Zealand aviation fatigue risk management regulations have not kept pace with scientific principles, knowledge and rapidly maturing regulatory practices from around the world. There are a number of safety risks associated with this.

We have identified a number of specific issues that may need addressing, which are categorised into four main themes:

1. Regulatory design – rule structure and guidance material; processes; one size does not fit all; building trust through the regulatory approach;
2. Competence of participants and the regulator;
3. Low information environment –safety culture, hazard identification and occurrence investigation; CAA capability and identified limits; and
4. Other considerations specific to certain sectors.

Fatigue is a complex issue that does not have simple solutions. The mix of issues we have identified suggests that a multi-pronged approach will be the most effective.

It could include:

- ***Legislative changes*** to update prescriptive flight and duty time limits and rest periods for flight crew; introduce prescriptive flight and duty time limits and rest periods for cabin crew; scheduling limits for air traffic controllers; and introduce performance-based standards for fatigue management, including an option for Fatigue Risk Management Systems (FRMS);
- ***Adopting non-legislative interventions*** such as providing information and guidance on fatigue management and industry education; and supporting initiatives to increase capabilities to monitor, report and analyse fatigue-related occurrences; and
- ***Rely on existing legislation***, including safety management systems (SMS) and Health and Safety and Work regulations, for agricultural aircraft operations, aircraft maintenance and airline ground operations.

This document examines the different issues and considers options for resolving them. We are interested in learning your views on whether you agree with the issues identified and the options presented, and whether there are any issues we have not yet identified and how these may be resolved.

Providing Your Feedback

The CAA is seeking your feedback on potential improvements to the regulatory framework that underpins the management of fatigue-related risks. We are interested in your views on the questions posed throughout this document, and also welcome any other comments you wish to make about the management of fatigue-related risks. All questions are collated into a response form in Attachment A.

Please provide any feedback you wish on the issues and options presented by close of business on **20th February 2017** to:

E-mail: consultation@caa.govt.nz

Post: Charlotte Webby, Policy Advisor
Civil Aviation Authority
PO Box 3555
Wellington 6140

We can also meet with you to discuss this review and receive your feedback in person if you wish. To arrange a meeting, please contact us at the above address with your preferred time and place.

This discussion document, and the response form in Attachment A (as a separate form), are available on the CAA's website at www.caa.govt.nz/fatigue.

Confidentiality

Please note that, once received, submissions become public information that can be requested under the Official Information Act 1982 (OIA).

If you are happy for the CAA to have your personal information, but would not like it to be released, please state this and the reason why in your submission. Also indicate clearly if any parts of your comments are commercially sensitive, or if for any other reason you would not want them disclosed. We will take this into account should we receive any OIA request.

You can also make an anonymous submission; this can be done orally, by post, or in person. Please do, however, give us context about your role in the industry, for example Part 135 pilot, NZALPA member, chief engineer of a maintenance organisation, etc.

Introduction

The Civil Aviation Authority's Fatigue Risk Management policy development project is a coordinated effort to address several long-standing issues regarding the management of fatigue-related risks in the New Zealand civil aviation system.

The current regulatory regime focuses on flight crew fatigue. This regime is based on a traditional model of regulating flight crew fatigue by limiting the hours of flight and duty, and imposing rest periods. It also offers the added flexibility for operators to develop their own schemes that must be assessed and accepted by the Director.

Recent advances have improved fatigue management, including approaches based on better fatigue science, and a more sophisticated understanding of how human performance and organisational systems increase system resilience or contribute to accidents. In light of this, the CAA believes the current New Zealand approach of flight and duty time schemes has limited effectiveness.

This document presents our assessment of the three themes identified that apply to all sectors – regulatory design, competence of participants and the regulator, and a low information environment – as well as other sector-specific considerations.

We assessed these themes in the context of four broad industry sectors:

(1) Air operators of large and medium-sized aeroplanes, cabin crew and line management, including ground operations;

(2) Air traffic services;

(3) Air operators of small aeroplanes and helicopters, including agricultural and adventure aviation; and

(4) Aircraft maintenance and engineering.

This project also considered whether the Health and Safety at Work Act 2015 (HSW Act) could provide a regime to manage fatigue-related risk in the civil aviation system.

The HSW Act underpins a performance- and risk-based regulatory regime. It sets outcomes that organisations must achieve[1], but does not prescribe the standards, methods or practices that organisations must use to achieve these goals.

Problem Statement

The regulatory structure that underpins the management of fatigue-related risk in New Zealand civil aviation has not kept pace with growing scientific knowledge and rapidly maturing fatigue risk management practices from around the world. This gives rise to a number of safety issues that potentially need to be addressed. In terms of safety, there may be barriers to

- The regulator drawing a "line in the sand" providing a level playing field that is clearly understood and applied by participants, based on sound evidence, and that recognises the operational diversity in the aviation system;

[1] Protecting workers against harm to their health, safety, and welfare by eliminating or minimising risks arising from work.

- Aviation organisations – and operators in particular – applying effective management processes and practice that are appropriate to the nature and complexity of their operations.

The regulatory structure also introduces risks to New Zealand's international alignment, presenting barriers to economic opportunities and New Zealand's aviation reputation.

Weaknesses in participant and regulator competence also undermine the regulatory framework. Insufficient knowledge of the causes and consequences of fatigue, and mitigation strategies, may hamper participants from implementing effective fatigue risk management approaches, and limit the CAA's effectiveness in assessing and monitoring them.

Finally, regulatory decision making is impaired by a low-information environment where not enough is known of the contribution of fatigue to incidents and accidents. This is at both an organisation level (internal reporting) and system level (safety data collection, analysis, and exchange).

Objectives

The objectives of this review are to re-design the fatigue management regulatory structure to enable:

- flexibility for operators to apply a fatigue risk management framework and processes that best suit their operations;
- alignment to the degree practicable with international best practice for fatigue risk management;
- increased competence of participants to identify fatigue hazards and implement effective risk mitigation strategies, and of the regulator to effectively assess and monitor aviation organisations' fatigue management systems; and
- improved flow of information amongst operators and the regulator to manage fatigue risks.

Next steps

Feedback received in response to this discussion document will be carefully considered to help inform the CAA's regulatory policy for managing fatigue.

Should these include proposed rule amendments, a second project will be undertaken to develop and propose rule changes to the Minister of Transport. In that case, there will be further opportunity for you to comment on draft rules.

Introductory questions

1. What other issues or comments do you wish to raise regarding fatigue risk management in the New Zealand civil aviation system?

Fatigue in Aviation

Fatigue and human performance

Human performance is cited as a causal factor in the majority of aircraft accidents. The discipline of "human factors" deals with the understanding of human capabilities and limitations and the impact on performance, health, and on safety. Aviation human factors practice focusses on understanding the human contribution to occurrences, reducing error, and improving defences so that the risk inherent in the complexity of the aviation system can be better managed.

Fatigue has long been identified as a human factor issue, but it also exacerbates the negative effects of other human factors. It creates an environment where slips are more likely to occur but are less likely to be detected, where communication drops, attention may be distracted away from critical tasks, and where creative thinking and decision-making is compromised. The insidious nature of fatigue means that it can reach harmful levels before the person is aware, or admits, that there is a problem. Once it is recognised, its effects on performance are frequently underestimated.

The International Civil Aviation Organization (ICAO) defines fatigue as:

> *a physiological state of reduced mental or physical performance capability resulting from sleep loss, extended wakefulness, circadian phase, and/or workload (mental and/or physical activity) that can impair a person's alertness and ability to adequately perform safety-related operational duties.*[2]

Fatigue impairs a person's alertness and ability to work safely and efficiently, and affects the person's decision-making abilities. This can lead to near misses and accidents. The safety risk presented by fatigue depends on what the person is being asked to do and the environment in which they are doing it. For example, a 30-second micro-sleep (an involuntary event when the brain stops processing information from the environment) has very different consequences for a solo helicopter pilot trying to avoid wires on take-off, versus a pilot in a 4-person crew during mid-cruise when the aircraft is on auto-pilot.

Fatigue is a recognised hazard that contributes to accidents in all transport industries. However, it is often difficult to obtain accurate information on the contribution of fatigue to aviation accidents or incidents. For example, it is difficult to establish the proportion of accidents that involve operator fatigue in highly complex and safe systems such as rail or aviation operations. Estimates in aviation range from 3.8 to 21%. This is because the link between human performance and accidents is not clear-cut in the safest systems; multiple layers of defence, such as automation, team work, and procedures, reduce the probability that accidents are attributable to a single cause. The accuracy of the information also depends on the reporting systems, the effectiveness of investigations, and the skill, knowledge, resources, and priorities of investigators[3].

Examples where fatigue has contributed to safety events include:

- poorly executed approaches (Asiana Flight 214 in 2013; three fatalities; 49 seriously injured; hull loss);
- inadequate reaction to conditions and situational information (Colgan Air Flight 3407 in 2009; 50 fatalities; hull loss);

[2] ICAO (2016, 2nd ed) *Doc 9966 Manual for the Oversight of Fatigue Management Approaches.*

[3] Gander PH (2015A) *Pilot Fatigue & Safety in General Aviation* (presentation, 22 July 2015).

