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Policy review of WC10.3.2 Work and Rest Scheme

Presented by PLC

SUMMARY

IFATCA's Technical and Professional Manual (TPM) holds a number of policies regarding the work and rest scheme of Air Traffic Controllers (WC 10.3.2). The work and rest scheme has had various amendments up to 2015. However, these policies haven't been updated since then. PLC is tasked to review the current policies to assess whether they require updating.

1. INTRODUCTION

1.1. With the advent of ICAO Doc. 9966 and EU 2017/373 there is a clear responsibility being placed on organisations to explicitly and actively manage some of the factors which determine an Air Traffic Controller's mental and physical fitness. Such a factor, is fatigue.[1] It is widely recognised, that fatigue impairs a range of human performance abilities and can play a role in aviation-related accidents or incidents. Because the human body and brain work best when allowed to sleep undisturbed at night, fatigue is unavoidable in a 24/7 industry. Therefore, as fatigue cannot be eliminated, it must be managed.[2]

1.2. Fatigue management is of paramount importance for air traffic controllers. Due to the nature of their work, controllers often experience demanding schedules, extended working hours, and significant mental and cognitive demands, which can lead to fatigue. The consequences of fatigue in air traffic controllers can be severe, potentially resulting in reduced alertness, impaired decision-making, slower response times, and increased risk of errors.[3] [4] [5] [6] To mitigate these risks and ensure optimal performance, fatigue management strategies are implemented within air traffic control systems.

1.3. Fatigue management in air traffic control is a collaborative effort involving air traffic management organisations, controllers, and regulatory bodies. Fatigue management strategies that take into consideration work and rest periods, can alleviate the effects of fatigue, allowing air traffic controllers to perform their duties safely, ensuring the

[1] SKYbrary Aviation Safety. Fatigue. Available from: https://skybrary.aero/articles/fatigue [last accessed 04 January 2024]
[2] ICAO Doc 9966 – Fatigue management guide for ATC service providers Second Edition, Version 2 2020. Chapter 1.
[3] IFATCA, (2015), Fatigue Risk Management Systems. Sofia,Bulgaria. WP No.155
[4] IFATCA, (2009), Fatigue Management in Air Traffic Control. Dubrovnik, Croatia. WP No.162
[5] IFATCA, (1988), Fatigue in ATC. Rio De Janeiro, Brazil. WP No. L004
[6] IFATCA, (2013), Fatigue Risk Management Systems. Bali, Indonesia. WP No.159

continued safety of the aviation industry. EU 2017/373 recommends implementing the ICAO Manual 9966 Annex D guidelines for ATM rostering. However, these guidelines are only intended to guide ANSPs.

1.4. This paper aims to review and re-evaluate the current policies on the work and rest scheme that is included in IFATCA's Technical and Professional Manual (TPM) and analyse if all, or only some, are still valid or need to be updated.

2. DISCUSSION

2.1. IFATCA has policy for the work and rest of ATCOs which can be seen below.

> Rosters should be constructed following a simple pattern, with shifts of the same or very similar lengths and adequate breaks between shifts and shift cycles.
> The average time of operational duty and breaks should not exceed 32 hours per week.
> Each shift should not exceed 7 hours 30 minutes including breaks.
> A minimum rest period of 11 consecutive hours per day should be provided.
> The continuous operational duty for a controller should be 2 hours maximum and should be reduced to 90 minutes for controllers working with visual terminals and/or radar displays; after which a minimum 30 minutes break, away from the working environment should be given to controllers.
> At least one break of a minimum of 1 hour duration, on both day and afternoon shift, shall be given to controllers for the purpose of eating at regular times and to prevent gastrointestinal dysfunctions.
> Extra rest hours shall be provided when requested by a pregnant controller.
> By night the total operational duty time should not exceed 5 hours.
> Controllers shall not be held liable in the case of an accident or incident if the controller has previously registered a formal complaint of exaggerated working hours or lack of fatigue management and these have been determined to be a major contributing factor to the incident or accident.

IFATCA TPM – WC 10.3.2 Work and Rest Scheme

2.2. The intention of this paper is to break down the policy into individual elements and then discuss them in greater detail.

2.3. The first elements are the following

Rosters should be constructed following a simple pattern, with shifts of the same or very similar lengths and adequate breaks between shifts and shift cycles.

And,

The average time of operational duty and breaks should not exceed 32 hours per week.

2.4. Air traffic control is currently struggling with staffing shortages that frequently push the existing personnel beyond their limits, leading to pronounced symptoms of fatigue.[7] [8]

[7] IFATCA, (2023), ATC Staffing Shortages. Montego Bay, Jamaica. WP No.160

[8] CANSO/ICAO/IFATCA (2016) Fatigue Management Guide for Air Traffic Service Providers. First Edition. Ch.2. p.19, ch.3.1.p. 46, Ch. 4.1.4. p. 54

Therefore, it is of utmost importance to prioritise the physical and mental well-being of air traffic controllers. This entails rejecting any further proposal to increase the average operational duty and break time beyond 32 hours per week, in line with IFATCA's work and rest scheme.

2.5. Furthermore, EUROCONTROL research regarding managing shift work in European ATM, indicates a gradual decline in reaction times when the average operational duty and break time is 40 hours per week, either as five eight-hour workdays or four ten-hour workdays.[9] Moreover, the ICAO Manual for Professional Career for Air Traffic Controllers Guide, emphasises that operational hours and rest periods should not exceed thirty-two hours per week.[10]

2.6. Despite various guidelines[11] [12] suggesting the possibility of extending the average weekly operational duty time, it remains unequivocal that adhering to the 32-hour policy holds true significance and validity. Without any changes, this policy should remain in place.

