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TECHNICAL COMMISSION

Agenda Item 24 Aviation Safety and Air Navigation Priority Initiatives

FATIGUE IN AVIATION MAINTENANCE ENVIRONMENT

(Presented by the United Arab Emirates)

EXECUTIVE SUMMARY

Fatigue has been recognized as one of the major contributing factors to incidents and accidents in aviation. A regional initiative led by the UAE General Civil Aviation Authority, with the support of Saudi Arabia and in collaboration with the ICAO MID Office, has confirmed fatigue as a key contributing factor in numerous reported maintenance related incidents.

This paper proposes the development of a global framework to address fatigue risk in maintenance environments through the introduction of ICAO provisions, guidance material, training programs, and oversight requirements. The proposal is aligned with ICAO Doc 9966 and builds upon successful regional best practices. This proposal directly supports Goals 1 and 4 of the ICAO Global Aviation Safety Plan by addressing fatigue as a systemic operational risk and fostering regional collaboration.

Recognizing the urgency of the issue and ICAO's resource constraints, the UAE expresses its willingness to contribute expertise, lessons learned, and institutional support to facilitate the early development of globally harmonized guidance.

Action: The Assembly is invited to:

a) explore the scope and feasibility of regulatory enhancements, including the potential development of provisions, based on global consultation and supporting evidence and report progress by the next session of the ICAO Assembly 43;
b) given the safety critical nature of maintenance fatigue, invite ICAO, with support from the UAE and other interested States, to develop dedicated guidance drawing on existing provisions and regional best practices;
c) encourage Member States to integrate fatigue risk considerations into their national safety oversight frameworks and maintenance regulations; and
d) support the establishment of fatigue management training requirements tailored to aviation maintenance environments.

Strategic Goals:	This working paper relates to *Every Flight is Safe and Secure* and *No Country Left Behind*
Financial implications:	This working paper has no financial implications

References:	Annex 6 — *Operation of Aircraft* Annex 19 – *Safety Management* Doc 9966, *Manual for the Oversight of Fatigue Management Approaches*

1. INTRODUCTION

1.1 Fatigue management is a core component of ICAO's proactive safety strategy, aligned with Goal 1 of the *Global Aviation Safety Plan* (GASP, Doc 10004), which aims to achieve a continuous reduction of operational safety risk. While fatigue risk management systems (FRMS) have been developed for flight and cabin crew, similar frameworks for maintenance personnel remain underdeveloped.

1.2 The UAE General Civil Aviation Authority, in collaboration with Saudi Arabia and the ICAO MID Regional Office, initiated a regional effort to investigate the role of fatigue in aviation maintenance incidents. This effort builds upon ICAO guidance found in the *Manual for the Oversight of Fatigue Management Approaches* (Doc 9966) and supports Goal 4 of the GASP, which encourages States to increase regional collaboration to enhance safety. It also aligns with the goals of the No Country Left Behind (NCLB) initiative.

2. DISCUSSION

2.1 Fatigue in aviation maintenance is an increasing concern, particularly during high pressure situations such as night shifts, aircraft on ground scenarios, or remote repair operations. These tasks often require rapid decision making under extended duty hours and disrupted sleep patterns, significantly heightening the risk of human error and compromising safety.

2.2 A detailed analysis was conducted using national and regional occurrence reporting systems, including voluntary and mandatory maintenance related safety reports collected between 2021 and 2024. The review revealed that fatigue was a contributing factor in over 25 per cent of reported human error incidents in maintenance activities, particularly during extended shifts and urgent AOG repairs. The dataset included more than 400 relevant reports across the MID Region.

2.3 During the study, the UAE identified a lack of globally recognized requirements and guidance for maintenance personnel, especially when compared to the more established fatigue risk management frameworks for flight operations.

2.4 In response, the UAE organized multiple national and regional workshops between 2023 and 2024 to raise industry awareness and build capacity on fatigue management in aviation maintenance, reaching over 350 participants from regulatory authorities, maintenance organizations, airlines, and training institutions. These workshops were conducted in collaboration with the ICAO MID Regional Office and regional partners. These collaborative activities reinforced the objectives of GASP Goal 4 by strengthening regional engagement and sharing of best practices among MID States.

2.5 To further address the issue, the UAE issued a Safety Decision aimed at mitigating and controlling the effects of fatigue.

2.6 Following the Safety Decision, the UAE presented a working paper on fatigue in aviation maintenance during the RASG-MID/12 meeting in 2025. The proposal received strong support from

participating States including but not limited to: Saudi Arabia, Oman, Bahrain, and Jordan, as well as international organizations such as International Air Transport Association (IATA) and International Federation of Air Line Pilots' Associations (IFALPA). In partnership with the ICAO MID Office and Saudi Arabia, the UAE also conducted a regional survey to assess the effectiveness of existing fatigue mitigation strategies and gather input on future regulatory improvements. The Appendix to this paper presents the survey's summary statistics.

3. RECOMMENDED ELEMENTS FOR GLOBAL ACTION

3.1 Given the clear safety risks, strong industry demand, and existing regulatory gaps-and mindful of ICAO's finite resources-the UAE is prepared to assist in the coordination and knowledge-sharing efforts required to develop global guidance on fatigue risk in aviation maintenance. This guidance should build upon existing provisions and materials, such as Doc 9966, while addressing the unique demands of maintenance work and incorporating best regional practices.

3.2 ICAO is encouraged to review Annex 8 — *Airworthiness of Aircraft* with a view to establishing new or revised provisions related to fatigue in maintenance environments.

3.3 Training is essential. ICAO is encouraged to develop training requirements covering fatigue physiology, risk recognition, and mitigation strategies. This could be supported through standardized training modules and global capacity-building initiatives.