- flawed situational awareness (Guantanamo Bay 1993; three seriously injured; hull loss);
- drivers falling asleep and vehicles leaving the road (33 deaths in fatigue-related crashes on New Zealand roads in 2014);
- impacting obstacles (Helicopter wire strike, Nepal 2015, total loss of aircraft, 4 fatalities)
- shortcutting safety procedures (Chernobyl 1986).

These are not isolated cases. A review of 182 major National Transportation Safety Board (NTSB) investigations completed between 1 January 2001 and 31 December 2012 found that 20% of these investigations identified fatigue as a probable cause, contributing factor, or a finding[4]. The NTSB has just put fatigue at the top of its "Wanted List of Transportation Safety Improvements"[5] and recent regulatory changes have been supported by extensive scientific cases that highlight safety events[6]. Fatigue is also identified as one of the aviation maintenance sector's "dirty dozen", the 12 most common conditions contributing to accidents and incidents[7].

Fatigue risk management

Having identified fatigue and its causes as an operational hazard, risk management aims at minimising the impact of those hazards on safety. Three levels of safety management can be identified:

- Suppression of the risk, for example by eliminating schedules or operations that are associated with high levels of fatigue;
- Mitigation of the risk, for example by providing additional crew members and the opportunity for in-flight rest, or ensuring that schedules include options for sufficient recovery sleep, or providing education to aviation personnel on strategies to improve their sleep;
- Strategies to maintain operational safety when personnel are fatigued, for example through the use of automation, task rotation, etc.

Ultimately, the risk of fatigue itself cannot be eliminated, so it must be managed.

Shared responsibilities

Companies, health and safety practitioners, sleep scientists, industry associations, and regulators have been considering how best to implement effective fatigue risk management frameworks, including regulatory systems. Whatever approach is chosen, both good practice and research confirm that the framework must be built around shared responsibilities to reap the full benefits of fatigue risk management.

At the operational level, fatigue risk management is a shared responsibility of the regulator, employers/organisations, employees and their representatives. This is unavoidable, because

[4] Marcus JH, MR Rosekind (2015) "Fatigue in transportation: NTSB investigations and safety recommendations", *Injury Prevention*, doi:10.1136/injuryprev-2015-041791.

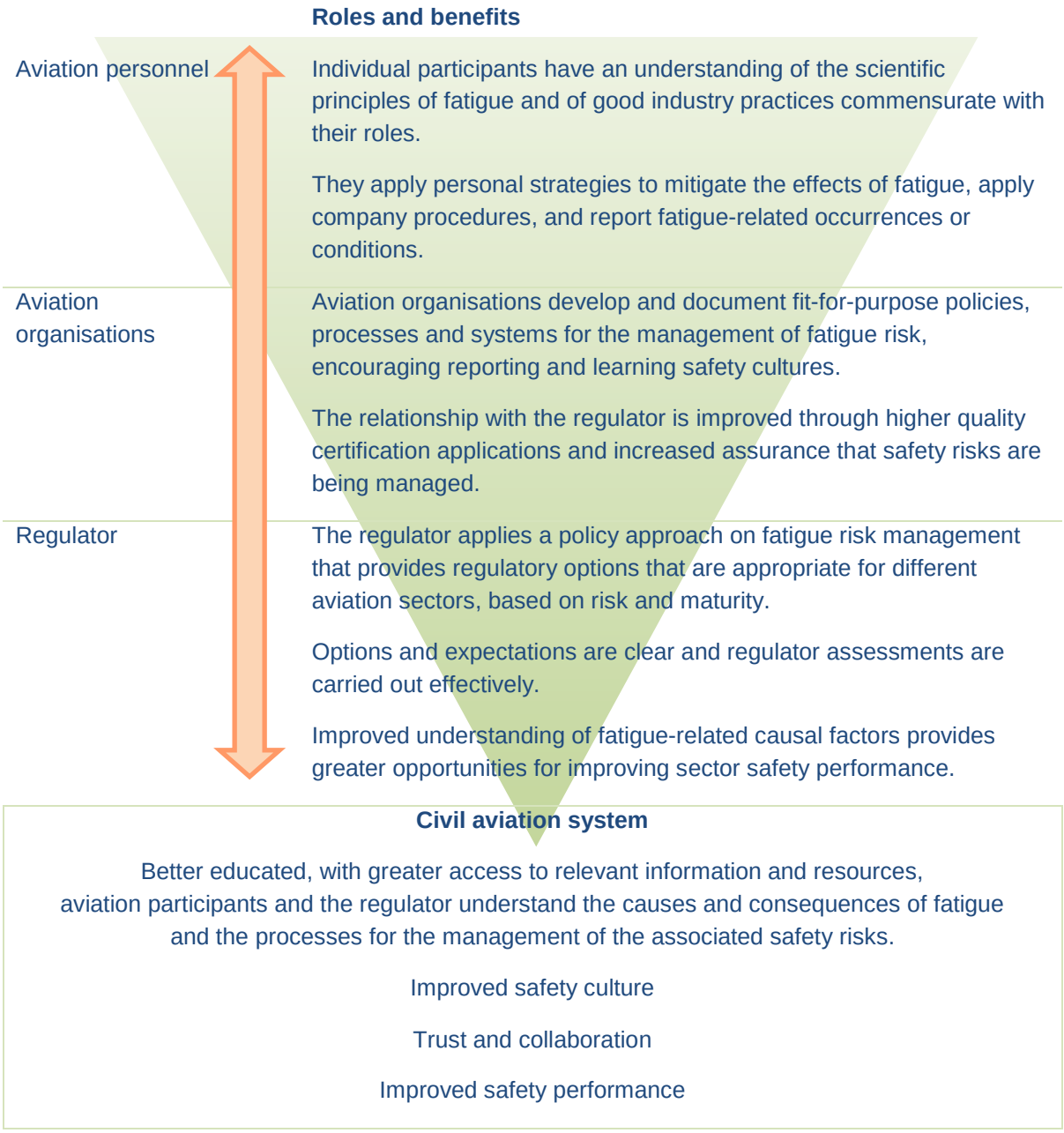
[5] http://www.ntsb.gov/safety/mwl/Pages/mwl1-2016.aspx.

[6] For example: ICAO Working Paper OPSP-WG/WHL/9-WP/6 Operations Panel (OPSP) Meeting on Fatigue Risk Management Systems; and https://www.casa.gov.au/standard-page/fatigue-management-rules-latest-news.

[7] http://www.skybrary.aero/index.php/The_Human_Factors_%22Dirty_Dozen%22.

fatigue differs from many other workplace hazards in that it is affected by all waking activities, not only those that are work-related.

The diagram on this page illustrates the shared responsibilities concept and the benefits gained from a regulatory system that is fit for purpose. The diagram depicts the roles of different participants in the system and how, all together, these stakeholders take part in effective fatigue risk management.



Global Context

ICAO Standards and Recommended Practices

Operators of large and medium-sized aeroplanes

In commercial aviation operations, the international benchmark represented by ICAO's Standards and Recommended Practices (SARPs) traditionally relied on prescriptive rules for addressing fatigue, especially for flight and cabin crew. ICAO stipulates that States must establish regulations specifying the limitations applicable to the flight time, flight duty periods, duty periods and rest periods for flight and cabin crew members[8]. These regulations must be based upon scientific principles and knowledge, with the aim of ensuring that flight crew members are performing at an adequate level of alertness.

In 2011 ICAO amended fatigue-related SARPs in Annex 6 Part I applicable to both flight crew and cabin crew.

The standards contain two distinct methods for fatigue management:

i. the *mandatory* establishment by the State of prescriptive duty and rest limitations, and

ii. the *optional* establishment of FRMS regulations.

In effect, States must have prescriptive limits on flight, duty, and rest times; and may also choose to develop a regulatory framework to support fatigue risk management systems as an alternative means of compliance. Similarly, operators would either need to comply with the prescriptive limits or choose to develop an FRMS.

The prescriptive limits can be seen as a baseline from which an FRMS could be developed. It is also a baseline to which an operator could be made to return to when an FRMS was found not acceptable by the aviation authority.

Both approaches are accompanied by requirements to use specific processes for managing safety hazards in general:

- A prescriptive approach requires an aviation organisation to comply with limits defined by the State, while managing fatigue hazards using the safety management system (SMS) processes that are in place;
- An FRMS allows an aviation organisation to go beyond State-prescribed limits, but the organisation must do more to manage fatigue than would reasonably be expected using an SMS. The ICAO standards explicitly state that an FRMS must include:
    i. FRMS policy and documentation;
    ii. Fatigue risk management processes;
    iii. FRMS safety assurance processes;
    iv. FRMS promotion processes.

Air Traffic Control (ATC) operations

Internationally, Air Traffic Control (ATC) services are facing considerable pressure due to increasing traffic volumes, increasing night traffic and major technological changes that require controllers to spend more time monitoring systems.

[8] These are also sometimes called "hours of service" regulations (HoS).

Fatigue is recognised as a hazard in the ATC environment[9] and fatigue management approaches are required. In principle, implementing a fatigue management approach in this environment should not require fundamental organisational changes. Controllers generally have a fixed place of work with relatively regular rosters. They have regular health and proficiency checks, safety is a high priority in the industry, and companies are accustomed to oversight by the regulator. Fatigue management regimes in ATC are still in their infancy, and ongoing evaluation will be necessary to improve practice.