Each shift should not exceed 7 hours 30 minutes including breaks.

2.7. As previously reported in the fatigue risk management IFATCA working paper[13], a person's ability to perform can be negatively impacted by fatigue in a variety of ways, including decreased situational awareness, diminished attention, impaired judgment, a higher risk of operational errors, a decline in accuracy and timing due to involuntary micro-sleeps, a subjective feeling of drowsiness or tiredness as your attention wanes, an overall decline in performance, cognitive functions, and ultimately decreased safety. [14] [15] [16] Several scientific studies[17] examining both eight-hour and twelve-hour shifts have revealed marginal negative effects associated with the twelve-hour shift system. Conversely, other research[18], has demonstrated a notable rise in fatigue and a decline in performance due to the elongation of the workday. Additionally, there is an escalation in the occurrence of accidents with extended working hours leading to health issues, and creating more pronounced disruptions in family life. The individual health and performance decreases with shift duration beyond eight hours. Considering the records of workplace accidents, the exponential increase in the probability of an

[9] EUROCONTROL.European organisation for the safety of air navigation. 2006. Managing Shiftwork in European ATM: Literature Review. Brussels. EUROCONTROL. 1st. ch.4.2. p.21

[10] ICAO (2001, March 26-20). Professional Career for Air Traffic Controllers Guide. Grepecas ATC/TF3 ATS Professional Career Task Force. Panama. Ch. 4.2.41. p. 14

[11] ICAO Doc 9966 – Fatigue management guide for ATC service providers Second Edition, Version 2 2020. Annex D.3. p. 184

[12] Civil Aviation Authority Official Record Series 9. (n.d.) (2021). CAA Decision to amend AMC and GM for UK Reg (EU) 2017/373 pursuant to Article 76(3) UK Reg (EU) 2018/1139 https://publicapps.caa.co.uk/docs/33/ORS9CAADecisionNo6.pdf [accessed 19 September 2023]

[13] IFATCA, (2013), Fatigue Risk Management Systems. Bali, Indonesia. WP No.159

[14] Prof. Dawson, D. & McCullough, K. (2004) 'Managing Fatigue as an Integral Part of a FRMS'.

[15] London Department for Transport (2010) Road safety research report no. 110, 'FRMS; a Review of the literature

[16] Gimbrere, P.F. (2011) 'The Controller, Science/based fatigue Mitigation'

[17] EUROCONTROL.European organisation for the safety of air navigation. 2006. Managing Shiftwork in European ATM: Literature Review. Brussels. EUROCONTROL. 1st. ch.4.3.p22.

[18] EUROCONTROL.European organisation for the safety of air navigation. 2006. Managing Shiftwork in European ATM: Literature Review. Brussels. EUROCONTROL. 1st. ch.4.3.p22.

accident after the eighth hour of work was demonstrated by Folkard (1997, Folkard et al., 2000)[19], Nachreiner et al. (2000)[20], and Akerstedt (1995)[21].

2.8. Helsegrave et al. (2000) conducted an investigation into the adaptation following a shift extension from eight to twelve hours within a nuclear power plant. Their findings indicate a notably greater decline in performance towards the end of a shift, heightened fatigue, and decreased vigilance. Employees also reported an increased occurrence of sleep disorders, gastrointestinal issues, and heart-related sensations. [22]

2.9. The elongation of working hours in various sectors is linked to heightened workload and stress levels. Research has demonstrated that extended shifts lead to heightened fatigue and an increased risk of incidents, reduced productivity, prolonged exposure to elevated stress levels, and potential exposure to other harmful conditions (such as radiation).[23]

2.10. A scientific study conducted by Knaupp, assumed that extending a shift to twelve hours leads to fatigue, more effort to fight attention and concentration problems at the end of the shift (risk of accidents), long-term health effects.[24]

2.11. In line with the above mentioned research, guidelines by EUROCONTROL[25] and ICAO [26] [27] recommend that the duration of the shifts should not exceed eight hours.

2.12. Nowadays, due to vast staffing shortages, air traffic controllers are being required to work mandatory overtime, and especially in some countries, overtime is at a historical level and increasing.[28] Many ANSPs force their ATCOs to work longer shifts, take shorter rest periods and other questionable practices. Unfortunately, many ATCOs are willing to accept an elongation of working hours in order to “condense” their working schedule and in exchange to shift reductions and a compressed shift schedule. As scientific research has proven and is mentioned above, those alleged short-term gains jeopardise the ATCO’s state of mental fitness by surpassing the scientifically accepted shift length and eventually lead to the decrease of health and performance levels. Such practices should be strongly discouraged, as they inevitably beget higher fatigue levels.

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[19] Folkard, S., Akerstedt, T., Macdonald, I., Tucker, P. & Spencer, M. (2000). Refinement of the three-process model of alertness to account for trends in accident risk. In: S. Homberger, P. Knauth, G. Costa, & S. Folkard (Eds.), Shiftwork in the 21st century. Challenge for research and practice. Frankfurt a. Main: Peter Lang.

[20] Nachreiner, F., Akkermann, S. & Haenecke, K. (2000). Fatal accident risk as a function of hours of work. In: S. Hornberger, P. Knauth, G. Costa & S. Folkard (Eds), Shiftwork in the 21st Century. Frankfurt a. Main: Lang, 19-24.

[21] Akerstedt, T. (1995). Work injuries and time of day - national data. Shiftwork International Newsletter 12(1) 2.