3.4 States should be encouraged to integrate fatigue oversight into their regulatory systems by mandating fatigue reporting, collecting relevant operational data, and reviewing scheduling practices. These efforts would embed fatigue management into the broader framework of safety oversight responsibilities.

3.5 Finally, ICAO guidance should take into account special operational circumstances, such as Aircraft on Ground events, off-base repairs, or onboard maintenance duties, by providing tailored provisions for rest periods, duty limits, and fitness-for-duty requirements in these demanding scenarios.

4. CONCLUSION

4.1 Fatigue in aviation maintenance environments presents a growing and under addressed risk to aviation safety, and addressing it is essential to achieving Goal 1 of the GASP: the continuous reduction of operational safety risk.

4.2 ICAO is well-positioned to lead efforts in closing this regulatory and safety gap. By leveraging existing provisions in Doc 9966 and harmonizing Annex 8, the development of targeted guidance and Standards and Recommended Practices (SARPs) fatigue risk in maintenance can support States in enhancing regulatory oversight, assist industry in improving operational safety, and empower personnel to manage fatigue-related risks effectively.

4.3 Furthermore, special operational circumstances, such as aircraft on ground events or remote maintenance operations, must be adequately reflected in ICAO's global safety guidance. This initiative also exemplifies how States can work together at the regional level to advance safety, in alignment with Goal 4 of the GASP. Addressing fatigue comprehensively and inclusively will reinforce ICAO's No Country Left Behind initiative and contribute to enhanced safety performance across all regions.

4.4 In recognition of the strategic safety value of addressing fatigue and to mitigate any financial barrier to progress, the UAE is willing to collaborate closely with ICAO and regional partners by contributing technical expertise, capacity-building resources, and lessons from regional implementation efforts.

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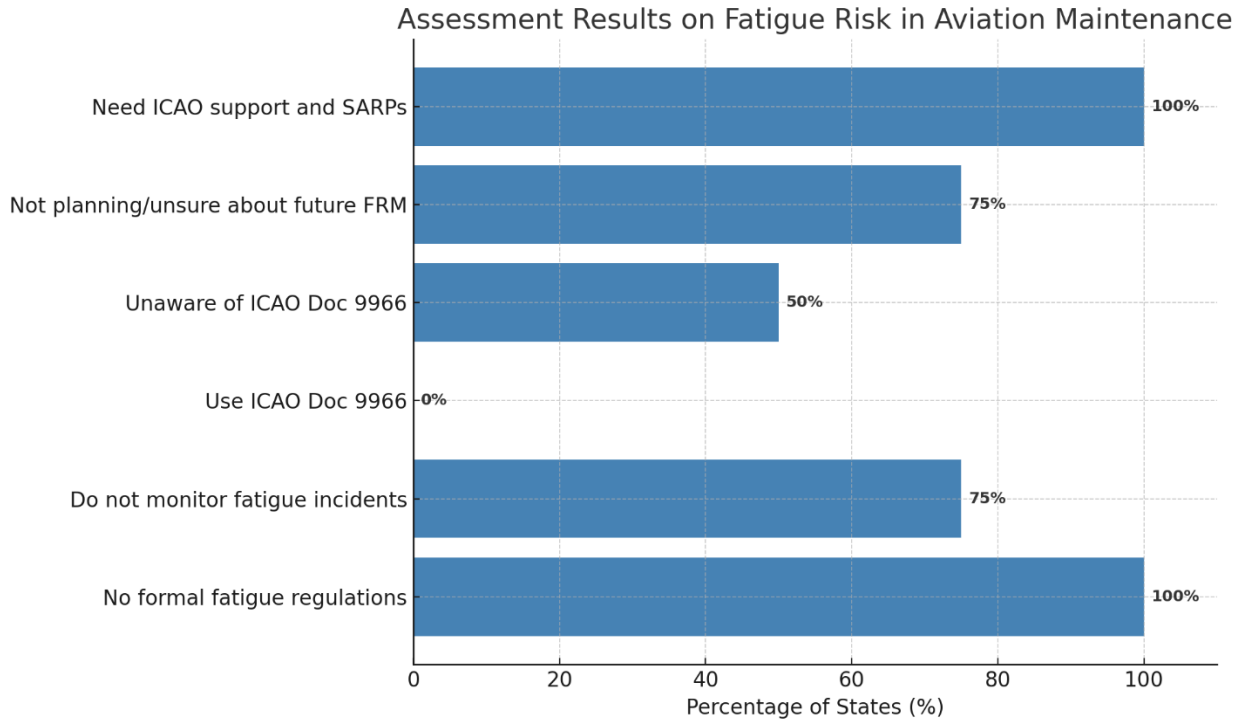
APPENDIX

An assessment of responses from ICAO MID States was conducted to evaluate current practices, challenges, and needs related to fatigue risk management in aviation maintenance environments.

1. Absence of national regulations
    a) 100 per cent of surveyed States lack formal regulations for managing fatigue in maintenance environments; and.
    b) main reasons included a lack of ICAO requirements, limited awareness, and resource constraints.
2. Weak occurrence monitoring
    a) 75 per cent of States do not monitor fatigue-related incidents or accidents; and
    b) where monitoring exists, it is informal and inconsistent.
3. Limited awareness of ICAO Doc 9966
    a) no State currently applies ICAO Doc 9966 in the maintenance context; and
    b) 50 per cent of respondents are unaware of the document.
4. Lack of future planning
    a) 75 per cent of States are either not planning or are uncertain about implementing fatigue risk measures in the future.
5. Need for ICAO support

5.1 All States expressed a need for:
    a) clear ICAO guidance / SARPs;
    b) training programs;
    c) support in developing fatigue risk systems; and
    d) better data tools for monitoring fatigue.



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