ICAO have extended their fatigue-related regulatory principles to air traffic services. In February 2016, Annex 11 — *Air Traffic Services* was amended to introduce a fatigue management section consistent with the approach taken in Annex 6. This uses the same two distinct methods for fatigue management of prescriptive limits and an FRMS option.

The amendments will become effective on 5 October 2020.

Operators of small aircraft

ICAO SARPs for fixed-wing aircraft distinguish between commercial air transport[10] and general aviation operations rather than aircraft size, with a focus on international operations. The current SARPs[11] for general aviation may therefore not provide the best framework for domestic operators of small aircraft. They are quite limited and require that:

- International operators of large and turbojet aeroplanes establish fatigue management programmes that address flight and duty times; and
- States establish regulations specifying the limitations applicable to the flight time and flight duty periods for flight crew members.

The current guidance is limited to a manual for general aviation operators of large and turbojet aeroplanes[12] and some recommendations on how to establish flight time and duty period limitation regulations.

For rotary wing, an international task force of regulators, operators, and scientists has been established to align the SARPs for helicopter commercial air transport operations (Annex 6 Part III) with the standards for international commercial air transport with aeroplanes (Annex 6 Part I).

Maintenance

The fatigue-related SARPs of Annex 6 do not extend to the certification of maintenance organisations. The focus is on human factors. The standards require the inclusion of training in human performance into both initial and on-going maintenance training:

> *The maintenance organization shall ensure that all maintenance personnel receive initial and continuation training appropriate to their assigned tasks and responsibilities. The training programme established by the maintenance organization shall include training in*

[9] Refer NASA study *Evaluating the Effectiveness of Schedule Changes for Air Traffic Service (ATS) Providers: Controller Alertness and Fatigue Monitoring Study* (DOT/FAA/HFD-13/001, December 2012); and presentations at the ICAO Fatigue Management Approaches Symposium 2016 (http://www.icao.int/Meetings/fmas/Pages/default.aspx).

[10] Transport of passengers, cargo or mail for remuneration or hire.

[11] ICAO Annex 6 *Operation of Aircraft Part II International General Aviation – Aeroplanes*.

[12] IBAC ICAO Flight Safety Foundation *Fatigue Management Guide for General Aviation Operators of Large and Turbojet Aeroplanes*.

knowledge and skills related to human performance, including coordination with other maintenance personnel and flight crew. (8.7.6.4)

This is supported by guidance in ICAO Doc 9683 *Human Factors Training Manual*, though this has remained unchanged since 1998.

Other international approaches

Unites States Federal Aviation Administration (FAA)

In January 2012 the FAA published *Part 117 Flight and Duty Limitations and Rest Requirements: Flightcrew Members* and associated amendments to Federal Aviation Regulation (FAR) Parts 119 and 121. It applies to certificate holders conducting passenger operations under FAR Part 121 if any segment is conducted as a domestic passenger, flag passenger, or supplemental passenger operation.

Part 117 prescribes flight, duty, and rest time limits, offers an FRMS option, and also prescribes fatigue education and awareness training programmes. The rules are supported by several advisory circulars covering a wide variety of subjects.[13]

FAR Part 121 also imposes maximum duty and minimum rest periods for flight attendants in domestic, flag, or supplemental operations.

The only hours of service limit currently applying to aviation maintenance is in FAR Part 121. It requires that a person performing maintenance be relieved of duty for at least 24 hours in any seven consecutive days or the equivalent within a calendar month. In effect, a person could work up to 52 days straight, in a period of two consecutive months, and still be in compliance with the regulation. The regulation only applies to personnel maintaining aircraft operated by Part 121 air carriers.

An FAA working group is currently developing draft hours of service guidelines for maintenance. It is uncertain whether the FAA will propose broader hours of service regulations at a future time. An FAA report in 2011[14] identified three fundamental objectives for an FRMS in the maintenance environment:

- Reduce fatigue to an acceptable level;
- Reduce or capture fatigue-related errors;
- Minimise the harm caused by fatigue-related errors.

European Aviation Safety Agency (EASA)

In January 2014 the European Commission introduced amended EASA regulations to include *Subpart FTL Flight and Duty Time Limitations and Rest Requirements* to *Part-ORO Organisation Requirements for Air Operators*. Operators were given until 18 February 2016 to transition to the new requirements.

The regulations apply to commercial air transport aeroplane operators, with some exceptions: air taxi operators of aeroplanes of 19 seats or less; Emergency Medical Services (EMS); single pilot operations; and helicopter operations. The current exceptions will be reconsidered over the next

[13] Refer FAA website: https://www.faa.gov/about/office_org/headquarters_offices/agc/pol_adjudication/agc200/Part117/Part117_AC/

[14] Report No. DOT/FAA/AM-11/10.

few years. In the future, new rules will also cover ultra-long range operations and non-commercial complex operations.

The Subpart sets prescriptive limits, some specifically defined options for varying the limits, and allows operators to adopt an FRMS. It covers both flight and cabin crew. The Subpart is supported by an extensive range of guidance material and industry seminars.

Operators wishing to operate within the prescriptive limits must develop plans to describe how their SMS processes will help manage fatigue-related risk. Strict compliance with rule limits is not enough.

EASA uses a multi-tiered assessment approach, where national authorities can assess and approve fatigue management schemes within the prescriptive limits, but final assessment and approval of FRMS safety cases is made by EASA.

The requirements for aviation maintenance fatigue management currently reside in the AMC for production planning[15]. The EASA regulations explicitly require Part 145 maintenance organisations to incorporate human factors into their maintenance procedures at both initial and on-going training[16].

Future developments for maintenance are considered in a Notice of Proposed Amendment[17] that would establish fatigue risk management as an acceptable means of compliance to the production planning rule requirements. This rule amendment is unlikely to be completed before 2018.

Australian Civil Aviation Safety Authority (CASA)

In March 2013 CASA published *Civil Aviation Order 48.1 Instrument 2013* (CAO 48.1). It has adopted a three-tier approach to fatigue management regulation. The three tiers cover the following:

1. Tier 1 – basic prescriptive limits for non-complex operations;
2. Tier 2 – using SMS processes to identify fatigue hazards and determine appropriate company limits within the State's regulatory framework; and
3. Tier 3 – an FRMS option.

The framework does not cover cabin crew.

The regulations are supported by advisory material and comprehensive online resources and industry seminars.

CASA does not specify hours of service limits for maintenance personnel. However, CASR Part 145 makes it an offence for a maintenance organisation to permit a maintainer who is significantly impaired by fatigue to carry out maintenance on an airline aircraft. The regulation also requires organisations to ensure that schedules permit maintainers to take sufficient rest and prohibits organisations from requiring people to continue working if their capacity to carry out maintenance work has become significantly impaired. The acceptable means of compliance supporting CASR

[15] http://easa.europa.eu/system/files/dfu/Annex%20II%20to%20Decision%202015-029-R%20-%20%28AMC-GM%20Part-145%29.pdf

[16] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOL_2014_362_R_0001&from=EN, 145.A.65(b); 145.A.30(e).

[17] https://www.easa.europa.eu/document-library/notices-of-proposed-amendments/npa-2013-01

Part 145[18] notes that an FRMS is an acceptable means to comply with the intent of those parts of the regulation dealing with fatigue.

Transport Canada

Transport Canada is proceeding with the amendment of its prescriptive requirements for flight and flight duty time limitations and rest periods, and the introduction of fatigue risk management systems for all air transport services in Canada. The proposed amendments to the civil aviation rules will be staggered, starting with airline operators (Subpart 705) and subsequently air taxi operators (Subpart 703) and commuter operators (Subpart 704). The amendments will not apply to private operators (Subpart 604) or to aerial work operators (Subpart 702).

United Kingdom (UK)

In 1991, the UK Civil Aviation Authority implemented the Scheme for the Regulation of Air Traffic Controllers' Hours (SCRATCOH). Although the approach essentially imposed prescriptive limits, it recognised that there was a need for "sensible but sparing modification", given the variety of Air Traffic Control (ATC) units that the regulations would cover, and the rapid pace of change in the aviation industry.

In practice, ATC providers set additional, operational limits that are equal to or more restrictive than the generic, maximum limitations provided by SRATCOH. Local agreements take into account what a controller in that part of the operation actually does, and supervisors make ongoing tactical decisions based on current and predicted controller workload and staff availability.

The UK has a comprehensive suite of regulations and guidance material for human factors for both aviation maintenance organisations and aviation maintenance engineer training, including a human factors strategy and action plan[19]. The most comprehensive resource is CAP 716 *Aviation Maintenance Human Factors, Appendix P Working Time Requirements and Guidelines*.

[18] https://www.casa.gov.au/standard-page/casr-part-145-continuing-airworthiness-part-145-approved-maintenance-organisations-0

[19] http://www.caa.co.uk/default.aspx?catid=2055&pagetype=90

New Zealand Context

Air operators of large and medium-sized aeroplanes, cabin crew and line management, including ground operations

This sector of the aviation industry is characterised by scheduled operations that carry the large bulk of fare-paying passengers in New Zealand (about 98% of sector-seat hours), and all passengers in and out of New Zealand. It covers a broad range of operations[20]. There are eight Civil Aviation Rule (CAR) Part 121, and 14 Part 125 operators that hold a New Zealand CAR Part 119 Air Operator Certificate.