[22] Heslegrave, R.J., Reinsh, L., Beyers J. & Hall, G. (2000). Innovative Ansätze für längere Arbeitsschichten können Arbeitern zugute kommen. In: Z. Arb. Wiss. 2000 (NF 5), 318-323

[23] EUROCONTROL.European organisation for the safety of air navigation. 2006. Managing Shiftwork in European ATM: Literature Review. Brussels. EUROCONTROL. 1st. ch.4.3.p22.

[24] Knaupp (1983). Die Zwölf-Stunden-Schicht: Eine Literatur-Studie, Eschborn. Rationalisierungs-Kuratorium der Deutschen Wirtschaft.

[25] EUROCONTROL.European organisation for the safety of air navigation. 2006. Managing Shiftwork in European ATM: Literature Review. Brussels. EUROCONTROL. 1st. ch.4.3.p23.

[26] ICAO Eastern and Southern African (ESAF). 2016. Guidelines to reduce fatigue in operational environment. Available from: https://www.icao.int/ESAF/Documents/meetings/2016/Air%20Traffic%20Services%20System%20Capacity%202016/ATNSGuidelines%20to%20reduce%20fatigue%20in%20operational%20environment.pdf [accessed 14 August 2023]

[27] ICAO (2001, March 26-20). Professional Career for Air Traffic Controllers Guide. Grepecas ATC/TF3 ATS Professional Career Task Force. Panama. Ch. 4.2.2. p. 14

[28] FAA National Airspace System Safety Review Team’s (SRT’s) final report, released Nov. 15. Available from: https://www.faa.gov/NAS_safety_review_team_report.pdf [Last accessed: 06 January 2024]

2.13. The value of the use of a Fatigue Risk Management System (FRMS) to manage controller fatigue, should be highlighted. As the demand for working hours increases and the affordability of resting time decreases, ANSPs are strongly encouraged to adopt and use effective FRMS.

2.14. ICAO has defined a Fatigue Risk Management System (FRMS) as "a data-driven means of continuously monitoring and maintaining fatigue related safety risks, based upon scientific principles and knowledge as well as operational experience that aims to ensure relevant personnel are performing at adequate levels of alertness".[29] Extensive scientific research outlines the essential components that a truly effective FRMS should encompass.[30] Furthermore, ICAO offers guidance on the implementation and oversight of FRMS.[31]

2.15. An effective Fatigue Risk Management System (FRMS) should not merely be a "box-ticking exercise" where base rosters typically operate at the maximum permitted fatigue level. In such cases, additional hours may exceed "acceptable" limits, yet be deemed "safe" based on a basic assessment of prior sleep and management's acceptance of "residual" risk. In contrast, a robust FRMS presents an excellent opportunity to employ a dynamic tool integrated into an overarching fatigue management system. This system should ensure thorough assessments not only of "base" duty hours and rosters but also of any additional hours or shifts, with proper consideration and management of fatigue risk.[32]

2.16. As a result, ATCOs are advised against accepting additional hours aligned with the shift length recommended by IFATCA, particularly with the aim of achieving a shorter rostering period or other questionable short-term gains. This is especially pertinent in cases where an effective Fatigue Risk Management System (FRMS) is not implemented, as it could result in the manifestation of pronounced symptoms of fatigue.

2.17. The utilisation of IFATCA's policy, stipulating that each shift should not surpass 7 hours and 30 minutes, should persist as a beneficial measure for air traffic controllers. This policy is considered valid and favourable in their regard. To this policy should be added that, a safety risk assessment, considering the air traffic controllers fatigue, should be performed to verify any maximum hours that are exceeded beyond the recommended 7 hours and 30 minutes.

A minimum rest period of 11 consecutive hours per day should be provided.

2.18. EUROCONTROL's guideline on fatigue management within ATC rostering systems proposes a minimum of 11-hours rest following a duty period. This duration is calculated to encompass 8 hours of sleep and an additional 3 hours for commuting and meals, ensuring sufficient time for rest, sleep, meal preparation, and personal tasks. An alternative viable criterion could be: "not less than the duration of the duty period and under no circumstances less than 8 hours." [33] It is strongly advised not to deviate from this criterion, even if air traffic controllers express a preference for a shorter recovery period. The consideration of commuting, meals, and other factors is crucial to guarantee the availability of an uninterrupted 8-hour sleep window. According to ICAO research, if the average adult requires 7-8 hours of sleep per 24 hours, then

[29] ICAO Doc 9966 – Fatigue management guide for ATC service providers Second Edition, Version 2 2020. Glossary

[30] IFATCA, (2013), Fatigue Risk Management Systems. Bali, Indonesia. WP No.159

[31] ICAO Doc 9966 – Fatigue management guide for ATC service providers Second Edition, Version 2 2020. Annex 6, part III

[32] Shallies, S. (2011) 'The Controller, IFATCA on Fatigue', p. 10

[33] EUROCONTROL. (2023) Guidelines on fatigue management in ATC rostering systems. Brussels. Draft 1.0. Ch. 4.5. p.20

an ATCO who has had less than 21 hours sleep in the last 72 hours was probably experiencing the effects of a sleep debt.[34] Any motivation stemming from extra income or a compressed shift schedule aimed at providing an extended off-duty interval must not compromise the risk of increased fatigue.[35]

2.19. According to ICAO regulations, a minimum of 12 hours must separate the conclusion of one duty period from the commencement of the subsequent one.[36] This requirement mandates a continuous rest period of at least twelve hours between shifts.[37] ICAO's Eastern and Southern African (ESAF) region additionally suggests that the average rest period following a duty period should encompass 11 hours, allowing ample time for rest, sleep, meals, sleep preparation, and personal tasks. [38]

2.20. In alignment with the points mentioned above, this policy remains upheld and valid.

The continuous operational duty for a controller should be 2 hours maximum and should be reduced to 90 minutes for controllers working with visual terminals and/or radar displays; after which a minimum 30 minutes break, away from the working environment should be given to controllers.