Fatigue management provisions for air transport operators operating large and medium aeroplanes are contained in CAR Parts 121 and 125, Subpart K – *Fatigue of Flight Crew*. This requires operators to adopt a scheme for the regulation of flight and duty times.

The CARs are supported by Advisory Circular (AC) 119-2 *Air Operations - Fatigue of Flight Crew,* which provides an acceptable means of compliance with the schemes provided for in CAR 121.803(a)(1) and CAR 125.803(a)(1). These requirements have not changed since 1995.

In terms of cabin crew, New Zealand is currently not compliant with the ICAO fatigue management standards and recommended practices in Annex 6.

ATC operations

Civil Aviation Rule 19.403 allows the Director to prescribe duty time limitations for air traffic controllers. There are, however, no duty limits or fatigue management requirements in Part 172 that sets out certification and operating requirements for organisations providing air traffic services.

Airways New Zealand is currently the sole CAR Part 172 provider of air traffic services in New Zealand. It manages fatigue through its Service Delivery Fatigue Management Policy and collective employment agreement negotiated with the controllers' union.

The Sleep/Wake Research Centre[21] is one of New Zealand's leading sleep and fatigue research centres. They reviewed Airways' policy in early 2015 and concluded that:

- The specific duty limits could not be effectively assessed with current scientific information;
- The policy could be improved by the implementation of some of the basic processes that would eventually form part of a full Fatigue Risk Management System (FRMS), including data collection, risk assessment, implementation of controls and mitigations and an assessment of their effectiveness, and a thorough education and training programme; and
- The policy was a good base from which an FRMS could be developed and implemented.

[20] Short and long haul; Visual Flight Rule operations to regional destinations; Trans-Tasman operations; 24/7 very long range operations across the globe; regular and scheduled services; charter and on-demand operations, including scenic flying; freight only, including night only operations; operators with large fleets of multi-engine jet aircraft; operators of single-engine turboprop aeroplanes; airlines who are recognised internationally for their FRMS expertise or who are part of larger international airlines that use or are implementing FRMS in other jurisdictions; and airlines who strictly follow the CAA's fatigue management limits and schemes.

[21] http://www.sleepwake.ac.nz/

According to Airways New Zealand's data there have been four air safety incidents over the last two years where fatigue was one of the contributing factors. An informal assessment using the FAID[22] fatigue assessment tool scored the current rosters as well within safe operating limits.

Airways New Zealand operates an Air Safety Incident database and a confidential safety reporting system. It has also implemented an internal electronic fatigue reporting system that is being managed by the health and safety department. Terms of reference for a Fatigue Monitoring Group are being developed. Composed of representatives from all shiftwork parts of Airways, this group will meet regularly and moderate all fatigue reports and metrics. Current rostering metrics – while not scientifically validated – are being retained, until sufficient evidence has been gathered through internal reports to validate their use or develop others.

Air operators of small aeroplanes and helicopters, including agricultural and adventure aviation

This sector includes a variety of smaller fixed wing and rotorcraft air operations, including Part 135 operations, Part 137 agricultural aircraft operations, and Part 115 adventure aviation operations. This group is characterised by significant differences in size and complexity, from operators with large fleets of aircraft and large numbers of pilots, to owner-operators flying a single aircraft. Some companies also have a wide range of activities across several operating certificates.

Part 135 operations

Fatigue management requirements for Part 135 operations are similar to those of larger operators certificated under Parts 121 and 125. The main difference is that Part 135 operators do not have prescribed maximum flying hours, and there are additional requirements for Part 135 commercial transport operations.

The requirements are supported by guidance material in *AC119-3 Air Operator Certification — Part 135 Operations*, including a crew endurance guide and an example of fatigue assessment and monitoring. This has not been updated since the initial publication in 2000. The advisory circular stipulates that a scheme following AC119-2 *Air Operations — Fatigue of Flight Crew* in its entirety would provide an acceptable means of compliance with the scheme requirement of 135.803(a)(1).

Part 137 agricultural aircraft operations

There are currently no fatigue management rules for Part 137 operators. The CAA considered establishing rules for this sector in 2010, but ultimately concluded that a rule would not generate sufficient safety benefits for the costs involved.

Part 115 adventure aviation operations

Fatigue management provisions for adventure aviation operators are similar to those for Part 121 and 125 operators. The main difference is the absence of maximum monthly and annual crew flying time, and fewer criteria to consider for the development of a scheme.

The requirements are supported by guidance material in *AC115-1 Adventure Aviation – Operator Certification*. This is very similar to the content of AC119-3.

[22] FAID is a scientifically-supported modelling software developed by InterDynamics that analyses hours of work and provides a fatigue exposure assessment of work patterns and developed.

Aircraft maintenance and engineering

New Zealand is one of the few countries to specify prescriptive duty limits for maintenance personnel. Civil Aviation Rules 43.53 and 145.52 require that maintenance personnel must have had at least eight hours off duty in the preceding 24 hours and at least four periods of 24 consecutive hours off duty in the preceding month before performing work. These limits are a relatively crude approach that does not recognize the complexities of fatigue.

Issue 1 - Regulatory design and approach

This section describes how the current regulatory framework does not allow New Zealand to achieve all the potential safety and efficiency benefits of recent developments in fatigue management approaches from around the world.

Rule structure and guidance material for operators

Civil Aviation Rules (CARs) require that Parts 121, 125, 135, and 115 operations manage the flight and duty times and rest periods for their flight crews. These rules have not kept pace with scientific developments and best practice.

The CARs provide performance-based rules that give operators flexibility to develop schemes for the regulation of flight and duty times of flight crew but there are barriers to achieving greater effectiveness due to:

- Limits, and criteria for establishing them, that do not take into account the latest scientific principles and fatigue research reflected in other regulators' rules;
- A lack of clarity, in the combination of rules and advisory circulars as to what constitutes the actual prescriptive limits set by the State, what constitutes the performance-based approach, what constitutes acceptable means of compliance, and what constitutes guidance;
- A lack of clarity as to how the regulator will assess schemes, what its expectations are and what it means for an operator to choose between a prescriptive or a performance-based approach. This is reflected in the difficulty to develop a fatigue management scheme outside the options provided for in AC 119-2, and may also lead to an inconsistent oversight of fatigue management approaches;
- The regulatory framework does not explicitly make the connection to the associated processes that provide the backbone for effective management of fatigue-related risk. There is a risk that operators may focus too narrowly on rigid, compliance-based procedures rather than trying to implement effective processes to achieve the desired safety performance;
- The CARs not keeping up with operational experience and the growing maturity of certain operators[23];
- Current advisory circulars describe several schemes and provide guidance material for *all* operator sectors covered by CAR Parts 121, 125, 135, and 115. They are founded on approaches from the old Civil Aviation Safety Orders based on regular scheduled operations, and do not address the variety of modern operations and different types of risk existing in New Zealand aviation today[24];
- The alternative schemes allowed by the rules – meaning those that would not meet the limits in AC119-2 – do not constitute an FRMS in the full sense of ICAO's SARPs.

[23] For instance operators proactively applying FRMs principles, applying for FRMS in other jurisdictions, or using the services of fatigue management experts to develop their schemes.

[24] For example: night-only freight operations, emergency and aero-medical operations, adventure operations, etc.

This situation leads to a wide variety of fatigue management approaches that are not fully supported by a consistent, clear, and modern set of standards and processes. The approaches may therefore not be the most effective at managing fatigue-related risk.

We believe that updating the fatigue management rules and improving the associated advisory circulars to correct these weaknesses will provide safety benefits to New Zealand aviation. We also believe the improvements will be particularly beneficial to Part 135 and 115 operations by taking into account more emphatically the needs and circumstances of those operators.

Part 135 air operations

The CAA's November 2015 *Part 135 Sector Risk Profile*[25] identified specific fatigue-related risks, as well as associated risks that can impact fatigue. These include pilots' attitude to fatigue, business pressures to fly, operator and sector culture, and the role of the regulator and rules.

While there are very few safety events recorded showing an observable contribution of fatigue, the report's conclusion highlighted many areas that could have an effect on fatigue or could influence the management of fatigue-related risk:

- A diversity of risks and activities in this sector;
- Pilot experience and attitude, company culture and communication;
- Variability in the interpretation of the rules;
- The influence of some key clients on the ability to plan and resource for safety;
- Shared responsibility and the need for mutual trust, close collaboration, and more frequent communication between the regulator and the sector;
- Expectations that the regulator provide guidance for understanding rules, and support the sector's continuous learning and development.

Part 115 adventure aviation operations

Although there is limited fatigue-related data for the adventure aviation sector, its characteristics create potential fatigue-related risks:

- Seasonal and weather-dependency which leads to intense periods of work with peak in demand and potential pressure from customers;
- A mix of operations where companies holding adventure aviation operator certificates may also hold other operating certificates, for example Part 135;
- The impact on pilots of combining flying in adventure aviation operations and other types of air operations;
- Small operations, and the stress of flying and managing a business;
- Operations where flight time may not be the best operational indicator of fatigue (for example parachute drop operations);

We believe that the balance of our legislative and non-legislative proposals would help mitigate the risks in these sectors.