2.21. As per ICAO Document 9966, no operational duty should extend beyond 2 hours without a break being taken either during that period or at its conclusion. These breaks should not be shorter than 30 minutes. Consideration must be given to scientific and operational factors, where the duration of time spent in the controlling position should be restricted based on the complexity of tasks and workload. Breaks should be designed to offer ample time away from work-related tasks, enabling individuals to return to work with a satisfactory level of performance. These breaks could be structured to allow opportunities for napping or sleeping if appropriate.[39]

2.22. Few studies have been designed to examine the impact of workload on fatigue or the potential interplay between workload and other fatigue-inducing factors, such as time-on-task, wakefulness duration, sleep deprivation, and time of day.[40] A study looking into fatigue ratings provided by air traffic controllers uncovered certain indications of interactive effects between self-rated workload and time-on-task concerning fatigue. When self-rated workload was minimal, fatigue ratings remained relatively stable during continuous work stretches of up to 4 hours.[41]

2.23. Conversely, high workload led to a rapid surge in fatigue after 2 hours of continuous work. These workload-related effects on fatigue became more pronounced after controllers had been awake for more than 12 hours. The time-of-day variation in fatigue ratings was also influenced by workload, being more marked at low and high levels of workload than at intermediate levels. Operationally, breaks during a duty period play a

[34] ICAO (2016) Fatigue Management Guide for Air Traffic Service Providers. First Edition. Ch. B6.1. p.127

[35] EUROCONTROL. (2023) Guidelines on fatigue management in ATC rostering systems. Brussels. Draft 1.0. Ch. 4.5. p.20

[36] ICAO Doc 9966 – Fatigue management guide for ATC service providers Second Edition, Version 2 2020. Annex D.3. p. 184

[37] ICAO (2001, March 26-20). Professional Career for Air Traffic Controllers Guide. Grepecas ATC/TF3 ATS Professional Career Task Force. Panama. Ch. 4.2.3. p. 14

[38] ICAO Eastern and Southern African (ESAF). 2016. Guidelines to reduce fatigue in operational environment. Available from: https://www.icao.int/ESAF/Documents/meetings/2016/Air%20Traffic%20Services%20System%20Capacity%202016/ATNSGuidelines%20to%20reduce%20fatigue%20in%20operational%20environment.pdf [accessed 14 August 2023]

[39] ICAO Doc 9966 – Fatigue management guide for ATC service providers Second Edition, Version 2 2020. Annex D3.2.

[40] ICAO (2016) Fatigue Management Guide for Air Traffic Service Providers. First Edition. Ch. 2.4. p.43

[41] Spencer, M.B., Rogers, A.S., Stone, B.M. (1997) A review of the current scheme for the regulation of air traffic controllers hours (SCRATCOH). Farnborough, England: Defense Evaluation and Research Agency

vital role in mitigating the decline in performance that occurs with extended time-on-task.[42]

2.24. ICAO Eastern and South African Office recommends that personnel engaged in providing air traffic control (ATC) service, particularly those working with visual terminals and/or surveillance displays, should not exceed 2 hours of continuous service. These intervals could be subject to periodic review or adjustment in cases where there is an observed increase in traffic load. Air Traffic Service Units (ATSUs) facing extended periods of low traffic may consider extending shift sessions to 3 hours.[43]

2.25. ICAO Manual for Professional Career for Air Traffic Controllers Guide proposes a similar guideline. It stipulates that operational controllers should not be working for more than two consecutive hours, with this duration being further reduced to 90 minutes for controllers operating within a surveillance environment. The specified operational time can be further adjusted based on the volume of traffic being managed.[44]

2.26. The most recent fatigue management guidelines from EUROCONTROL pertaining to ATC rostering systems suggest that personnel engaged in providing air traffic control (ATC) services, particularly those operating with visual terminals and/or surveillance displays, should not exceed 2 hours of continuous service. The intervals for breaks should be subject to periodic assessment or modification in response to increased traffic loads. In cases where Air Traffic Services Units (ATSUs) encounter prolonged periods of low traffic, shift sessions may be extended to 3 hours.[45]

2.27. For non-surveillance traffic services, such as Towers, the latest EUROCONTROL guidelines suggest that air traffic services shift sessions can extend up to 4 hours if the traffic and complexity levels are low. The specific definition of "low traffic and complexity" should be determined by local arrangements. It is recommended to develop a complexity index for defining the types of Units where the time spent in the controlling position can be extended and varied. This complexity index could be based on formulas such as the FAA ATC Complexity formula or equivalent.[46]

2.28. According to these EUROCONTROL latest guidelines, digital/remote towers should be considered as ATS Units performing surveillance services. In alignment with the recommendations above, the maximum recommended, by EUROCONTROL, duration for working in the controlling position of digital/remote towers, should not exceed 2 hours or 3 hours, depending on the context outlined earlier.[47]

2.29. It should be highlighted that air traffic controllers operating within digital/remote towers should be indeed classified as controllers engaged in a situation display. According to PANS-ATM, a situation display is an electronic display depicting the position and movement of aircraft and other information as required.[48] Consequently, they are

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[42] ICAO Doc 9966 – Fatigue management guide for ATC service providers Second Edition, Version 2 2020. Ch. 2-33