[25] https://www.caa.govt.nz/Safety_Reports/sector_risk_profiles.html

Regulating cabin crew fatigue

Cabin crew clearly have a safety role: managing potential crises and emergencies; dealing with routine safety procedures; managing passenger welfare during all types of operational disruption; and dealing with unruly passengers. These tasks require sustained concentration.

Technical reports commissioned by the FAA[26] concluded that US-based cabin crew exhibited significant impairments from fatigue. Study data provided evidence suggesting that they shared a state of chronic sleep restriction and fatigue that was considerably worse than their own perceptions, with sleep/wake patterns similar to those of industrial shift-workers.

In New Zealand, feedback from the main airline operators indicates that they are managing cabin crew fatigue by:

- Imposing internal duty and rest restrictions through industrial or employment agreements;
- Managing fatigue-related risks through SMS and FRMS[27] processes;
- Receiving and analysing fatigue reports;
- Involving cabin crew and union representatives in fatigue review groups; and
- Conducting fatigue training.

The effectiveness of these processes has not been measured. In the absence of a safety standard set by the CAA, industry participants have established their own standards that are not assessed by the regulator and may not be as effective as practices mandated by international jurisdictions and recommended by fatigue experts.

Regulating ATC fatigue

It is too early, from the regulator's perspective, to assess the effectiveness of the schemes implemented by Airways in New Zealand. There is also the added risk that it represents the approach of a single provider, and not that of the whole industry.

Alignment with international best practice and setting a New Zealand standard

ICAO SARPs require some form of fatigue risk management regulation for ATC to be implemented in the next few years. The CAA's main aviation partners (FAA, EASA, and CASA) are working towards implementing these standards, though it is too early to say which approach will be favoured and at what pace.

Airways New Zealand has expressed interest in putting in place a system that would provide flexibility across their business, establish fatigue metrics, address the differences between fatigue and tiredness, balance personnel requirements against management best practice, and meet the future needs of the organisation.

There are challenges associated with implementing a fatigue risk management framework for ATC operations in New Zealand:

- There is tension between the potential effectiveness of new approaches to fatigue management as promoted by ICAO and the demonstrated effectiveness of current industry practices.

[26] Refer bibliography.

[27] Note: these are not CAA-approved FRMS in the ICAO sense of the term.

- There are also issues associated with establishing a standard that sets the acceptable level of safety for the New Zealand civil aviation system in general, and not just for any particular service provider.

One size does not fit all: prescriptive vs. FRMS

Setting prescriptive limits is complicated, and many factors could make higher or lower limits appropriate.

Hours of service (HoS) regulations do not fully address the exposure of aviation participants to some of the major causes of fatigue. Comprehensive performance-based fatigue risk management standards may be more effective at minimising fatigue risk in the aviation industry for the following reasons:

- Prescriptive regimes lack flexibility and may not respond quickly to change;
- Prescriptive limits cannot address the complex combination of factors that influence fatigue, or the interactions between the various factors in the workplace (for example inadequate sleep, circadian variation, the duration of duty periods, and the pattern and level of workload and breaks from operational duty);
- Prescriptive limits do not address the contribution of non-work related activities to fatigue, such as commuting, and cannot mandate behaviours and schedules outside of work;
- There may be inconsistencies between rosters (which must meet regulatory requirements) and what is actually worked.

In developing HoS regulations, regulators are in effect challenged to develop a set of rules that will work across a diverse range of industry operations. This one-size-fits-all approach is at best a very blunt instrument for managing the risks associated with operator fatigue. In some instances it may have the unintended consequence of exacerbating fatigue where an operator uncritically adopts the prescriptive approach without analysing their operations, personnel needs, specific hazards and capabilities to implement appropriate mitigation strategies.

Scientific knowledge and operational experience has also clearly shown that a specific duty/rest limit, used in isolation from the factors that influence fatigue risk, creates an unrealistic and simplistic expectation that one side of the limit is safe (e.g. *I have worked a legal number of hours, hence I am not fatigued and I am safe*) and the other is not (i.e*. I have worked more than the limit and I am inevitably fatigued and unsafe*).

Consequently, the one-size-fits-all approach can lead to the proliferation of applications for variations or exemptions. An FRMS approach, supported by a coherent and consistent methodology to develop and assess such systems, would potentially address these shortcomings and offer an alternative means of compliance to achieve the same or better safety outcomes than specific duty limits.

The demands of performance-based regulation

FRMS and the CAA's current approach to flight and duty time schemes – where an operator applies for a scheme beyond the means of compliance in AC119-2 – are examples of performance-based regulation[28]. For greatest effectiveness, they require aviation personnel, their union representatives, company management, and regulators to adapt their traditional roles and

[28] Regulation that prescribes safety performance objectives, but not actual methods of achieving those objectives.

attitudes, and adopt a more collaborative approach to improve trust between the parties. Here are some examples of the challenges:

- Encouraging companies to apply their operational expertise to develop effective fatigue management schemes also requires regulators to reconsider the certification and auditing criteria against which novel ideas are to be judged;
- Where regulation permits responsible operators to take a bigger role in the management of their risks, according to the principle that "those that create the risk are best placed to manage it", it shifts the focus of responsibility from regulators towards employers and employees. This creates challenges in regulatory oversight. Organisations must demonstrate an ability to establish and manage processes that fit their needs, and monitor performance measures, while the regulator must assess process effectiveness and the soundness of management decisions, rather than compliance with set standards. These approaches require that there are clear methods and processes to manage the relationships and pathways.
- Signal et al (2006) found significant discrepancies within organisations between how management, on the one hand, and line pilots, on the other, perceived how well the organisation was managing fatigue, in particular on education and what mitigation strategies were employed.

Essentially, it is an environment that requires a shift in organisational cultures, with a more astute use of knowledge and skills and a better perception of the risks and how to manage them. This is based on a solid understanding of the scientific principles that underpin fatigue management, applied at the right level of complexity and maturity.

We do not believe that the current regulatory framework, with its emphasis on the acceptable means of compliance provided by AC119-2 alone, provides an environment for the effective implementation of performance-based approaches. It does not emphasise the responsibility requirements or the necessary processes for hazard identification and risk management, safety assurance and continuous improvement, or competence building that underpin modern fatigue management approaches. Additionally, it does not provide clear and up-to-date guidance and standards to achieve the performance goals.

Safety Management Systems and Health and Safety at Work

Given these limitations just discussed, we considered whether the requirements of Part 100 *Safety Management* and the Health and Safety at Work Act 2015 (HSW Act) could provide a regime to manage fatigue-related risk in the civil aviation system.

Based on CAA experience, we consider that the management of the risks associated with fatigue hazards require specialised and codified approaches in most cases. These are in essence limiting flight and duty time and imposing rest periods, and/or the more nuanced and comprehensive approach of FRMS. Part 100 *Safety Management* and the HSW Act alone, with their very broad requirements, do not establish the technical framework for effective fatigue risk management. They do not provide the recognised standards, methods, or practices that organisations must use to achieve the safety goals of fatigue management.

We concluded that a modernisation of CAA rules – requiring prescriptive limits reinforced with SMS processes, and an option for a performance-based FRMS – supported with advisory circulars that provide clear, sector-relevant acceptable means of compliance and guidance for implementation, would provide methods of fatigue management that are reasonably practicable.

Recommendations

We believe that the regulatory design and approach for fatigue management can be improved by:

- updating the structure of the current rules on prescriptive flight and duty limitations and rest periods for flight crew, cabin crew, and schedules for air traffic controllers;

- explicitly including or referencing SMS processes in fatigue risk management rules to increase effectiveness;

- establishing a regulatory option for FRMS;

- updating the associated advisory circular(s) and other appropriate education and promotion material.

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2. What changes, if any, do you think are necessary to the rules and the prescriptive flight and duty limitations and rest periods for flight crew?
3. Do you support the introduction of prescriptive limits for flight, duty, and rest periods for cabin crew?
4. Do you support the introduction of prescriptive scheduling limits for air traffic controllers?
5. What changes, if any, do you think are necessary to the schemes currently in AC119-2 to better reflect sector-specific needs?
6. What are your views on the relationship between SMS and fatigue risk management, and how do you think they could be integrated, if at all?
7. Do you believe that the introduction of a regulatory option for Fatigue Risk Management Systems would provide additional benefits to manage fatigue-related risks in New Zealand?
8. What would the potential impact of the suggested changes to the regulations be on your operations?
9. Are there any matters identified that you consider are not a problem? Why not?

Issue 2 - Competence of participants and the regulator

Research and industry experience demonstrates that effective fatigue risk management is highly dependent on the knowledge and competence of those managing the risk. They need to understand the causes and consequences of fatigue, and the processes to manage the associated risks, commensurate with their responsibilities. This knowledge is required to:

- Recognise where fatigue is a hazard in the organisation;
- Recognise what operational conditions are hazards that may lead to fatigue-related risk;
- Move the debate out of the industrial, commercial and political arenas and into the safety arena, including the understanding of human factors and their impact on safety; and
- Assess the needs of the organisation and its operational staff in order to develop and implement a scheme that is appropriate and compliant with the State's regulations.

A 2006 study by Signal et al found that many operators may believe they are managing fatigue well, when in fact a large proportion cannot specifically demonstrate how this is being done. It also concluded that more flexible regulatory options had not necessarily changed operator practices.

The study found that only a minority of operators reported educating their rostering staff or reviewing company processes for managing fatigue. Findings indicated that most respondents did not think that seeking information on fatigue management was necessary, or that they needed further help, advice, or resources on better managing fatigue. Anecdotal evidence gained from discussions with operators and inspector experience suggest this is still true. This is reflected in:

- Informal rather than systematic approaches;
- Fatigue training being driven by an individual's interest in the subject rather than a mature organisational process;
- The reliance on procedures training rather than a broader understanding of fatigue hazards, risks, and mitigations; and
- Varying ability for aviation organisations to carry out hazard identification, risk assessment, and internal investigations.

This may suggest insufficient knowledge among operators and that greater education may be one of the most effective means to improve performance.

The recommended inclusion or reference to SMS requirements will ensure that aviation participants implement applicable measures to train their personnel and establish competence in fatigue management. These regulatory defences could be reinforced by non-legislative initiatives to overcome the weaknesses identified in the current guidance material and provide educational resources to support participant competence. Strong, accessible, and practical guidance on human factors considerations, the scientific principles of fatigue, and fatigue mitigation strategies, remains limited in CAA material.

The recommendations for changes to the rules will also help clarify the capabilities the CAA needs to develop in its inspectorate. This would be for the purpose of assessing whether schemes proposed by participants are appropriate for their operations and are compliant, whether the supporting SMS processes are adequately managed, and whether schemes beyond the prescriptive limits are scientifically sound and provide an equivalent or improved level of safety.

Recommendations

We believe that competence in fatigue risk management and aviation safety can be improved by:

- setting performance-based standards for personnel competency in fatigue risk management through the inclusion of, or reference to, SMS processes; and

- implementing and supporting additional non-legislative interventions such as updating the associated advisory circular(s) and other appropriate education and promotion material, and conducting education campaigns.

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10. What are your views on whether the proposals would assist with improving industry and regulator competence to manage fatigue?

Issue 3 - Low-information environment

Limited data and research in the New Zealand context

The effective management of fatigue-related risk requires access to, analysis, and dissemination of data and information to make the right safety decisions.

Evidence indicates there is insufficient access by operators and the regulator to fatigue-related data to properly inform decision-making. This is reflected in:

- Low fatigue reporting levels, or at least very few formal or systematic methods to capture, analyse and act upon reports or events;
- The CAA not having a complete picture of how participants are managing fatigue-related risks; and
- Conclusions drawn from Transport Accident Investigation Commission (TAIC) and CAA investigation reports, suggesting not enough is known of the actual contribution of fatigue to accidents and incidents.

Another challenge in New Zealand is the limited amount of scientific literature in certain sectors. For instance there is limited research in ATC and maintenance working hours and some of it is over 15 years old.

These elements combine to provide a very incomplete picture of the size and nature of the risk in some sectors.

Safety culture, hazard identification and occurrence investigation

Fatigue can exacerbate the negative effects of other human factors. Its insidious nature also means persons aren't always aware they are affected. It is therefore important that persons can proactively report feeling fatigued within an organisation, and that all safety occurrences are reported and investigated to learn from these circumstances.

Incomplete safety investigations and low reporting ratios may result in a lack of information to help drive safety performance, the impact of which is a less effective system of safety management. Safety practice and operational experience in many industries typically reveal a very large ratio of incidents compared to accidents. The CAA however only receives 1.7 incident reports for every accident report in the agricultural sector and 3.9 incident reports for every accident report in the commercial helicopter sector. In the agricultural sector, 79% of incidents and 48% of accidents have no causal factor assigned. There are similar proportions in other general aviation sectors.

As with safety management systems, safety culture is critical to the success of fatigue management systems. A mature safety culture approaches safety lapses and errors as opportunities to learn lessons, encourage processes to evaluate the contribution of operator fatigue to accidents, and identify the conditions and contexts where operator fatigue jeopardises safety. This information is necessary to establish a baseline against which to evaluate the effectiveness of an organisation's fatigue management processes.

We believe that CAR Part 100 *Safety Management* and the HSW Act provide a legislative framework that will adequately address these issues for most aviation organisations. The implementation of Part 100, with its emphasis on more effective and mature processes focussing on safety performance, as well as the ongoing building of industry and regulator capability, should ensure that aviation organisations develop and maintain better hazard identification and internal reporting systems for fatigue-related risks. The HSW Act requirements for worker engagement and participation and the principles of shared responsibility should further help to establish and foster a

safety and learning culture, and an environment that encourages the gathering of relevant and useful data.

Where an operator decides to adopt our proposed option for FRMS, there would be specific requirements for applicants to implement reporting and data analysis processes in line with international best practice.

We therefore do not propose additional legislative requirements for aviation organisations to report fatigue related incidents, but recognise that the requirements present in existing legislation need to be supported by more guidance and education.

Recommendations

We believe that a lack of information on fatigue risk management and aviation safety can be improved by:

- implementing and supporting additional non-legislative interventions to improve the quality of incident reporting, and increased operator competency in identifying and responding to information indicating the presence of fatigue-related hazards.

11. What are your views on whether initiatives to improve reporting and investigation will contribute to the improved management of fatigue?

12. What education and guidance initiatives would you suggest to increase the capability of participants to report and investigate fatigue-related contributors to safety events?

Other Considerations

Our review identified three sectors where fatigue presents safety risks, where the issues of competence and low information are relevant, but where a direct and new legislative intervention may not constitute the most effective approach. They are Part 137 agricultural aircraft operations, aircraft maintenance, and airline ground operations. None of these sectors are currently covered by comprehensive fatigue risk management regulations and the fatigue management developments in other jurisdictions have not extended to these areas of operation.

Part 137 agricultural aircraft operations

Most of the recorded accidents where fatigue has been inferred as a possible contributor in New Zealand are related to agricultural aviation.

An NTSB report in 2014 into the safety of agricultural aviation operations in the Unites States found the following causes of fatigue in agricultural operations:

- Seasonal peak in demand with pressure from customers;
- Very long working days;
- Multiple short flights, and high total flight hours per day;
- Continuous, repetitive, low altitude, high attention demands leading to high workloads;
- Lack of breaks for eating, drinking, toilet stops.

These conditions are similar to those experienced in the New Zealand agricultural sector. There are also other characteristics that raise the risk of fatigue-related events in the agricultural sector:

- Strong weather dependency that leads to intense periods of work to make the most of favourable conditions;
- Small operations where the pilot has organisational and administrative work to do before or after flying;
- Frequent mixing of agricultural operations with air or adventure operations, combined with a lack of effective management of the fatigue accumulated in any one activity when transitioning to another.

In its *Sector Risk Profile - Agricultural Aviation*[29] published in September 2013, the CAA specifically identified management of fatigue as a potential risk area:

> *As a result of what can be a low maturity of safety management amongst some operators, there are few incentives for operators to systematically manage fatigue, distraction and enhance non-technical skills, thereby increasing the potential of poor safety outcomes during daily operations.*

The report also identified specific factors that could raise fatigue-related risks, such as:

- Some operators choosing to selectively comply with the multiple regulatory requirements;
- An absence of industry-agreed, best practice operational standards resulting in a lack of consistency and an overall degradation in safety performance;
- 'Industry pricing models' affecting operational behaviour;

[29] https://www.caa.govt.nz/Safety_Reports/sector_risk_profiles.html

- Reduced financial stability and small operator size;
- The prioritisation of productivity over safety; and
- The absence of consistent and robust sector training standards.

The risk profile for agricultural aircraft operations is also fundamentally different to commercial passenger transport. In the agricultural sector the risk is mostly to flight crew – and possibly agricultural ground support staff – and not to the general public.

The current regulatory framework – Part 100 *Safety Management* and the Health & Safety at Work Act 2015 – provides some regulatory defences to mitigate against fatigue-related risk. We do not believe that, under the current circumstances, additional regulatory requirements through flight and duty limitations would provide additional benefits or would effectively address the behavioural risks identified above.

These defences should however be reinforced by initiatives for increased competence in the area of human factors and pilot performance, as well as an improved ability to detect, analyse and disseminate lessons from safety occurrences.

Maintenance

There is fatigue-related risk in aviation maintenance due to the need to perform shift work and the potential for long duty days. However, the CAA does not currently have enough evidence in New Zealand to suggest that immediate changes need to be made to the current regulatory framework to mitigate fatigue-related risk at the system level.

As with the agricultural aircraft sector, the current regulatory framework – Part 100 *Safety Management* and the Health & Safety at Work Act 2015 – provides some regulatory defences and should be reinforced by initiatives for increased competence in the area of human factors, as well as an improved ability to detect, analyse and disseminate lessons from maintenance errors.