[43] ICAO Eastern and Southern African (ESAF). 2016. Guidelines to reduce fatigue in operational environment. Available from: https://www.icao.int/ESAF/Documents/meetings/2016/Air%20Traffic%20Services%20System%20Capacity%202016/ATNS-Guidelines%20to%20reduce%20fatigue%20in%20operational%20environment.pdf
[accessed 14 August 2023]

[44] ICAO (2001, March 26-20). Professional Career for Air Traffic Controllers Guide. Grepecas ATC/TF3 ATS Professional Career Task Force. Panama. Ch. 4.2.4. p. 14

[45] EUROCONTROL. (2023). Guidelines on fatigue management in ATC rostering systems. 1st ed. Brussels.p.18

[46] EUROCONTROL. (2023) Guidelines on fatigue management in ATC rostering systems. Brussels. Draft 1.0. Ch. 4.3. p.18

[47] EUROCONTROL. (2023) Guidelines on fatigue management in ATC rostering systems. Brussels. Draft 1.0. Ch. 4.3. p.18

[48] ICAO Doc 4444, PANS-ATM.

subject to the same potential risks and outcomes linked to fatigue as their counterparts working with surveillance systems.

2.30. All the guidelines mentioned above share a common principle: an operational controller, particularly in a surveillance-based environment, should not exceed 2 consecutive hours of continuous work. Furthermore, it is essential that the break interval should be a minimum of 30 minutes and should take place away from the working environment and away from work-related tasks.

2.31. It is clear that that variations exist among the guidelines, and therefore a discussion is currently in progress concerning whether air traffic controllers, particularly tower controllers handling minimal traffic volumes, might be permitted to surpass the stipulated 2 consecutive hours of continuous work in their operating positions.

2.32. According to IFATCA's TPM

> Single or Lone Person Operations (SPO/LPO) shall be avoided. The use of SPO/LPO should be strongly discouraged by MAs, both through ANSP and their regulator.
>
> If providers choose to operate SPO/LPO, they shall beat the responsibility for the resulting risk(s) to the system.
>
> If SPO/LPO occurs, appropriate measures shall be taken to ensure that the SPO/LPO situation changes to another manning scenario. Until such time, measures shall be taken to mitigate all impact of SPO/LPO, such as but not limited to: traffic regulation, work break provisions, and informing neighbouring ATC units. Procedures hall be in place to implement such measures in an efficient way, without increasing the workload of the ATCO.

IFATCA TPM – WC 10.1.6 Single/lone person operations

2.33. Regrettably, numerous Air Navigation Service Providers (ANSPs) do not adhere to this policy and compel air traffic controllers into single or lone-person operations. In some instances, proper measures regarding work breaks are not implemented. When compelled to work excessive hours without a break and operate in conditions without set break intervals, air traffic controllers are naturally more prone to experience signs of prolonged fatigue. And as mentioned earlier in this paper, fatigue is acknowledged as a hazard that predictably degrades various types of human performance, and can contribute to aviation accidents or incidents.

2.34. For example, on the 27th of April 2021, a Boeing 737-400 commenced a night take-off at Porto in good visibility without seeing a runway inspection vehicle heading in the opposite direction on the same runway. On querying sight of an opposite direction aircraft on a discrete frequency the driver was told to quickly vacate the runway. The aircraft became airborne 300 metres before reaching the vehicle and passed over and abeam it. Both vehicle and aircraft were following the controller's clearances. The detailed Investigation confirmed a controller error in a context of multiple systemic deficiencies in the delivery of runway operational safety at the airport. The on-duty controller had been working alone in the tower position, acting both as aerodrome

control and providing approach control service uninterruptedly, without any break, for about four hours when the event occurred.[49]

2.35. In this case, both policies on SPO/LPO and on providing simultaneous surveillance approach service and aerodrome control service were violated. In addition, one of the factors identified as contributing to the incident was the arrangement of air traffic services through combined tower and approach positions, overseen by a single controller without any supervision. This controller was engaged in uninterrupted, extended duty within a tedious and low-activity environment.

2.36. A situation characterised by low activity and minimal traffic load should never serve as an excuse for disregarding the necessary break period for an air traffic controller following 2 consecutive hours in their position. Instances of low workload may lack the required stimulation, potentially leading to feelings of monotony and boredom. Such conditions could uncover underlying physiological sleepiness, ultimately affecting performance adversely. Additionally, rather than inducing boredom, low workload situations might compel individuals to expend more effort to stay engaged, consequently increasing their workload.[50] Underload, though, can be equally unsafe. Underload has been largely ignored in favour of overload research in air traffic management. Studies have demonstrated that operational mistakes have also been documented in scenarios with low to moderate traffic complexity.[51]

2.37. The responsibility for aligning staffing levels with workload demands rests with management. The occurrence of Single-Person Operations (SPO) or Lone-Person Operations (LPO) should be avoided. Any adjustment necessitated by an ANSP due to staff shortages should only occur exceptionally and in response to unforeseen circumstances, while adhering to maximum duty periods without breaks. Utilising SPO/LPO solely as a means of making up for a staffing shortage—this should never be the case. In light of this, it is strongly recommended to devise a complexity index that categorises the units where time spent in the controlling position can be extended and adjusted. Nevertheless, even within units characterised by low traffic and complexity, such as non-surveillance traffic services (e.g., Towers), the maximum allowable time spent in the controlling position should not exceed 2 hours. It falls under the ANSP's and the regulators' jurisdiction to establish a clear procedure to ensure that the maximum duty periods are not surpassed.

2.38. Beyond the need of a 30-minute break, the strict enforcement of a specific ratio of duty period to break is not as crucial, as it significantly correlates with the length of service. For instance, in terms of fatigue prevention, a shift pattern involving 4 hours and 30 minutes of work, including 2 hours of sector time, followed by a 30-minute break, and then another 2 hours of sector time (resulting in an 80% work and 20% break ratio), is more effective than mandating a 25% break on an 11-hour shift. Various values can be established in alignment with different duty period lengths.[52]

2.39. This policy remains in effect, emphasising that a controller's continuous operational duty should not exceed a maximum of 2 hours, and this duration should be shortened to 90 minutes for controllers using a situation display (including in digital/remote

[49] Skybrary. (2021). B734 / Vehicle, Porto Portugal, 2021. Available from: https://skybrary.aero/accidents-and-incidents/b734-vehicle-porto-portugal-2021. [accessed 16 August 2023]

[50] ICAO Doc 9966 – Fatigue management guide for ATC service providers Second Edition, Version 2 2020. Ch. 2.4

[51] IFATCA, (2018), HF Considerations when Operating Multiple Operational Positions/Sectors. Accra, Ghana. WP No.162

[52] EUROCONTROL. (2023) Guidelines on fatigue management in ATC rostering systems. Brussels. Draft 1.0. Ch. 4.4. p.19

towers). Subsequently, a mandatory minimum 30-minute break away from the working environment should be allocated to controllers.

2.40. An addition to this policy is suggested, considering the aforementioned scientific research. Deviations from this policy shall only occur in exceptional circumstances and be accompanied by:

1. a written safety risk assessment that explicitly addresses, as a minimum, the risk of controller fatigue and the mitigation measures implemented; and

2. an investigation into the reasons why the maximum continuous operational duty limit was exceeded.

At least one break of a minimum of 1 hour duration, on both day and afternoon shift, shall be given to controllers for the purpose of eating at regular times and to prevent gastrointestinal dysfunctions.

2.41. Meals should align with the customary eating schedule of the employee. Working shifts can result in gastrointestinal disorders being experienced by shift workers.[53] Research has highlighted a notably higher occurrence of indigestion and peptic ulcers among rotating shift workers when compared to those on fixed day shifts. Although adhering to regular mealtimes might be more challenging for those on rotating shifts, it is still recommended to establish consistent eating habits whenever feasible to minimise the likelihood of indigestion or peptic ulcers.[54]

2.42. The ICAO Manual for Professional Career for Air Traffic Controllers Guide proposes that controllers allocate at least 1 hour for meals during morning and evening shifts, and 40 minutes in instances where shifts are less than 8 hours in duration.[55]

2.43. Given the paramount importance of upholding regular mealtimes, this policy remains valid.

Extra rest hours shall be provided when requested by a pregnant controller.

2.44. It has been proposed that differing work schedules, including rotating shifts and night shifts, might entail distinct risks for pregnant women. These risks include neuroendocrine changes resulting from sleep deprivation or disrupted circadian rhythms, potentially influencing foetal growth and the timing of parturition.[56]

2.45. A study conducted in 2014 among Japanese women revealed that those who worked over 40 hours per week faced a heightened risk of miscarriage and preterm labour. This risk increased with the number of hours worked, with the highest risk recorded during the first trimester.[57] Another study from Denmark in 2019, found that individuals working at least two night shifts per week might experience a greater risk of miscarriage (32 percent) compared to their daytime counterparts. This phenomenon is attributed

[53] EUROCONTROL.European organisation for the safety of air navigation. 2006. Managing Shiftwork in European ATM: Literature Review. Brussels. EUROCONTROL. 1st. 6.2.2. p.40, ch.4 p. 83.

[54] Chang W.P., Peng Y.X. (2021). Differences between fixed day shift workers and rotating shift workers in gastrointestinal problems: A systematic review and meta-analysis. Industrial health (online) Available from: **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8010167/** [accessed 12 August 2023].

[55] ICAO (2001, March 26-20). Professional Career for Air Traffic Controllers Guide. Grepecas ATC/TF3 ATS Professional Career Task Force. Panama. Ch. 4.2.5. p. 14

[56] Bonzini et al. Shift work and pregnancy outcomes: a systematic review with meta-analysis of currently available epidemiological studies. BJOG : an international journal of obstetrics and gynaecology. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3388382/. [accessed 12 August 2023].

[57] BMC Pregnancy Childbirth. 2014; 14: 245.Published online 2014 Jul 23. doi: 10.1186/1471-2393-14-245

to the body's circadian rhythm and the hormone melatonin, which plays a role in safeguarding the placenta.[58]

2.46. Additional research has indicated that maternal shift work during pregnancy could potentially lead to childhood overweight and insulin resistance, manifesting around the age of 7.[59]

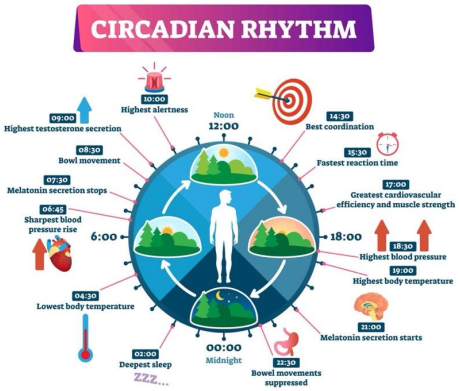
2.47. Though the NHS highlights the uncertainty surrounding whether shift work during pregnancy heightens the risk of preterm delivery or miscarriage, existing evidence suggests a slight increase in the risk of both preterm delivery and miscarriage. [60]

2.48. Moreover, it is not uncommon for pregnant women, particularly in the initial 12 weeks of pregnancy, to experience fatigue or even exhaustion due to hormonal shifts.