Ground operations

There are indications of fatigue-related risks in ground operations, as illustrated by:

- The 24/7 nature of airline operations, shiftwork, and the risks associated with the extensive use of contracting in these types of operations;
- JetBlue's demonstration[30] that an FRMS can effectively manage the fatigue of ground-based crew; and
- The high-profile case of the baggage handler who fell asleep in the cargo hold of Alaska Airlines Flight 448 in April 2015.

The CAA has not, however, received any information that would suggest that safety risks warrant new specific legislative interventions to manage fatigue in ground operations in New Zealand.

[30] Presentation to the FRMS Forum, Montreal, Canada, 7 April 2016.

Recommendations

We believe that competence in fatigue risk management and aviation safety in respect of agricultural aviation, maintenance and ground control operations can be improved by:

- implementing and supporting additional non-legislative interventions, such as updating the associated advisory circular(s) and other appropriate education and promotion material, and conducting education campaigns; and

- implementing and supporting additional non-legislative interventions to improve the quality of incident reporting, and increased operator competency in identifying and responding to information indicating the presence of fatigue-related hazards.

13. What are your views on whether the safety management system requirements of Part 100 and the Health and Safety at Work Act requirements are sufficient for managing fatigue in agricultural aviation, maintenance and ground control operations?

Intervention Options

The CAA has developed a set of options for addressing fatigue management. The options are suggestions as to how the CAA thinks the issues discussed in this paper would be best addressed. We would like your input on these options to help us with further decision making.

We considered the following broad options to address the four themes discussed in the previous sections:

A. Maintain the status quo – In most cases we did not think this was appropriate given the nature of the potential risks.

B. Rule amendment – to enable a modern and improved system for the management of fatigue-related risk. This would include relevant changes to ACs.

C. Non-legislative initiatives – Where changes are considered appropriate but amendments to the rules are not, certain non-legislative actions may improve the system for the management of fatigue-related risk. This includes amendments to relevant ACs, education initiatives, promotional activities or changes to administrative processes.

D. Other legislation – We considered whether the requirements of Part 100 *Safety Management* and the Health and Safety at Work Act 2015 could provide a regime to manage fatigue-related risk in the civil aviation system.

Parameters

We took into account the following parameters, based on our stated objectives on page 7, to inform these options:

- Alignment to the degree practicable with international best practice for fatigue risk management, including compliance with ICAO SARPs;
- Incorporation of scientific knowledge and principles; and
- A performance-based approach that sets very clear expectations, provides flexibility for the standards to evolve with scientific knowledge and operator experience, and provides flexibility for operators to apply a fatigue risk management process that best suits their operations and capabilities.

Recommended options

We seek your feedback on these options for managing aviation fatigue risks in the New Zealand civil aviation system:

Propose legislative changes to

- Update prescriptive flight and duty time limitations and rest periods for flight crew in the Civil Aviation Rules and associated ACs;
- Introduce prescriptive flight and duty time limitations and rest periods for cabin crew, and scheduling limits for air traffic controllers in the Civil Aviation Rules and associated ACs;
- Introduce performance-based standards for the management of fatigue-related risk within an SMS,
- Introduce a performance-based regulatory option for Fatigue Risk Management Systems (FRMS).

By updating the structure of its current rules, New Zealand would comply with ICAO requirements and reduce exposure to commercial risk for our international operators. It would set scientifically-based and operationally-informed baselines that that are fit-for-purpose for the New Zealand environment. It would recognise and cater for the diversity of operations and risk.

By setting performance-based standards for fatigue risk management, the CAA would help build aviation organisations' capability to develop and maintain more mature processes focussing on safety performance. These would lead to better hazard identification, internal reporting, personnel competency, and continuous improvement in the area of fatigue management.

By establishing a regulatory option for FRMS that is scalable to the size of an organisation, and the nature and complexity of the activities undertaken by the organisation, the CAA would provide a flexible framework for operators to achieve higher levels of safety performance than under prescriptive limits.

By clarifying its expectations and the rigorous assessment process for the acceptance of fatigue management schemes, the CAA would ensure fatigue risk management approaches are effectively developed, implemented, monitored, and reviewed. It would minimise the risks inherent in the variability of individual schemes allowed by a performance-based approach.

By including the latest terminology for fatigue management in its rules, advisory circulars and education material, the CAA will ensure participants and the regulator speak the same language and address the relevant factors that make up effective systems for managing fatigue-related risk.

Adopt additional non-legislative interventions, such as

- Providing information and guidance on fatigue management, and industry education;
- Supporting initiatives to increase the capability to monitor, report, and analyse fatigue-related occurrences.

By leading the development of advisory circulars, developing or promoting education campaigns, assisting participants in finding and using resources that are relevant to the New Zealand context, the CAA would increase the capability of participants to develop fatigue management systems and CAA inspectors to assess them.

This would also encourage the proactive adoption of practices to improve safety performance in all sectors, and help participants better understand the CAA's expectations in terms of managing human performance within an SMS.

By initiating such non-legislative interventions the CAA would help improve incident investigation capability and stimulate better-informed decision-making by individuals, organisations, and the regulator.

Rely on current legislation for certain sectors

In some sectors – agricultural aircraft operations, aircraft maintenance, and airline ground operations – we concluded that, at this time, the level of risk was best mitigated through initiatives to support current mandatory safety risk management frameworks, namely Part 100 *Safety Management* and the Health & Safety at Work Act 2015.

The non-legislative interventions to improve the quality of incident reporting, and increased operator competency in identifying and responding to information indicating the presence of fatigue-related hazards, would also apply in these sectors.

Options summarised

These options are summarised in the following table with explanations as to what it means for the sectors discussed here and in line with the themes identified.

Table 1 – Summary Table

Item number	Recommended interventions	What it means for each sector			
		Air operators of large and medium-sized aeroplanes, cabin crew and line management, including ground operations	**Air traffic control**	**Air operators of small aeroplanes and helicopters, including agricultural and adventure aviation**	**Aircraft maintenance and engineering**
1 - Regulatory design and approach					
1.1	**Legislative change** Update prescriptive flight and duty limitations and rest periods for flight crew, and the associated advisory circular(s) Introduce prescriptive flight and duty limitations and rest periods for cabin crew, and an associated advisory circular Introduce prescriptive scheduling limits for air traffic controllers, and an associated advisory circular	Amend Part 121 Subpart K Amend Part 125 Subpart K Update AC and prescriptive schemes to reflect scientific principles and operational contexts. Develop sector-based schemes	New rules in Part 172 (172.55 currently reserved) New AC	Amend Part 135 subpart K Amend Part 115 Subpart G Update AC and prescriptive schemes to reflect scientific principles and operational contexts. Develop sector-based schemes	N/A
1.2	**Legislative change** Introduce performance-based standards for the management of fatigue-related risk within an SMS.	Amend Part 121 Subpart K and Part 125 Subpart K to explicitly include or reference SMS processes under the prescriptive limits Update AC	Amend Part 172 to explicitly include or reference SMS processes under the prescriptive limits Update AC	Amend Part 135 subpart K and Part 115 Subpart G to explicitly include or reference SMS processes under the prescriptive limits Update AC	N/A
1.3	**Legislative change** By establishing a regulatory option for FRMS that is scalable to the size of an organisation, the nature and complexity of the activities undertaken by the organisation, the CAA would provide a framework for mature operators to achieve high levels of safety performance and gain greater operational flexibility.	Introduce an FRMS option in Part 121 Subpart K and Part 125 Subpart K	Introduce an FRMS option in Part 172	Introduce an FRMS option in Part 135 Subpart K and Part 115 Subpart G	N/A

Item number	Recommended interventions	What it means for each sector			
		Air operators of large and medium-sized aeroplanes, cabin crew and line management, including ground operations	**Air traffic control**	**Air operators of small aeroplanes and helicopters, including agricultural and adventure aviation**	**Aircraft maintenance and engineering**
2 - Competence of participants and the regulator					
2.1	**Non-legislative intervention** Provide information and guidance on fatigue management, and industry education to ▪ assist participants in finding and using resources that are relevant to the New Zealand context ▪ increase the capability of participants to develop fatigue management systems and CAA inspectors to assess them ▪ explain CAA's expectations in terms of managing human performance within an SMS	**Relevant to all sectors** Updated or new advisory circulars Education programmes Cross-agency resources and materials Learning from other industry initiatives Technical training for CAA staff			

Item number	Recommended interventions	What it means for each sector			
		Air operators of large and medium-sized aeroplanes, cabin crew and line management, including ground operations	**Air traffic control**	**Air operators of small aeroplanes and helicopters, including agricultural and adventure aviation**	**Aircraft maintenance and engineering**
3 – Low information environment					
3.1	**Non-legislative intervention** Support initiatives to improve the quality of incident reporting, and increase operator competency in identifying and responding to information indicating the presence of fatigue-related hazards.	**Relevant to all sectors** Updated or new advisory circulars Education programmes Sharing safety information with industry groups Technical training for CAA staff			

Item number	Recommended interventions	What it means for each sector			
		Air operators of large and medium-sized aeroplanes, cabin crew and line management, including ground operations	**Air traffic control**	**Air operators of small aeroplanes and helicopters, including agricultural and adventure aviation**	**Aircraft maintenance and engineering**
Other considerations					
4.1	**No legislative change** The current regulatory framework – Part 100 *Safety Management* and the Health & Safety at Work Act 2015 provide sufficient regulatory defences to mitigate against fatigue-related risk at the system level.	**Airline ground operations** Increased focus on the application of existing SMS processes targeted at fatigue hazards and associated risks.	N/A	**Part 137 Agricultural Aviation** Increased focus on the application of existing SMS processes targeted at fatigue hazards and associated risks.	**Part 145 Aircraft maintenance organisations** Increased focus on the application of existing SMS processes targeted at fatigue hazards and associated risks.
4.2	**Supported by non-legislative interventions** Reinforce the broad SMS requirements by initiatives to increase competence in the area of human factors, as well as an improved ability to respond to information indicating the presence of fatigue-related hazards. Provide information and guidance on fatigue management, and industry education. Support initiatives to increase the capability to monitor, report, and analyse fatigue-related occurrences.	Amend AC100-1 or create a Human Factors AC	N/A	Amend AC100-1 or others as appropriate, or create a Human Factors AC	Amend AC145-1 or AC100-1 or others as appropriate, or create a Human Factors AC

Conclusion

Fatigue is recognised as a major hazard because it affects people's ability to do their job safely. It's a big issue, so the CAA has been collaborating with the aviation industry to promote effective fatigue management through shared responsibility. We are now seeking your feedback on the conclusions of our review of current fatigue-related regulations and guidance material, to ensure they are relevant and fit for purpose.