2.49. In light of these considerations, and to support pregnant air traffic controllers while mitigating the aforementioned risks, the provision of additional rest hours upon request by a pregnant controller is deemed necessary.

By night the total operational duty time should not exceed 5 hours.

2.50. All bodily functions seem naturally attuned to function optimally during the day and restore during the night. As seen in the image below[61], the circadian rhythm is our body's internal clock, the cyclical 24-hour period of human biological activity, that works to stimulate the human to do something at the appropriate time. The more activities planned out of phase with your circadian rhythm, the more effect the work will have on your physiological state; fatigue will arise earlier when performing duties outside of your personal circadian rhythm.[62]



Prescription Hope – What is circadian rhythm?[63]

[58] Begtrup LM, Specht IO, Hammer PEC, et al Night work and miscarriage: a Danish nationwide register-based cohort study Occupational and Environmental Medicine 2019;76:302-308)

[59] Liao C-W, Wei C-F, Chen M-H, Hsieh W-S, Lin C-C and Chen P-C (2022) Association between maternal shift work during pregnancy child overweight and metabolic outcomes in early childhood. *Front. Public Health* 10:1006332. doi: 10.3389/fpubh.2022.1006332

[60] Physical and shift work in pregnancy - NHS Health at Work. Available from: https://www.nhshealthatwork.co.uk/images/library/files/Clinical%20excellence/Pregnancy_info_shiftwork_A4.pdf [accessed 09 January 2024]

[61] Prescription Hope. (2023, April 26). *What is circadian rhythm? - disorders, symptoms, health effects*. Available from: https://prescriptionhope.com/blog-what-is-circadian-rhythm-disorders-symptoms-health-effects/ [accessed 07 December 2023)

[62] IFATCA, (2013), Fatigue Risk Management Systems. Bali, Indonesia. WP No.159

[63] Prescription Hope. (2023, April 26). *What is circadian rhythm? - disorders, symptoms, health effects*. Available from: https://prescriptionhope.com/blog-what-is-circadian-rhythm-disorders-symptoms-health-effects/ [accessed 07 December 2023)

2.51. The challenges encountered by shift workers arise from the body's need to adapt to alternative rhythms. Should this adaptation fail, the detrimental impacts of stress become evident in various manifestations.

2.52. Participating in a rotating shift system, particularly involving night shifts, essentially involves working in opposition to the body's internal clock, or circadian rhythm. This can result in a de-synchronisation of bodily functions. In scenarios where shift workers are required to work during the night, their activity levels tend to decrease.[64]

2.53. As a result of the body's circadian rhythm and the lower activation levels typically experienced during night time hours, employees' motivation and capacity to work during the night are inherently restricted. According to Folkard and Tucker[65], there is a notable decrease in efficiency and performance between the hours of 7 pm and 7 am, with the most significant decline observed between midnight and 6 am. This period also corresponds to when air traffic controllers frequently report heightened levels of fatigue, stress, and subsequently, performance and health-related issues.[66] Research on flight crews indicates that shift-lag syndrome, which is characterized by feelings of exhaustion, drowsiness, insomnia, disorientation, digestive problems, irritability, decreased mental agility, and decreased performance efficiency, is brought on by a protracted asynchrony between circadian rhythms and work requirements. [67]

2.54. The guidelines [68] concerning shift work, which address safety, health, and social considerations in shift work management, can also be applied in the context of productivity enhancement. For instance, recommendations such as minimising night work, capping shift lengths at eight hours, and considering how task interactions, break quality, and quantity can impact productivity, hold relevance.

2.55. According to the EU Working Time Directive[69] “Length of night work should not exceed an average of eight hours in any 24-hour period”.

2.56. The distribution of time spent in the controlling position relative to the overall shift duration differs between day shifts and night shifts. Due to the distinct conditions of night shifts, this ratio should be adjusted to greater value, leading to longer breaks. Moreover, even in scenarios where rostering schemes extend beyond 7hours 30minutes, which still should be strongly discouraged, the aggregate operational duty time should not surpass 5 hours.

2.57. In summary, it is of paramount importance to address the health risks associated with working night shifts. This policy, aimed at mitigating such risks, is valid and remains firmly in place.

Controllers shall not be held liable in the case of an accident or incident if the controller has previously registered a formal complaint of exaggerated working

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[64] Rutenfranz, J. & Knauth, P. (1976). Rhythmusphysiologie und Schichtarbeit. In: Institut für Gesellschaftspolitik in Wein (Hrsg.), Schicht- und Nachtarbeit. Wien, 7-35 (Mitteilungen des Instituts für Gesellschaftspolitik in Wien, H. 20)

[65] Folkard, S. & Tucker, P. (2003). Shiftwork, safety and productivity. Occupational Medicine, 53, 95-101

[66] Vogt, J. & Kastner, M. (2002). Tinnituserkrankungen bei Fluglotsen: Eine klinisch–arbeitspsychologische Studie. Zeitschrift für Arbeits– und Organisationspsychologie, 46(1), 35-44.

[67] SKYbrary Aviation Safety. Circadian rhythms (OGHFA bn). Available from: https://skybrary.aero/articles/circadian-rhythms-oghfa-bn [last accessed 09 January 2024]

[68] European organisation for the safety of air navigation. 2006. Managing Shiftwork in European ATM: Literature Review. Brussels. EUROCONTROL, p.69

[69] Directive 2003/88/EC of the European Parliament and of the Council of 4 November 2003 concerning certain aspects of the organisation of working time

hours or lack of fatigue management and these have been determined to be a major contributing factor to the incident or accident.