Modern fatigue management approaches are applied on a spectrum, from compliance-based prescriptive limitations to fully-fledged, performance-based FRMS. In this review, the CAA has considered the full range of options as well as non-aviation regulation, such as health and safety at work legislation.

Fatigue is a complex issue that does not have simple solutions. The mix of issues we have identified suggests that a multi-pronged approach will be the most effective. We seek your feedback on options for:

- ***Legislative changes*** to update prescriptive flight and duty time limits and rest periods for flight crew; introduce prescriptive flight and duty time limits and rest periods for cabin crew; scheduling limits for air traffic controllers; and introduce performance-based standards for fatigue management, including an option for Fatigue Risk Management Systems (FRMS);
- ***Adopting non-legislative interventions*** such as providing information and guidance on fatigue management and industry education; and supporting initiatives to increase capabilities to monitor, report and analyse fatigue-related occurrences; and
- ***Relying on existing legislation***, including safety management systems (SMS) and Health and Safety and Work regulations, for agricultural aircraft operations, aircraft maintenance and airline ground operations.

Next steps

Feedback received in response to this discussion document will be carefully considered to help inform the CAA's regulatory policy for managing fatigue.

Should these include proposed rule amendments, a second project will be undertaken to develop and propose rule changes to the Minister of Transport. In that case, there will be further opportunity for you to comment on draft rules.

Attachment A – Feedback Form

The questions posed throughout the discussion document are collated below. This feedback form is also available as a separate document on our website at www.caa.govt.nz/fatigue. We are also interested in any views you may have that are not covered by these questions.

Please submit your response by **20th February 2017** to:

E-mail: consultation@caa.govt.nz

Post: Charlotte Webby, Policy Advisor
Civil Aviation Authority
PO Box 3555
Wellington 6140

Name: _____

Contact information: _____

_____

Organisation/business (if applicable): _____

Position (if applicable): _____

License held (if applicable)
(pilot, engineer, air traffic controller): _____

☐ Tick if you do not wish your details to be released. Please state the reasons why:

_____

_____

Introductory questions

1. What other issues or comments do you wish to raise regarding fatigue risk management in the New Zealand civil aviation system?

Regulatory design and approach

2. What changes, if any, do you think are necessary to the rules and the prescriptive flight and duty limitations and rest periods for flight crew?

3. Do you support the introduction of prescriptive limits for flight, duty, and rest periods for cabin crew?

4. Do you support the introduction of prescriptive scheduling limits for air traffic controllers?

5. What changes, if any, do you think are necessary to the schemes currently in AC119-2 to better reflect sector-specific needs?
6. What are your views on the relationship between SMS and fatigue risk management, and how do you think they could be integrated, if at all?
7. Do you believe that the introduction of a regulatory option for Fatigue Risk Management Systems would provide additional benefits to manage fatigue-related risks in New Zealand?
8. What would the potential impact of the suggested changes to the regulations be on your operations?
9. Are there any matters identified that you consider are not a problem? Why not?

Competence of participants and the regulator

10. What are your views on whether the proposals would assist with improving industry and regulator competence to manage fatigue?

Low-information environment

11. What are your views on whether initiatives to improve reporting and investigation will contribute to the improved management of fatigue?
12. What education and guidance initiatives would you suggest to increase the capability of participants to report and investigate fatigue-related contributors to safety events?

Other considerations

13. What are your views on whether the safety management system requirements of Part 100 and the Health and Safety at Work Act requirements are sufficient for managing fatigue in agricultural aviation, maintenance and ground control operations?

Selected Bibliography

Avers KB, SJ King, TE Nesthus, S Thomas, J Banks (2009) *Flight attendant fatigue, Part I: National duty, rest, and fatigue survey*. Report No. DOT/FAA/AM-09/24,. Washington, DC::Federal Aviation Administration, Office of Aerospace Medicine

Civil Aviation Authority of New Zealand (27 November 2015) *Part 135 Sector Risk profile 2015*. Report prepared by Navigatus. Available at https://www.caa.govt.nz/Safety_Reports/srp_part_135.pdf

Dawson D, K McCulloch (2005) "Managing fatigue: it's about sleep". *Sleep Medicine Reviews* 9 (5), 365–380

Fletcher A, B Hooper, I Dunican, K Kogi (2015) "Fatigue Management in Safety-Critical Operations". *Reviews of Human Factors and Ergonomics*, 2015, Vol.10(1), 6–28

Flight Safety Foundation (2005) "Fatigue risk management system helps ensure crew alertness, performance". *Flight Safety Digest* 26, 16–19

Gander PH (2001) "Fatigue management in air traffic control: the New Zealand approach". *Transportation Research Part F,* 4, 49–62

Gander PH (2015) "Evolving Regulatory Approaches for Managing Fatigue Risk in Transport Operations". *Reviews of Human Factors and Ergonomics*, 2015, Vol.10(1), 253–271

Gander PH (2015A) *Pilot Fatigue & Safety in General Aviation*. Presentation to the CAA and NZ Agricultural Aviation Association & NZ Helicopter Association (22 July 2015)

Gander PH, L Hartley, D Powell, P Cabond, E Hitchcock, A Mills, S Popking (2011) "Fatigue risk management: Organizational factors at the regulatory and industry/company level". *Accident Analysis and Prevention* 43, (2011), 573–590

Grech MR (2016) "Fatigue Risk Management: A Maritime Framework". *International Journal of Environmental Research and Public Health* 13, 175

Hobbs A, KB Avers, JJ Hiles (2011) Fatigue Risk Management in Aviation Maintenance: Current Best Practices and Potential Future Countermeasures. Report No. DOT/FAA/AM-11/10, Washington, DC: Federal Aviation Administration, Office of Aerospace Medicine

IATA (2015) *Cabin Operations Safety Best Practices Guide 2015*.

ICAO (2016, 2nd ed) Doc 9966 Manual for the Oversight of Fatigue Management Approaches

ICAO Working Paper (2015) Fatigue Risk Management Implementation. Paper presented by Turkey to the Second High-Level Safety Conference 2015 Planning for Global Aviation Safety Improvement. HLSC/15-WP/30

National Transportation Safety Board (May 2014) *Special Investigation Report on the Safety of Agricultural Aircraft Operations*. NTSB/SIR-14/01, PB2014-105983

Nesthus TE, DJ Schroeder, MM Connors, HK Rentmeister-Bryant, CW DeRoshia (2007) *Flight Attendant Fatigue.* Report No. DOT/FAA/AAM-07/21, Washington, DC: Federal Aviation Administration, Office of Aerospace Medicine.

Price JM (2005) "A Review of the Evidence Investigators Use in Determining Operator Fatigue". *Proceedings of the 2005 International Conference on Fatigue Management in Transportation Operations*, Seattle, WA, USA, September 11-15, 2005

Price JM, BG Coury (2015) “A Method for Applying Fatigue Science to Accident Investigation”. *Reviews of Human Factors and Ergonomics,* June 2015, Vol. 10, 79–114

Reason J (1997) Managing the Risks of Organizational Accidents. Ashgate Publishing Ltd.

Roma PG, MM Mallis, SR Hursh, AM Mead, TE Nesthus (2010) *Flight Attendant Fatigue Recommendation II: Flight Attendant Work/Rest Patterns, Alertness, and Performance Assessment*. Report No. DOT/FAA/AM-10/22, Washington, DC: Federal Aviation Administration, Office of Aerospace Medicine.

Signal L, D Ratieta, PH Gander (2006) *Fatigue Management in the New Zealand Aviation Industry*. ATSB Research and Analysis Report B2004/0048, April 2006

Van den Berg MJ, TL Signal, HM Mulrine, ATA Smith, PH Gander, W Serfontein (2015), “Monitoring and Managing Cabin Crew Sleep and Fatigue During an Ultra-Long Range Trip”. *Aerospace Medicine and Human Performance* Vol. 86, No. 8, August 2015.