2.58. Examining the role of the management in fatigue, IFATCA has the following policy[70]

> Management has the prime role for providing fatigue management and prevention of fatigue related catastrophes. Any situation where increased fatigue, decreased sleep, or performance loss can be demonstrated, is a situation where the margin for error is reduced, albeit by some unknown amount, and should be avoided in ATC.

IFATCA TPM - MED 8.2.4. Fatigue in Traffic Control

2.59. When implementing (or expanding) a fatigue risk management system (FRMS) at ANSP level, it is the management's responsibility to develop a rostering scheme which will be suitable for the air traffic controllers to work on and to mitigate the risks of fatigue. Fatigue is a consequence of many factors of the working organisation and environment, such as working times, time of day, duty length, shift sequence, shift rotation and shift change, workload, stress, stability and predictability of rosters and resting time, number of breaks, and how working time is arranged over months (i.e. shift schedules).[71] Alternatively, ICAO also supports another method for managing fatigue, which is a prescriptive approach, that requires the Service Provider (ANSP) to comply with duty time limits defined by the State, while managing fatigue hazards using the Safety Management System (SMS) processes that are in place for managing safety hazards in general.[72]

2.60. Should management neglect the responsibility of addressing controllers' fatigue prevention needs, it is strongly advised that controllers take the initiative to formally register a relevant complaint. In instances where an accident or incident occurs, and factors such as extended working hours or inadequate fatigue management are identified as significant contributors to the event, especially if the controller had previously raised formal complaints about these issues and has addressed the relevant authority, whether this is the ANSP or the National Regulator/ CAA, or any other relevant authority, the controller should not be held accountable. It becomes the duty of the management to establish, implement, and oversee a policy for managing air traffic controllers' fatigue. Consequently, an accident or incident stemming from the failure to adhere to this policy should not result in any form of liability being attributed to the controller.

2.61. This policy is still in effect, and it might be amended to state that a formal complaint should be registered and addressed to the relevant authority. Furthermore, exaggerated working hours or lack of fatigue management, do not necessarily have to be determined as a major contributing factor to the incident or accident. Being these determined as a contributing factor alone, the controller should not be held liable, if a formal complaint has been previously registered to the relevant authority.

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[70] IFATCA. (2023). IFATCA Technical and Professional Manual (TPM). 2023 Ed.
Montréal, Canada: International Federation of Air Traffic Controllers' Associations. 8.2.4.p.158

[71] EUROCONTROL. (2023). Guidelines on fatigue management in ATC rostering systems. 1st ed. Brussels.p.6.

[72] ICAO Doc 9966 – Fatigue management guide for ATC service providers Second Edition, Version 2 2020, Annex 11 – Appendix 6, FRMS requirements

3. CONCLUSION

3.1. The Work and Rest Scheme section has been reviewed with the amendments suggested as outlined in the draft recommendations below.

3.2. There is no one-fits-all solution as every unit has its own specificities. However, all of them should address a balance between individual health and social life, productivity, safety, individual performance and efficiency.

3.3. The combination of inadequate staffing and increasingly congested airspace leads to a need for overtime work. The continued use of extended work hours and overtime in lieu of proper ATCO staffing will continue to be detrimental to the individuals involved and has the potential to decrease the margins of safety and redundancy built into the global air traffic control system.[73] Therefore, it is important that the work and rest policy is being followed and respected.

3.4. Air traffic controllers operating within digital/remote towers should be considered on par with controllers providing surveillance services and their management must adhere to the equivalent policy concerning work and rest.

3.5. In any case, it is of high importance that an effective fatigue strategy should be adopted and used by ANSPs to mitigate fatigue-related repercussions, as mandated by ICAO Annex 11.

4. DRAFT RECOMMENDATIONS

4.1. The recommendation is that the policy included in 10.3.2 of the Technical and Professional manual, is amended as follows.

IFATCA TPM (2023), WC 10.3.2. – WORK AND REST SCHEME

Proposal:

Each shift should not exceed 7 hours 30 minutes including breaks. A safety risk assessment, considering the air traffic controllers fatigue, should be performed to verify any maximum hours that are exceeded beyond the recommended 7 hours and 30 minutes.

4.2. The recommendation is that the policy included in 10.3.2 of the Technical and Professional manual, is amended as follows.

IFATCA TPM (2023), WC 10.3.2. – WORK AND REST SCHEME

Proposal:

Continuous operational duty for controllers should not exceed 2 hours. For controllers using a situation display (including in digital/remote towers), continuous operational duty should not exceed 90 minutes.

Deviations from this policy shall only occur in exceptional circumstances and be accompanied by:

1. a written safety risk assessment that explicitly addresses, as a minimum, the risk of controller fatigue and the mitigation measures implemented; and

[73] IFATCA, (2023), ATC Staffing Shortages. Montego Bay, Jamaica. WP No.160

2. an investigation into the reasons why the maximum continuous operational duty limit was exceeded.

Note: PANS-ATM

Situation display. *An electronic display depicting the position and movement of aircraft and other information as required.*

4.3. The recommendation is that the policy included in 10.3.2 of the Technical and Professional manual, is amended as follows.

IFATCA TPM (2023), WC 10.3.2. – WORK AND REST SCHEME

Proposal:

Controllers shall not be held liable in the case of an accident or incident if the controller has previously registered a formal complaint to the relevant authority of exaggerated working hours or lack of fatigue management and these have been determined to be a ~~major~~ contributing factor to the incident or accident.

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