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Agenda Item 31: Aviation Safety and Air Navigation Standardization

MEDICAL STANDARDS FOR THE EVOLVING GLOBAL AIRCRAFT OPERATIONAL ENVIRONMENT

(Presented by the United States)

EXECUTIVE SUMMARY

The Federal Aviation Administration (FAA) is carefully considering what medical standards are necessary to ensure an acceptable level of public safety across the range of continuously changing aircraft operations, from full automation to direct human control. Acceptable medical risk in most commercial transport operations today is based on the presence of two pilots on board the aircraft. Advances in technology are changing the risk equation and challenging the applicability of current medical standards in all crewed scenarios, regardless of pilot location. It is important to consider what risk level is acceptable in this evolving system — a global system that must accommodate both legacy aircraft operations and operations dependent on rapidly advancing technologies. Pilot incapacitation will continue to pose a safety risk in the aerospace system, whether the pilot is located on the ground or at altitude. We must balance ensuring safety with the rights of individuals and the potential benefits of these emerging technologies.

Strategic Objectives:	This information paper relates to Strategic Objectives on Safety.
Financial implications:	This information paper has no significant financial implications.
References:	None

1. INTRODUCTION

1.1 This paper discusses risks, hazards, and questions that the FAA is considering regarding the medical standards necessary to ensure an acceptable level of public safety across the range of aircraft operations, from full automation to direct human control, today and into the future.

1.2 Both the rapid evolution of new technologies, and the demand to swiftly incorporate these new technologies into the existing complex aerospace system, require the FAA and other regulators to look at how we assess, analyse, and mitigate medical risk for the safety of operators (whether at altitude or not), passengers, and people on the ground.

1.3 In the current and future aerospace system, there are and will be wide ranges of technology, of automation, and of piloting. The fully integrated future system will include aircraft with either no on-board pilot, an optional on-board pilot, a monitored on-board pilot with automation backup, or legacy aircraft such as those flying today. What medical standards are necessary to improve safety in this system?

1.4 Thinking locally will not be sustainable in this future system. International harmonization of risk-based medical standards will be critical to ensuring global system safety.

1.5 Advances in medical treatments that improve health and prolong life are increasingly complex. It is easy to say “no”; it is challenging to know when one can safely say “yes.” Trained medical professionals will remain necessary as we consider the impacts that multiple or complicated treatments may have on the medical fitness of individuals in safety-critical positions in the system.

2. DISCUSSION

2.1 The safety and reliability of aircraft systems has steadily improved over the past century while the inherent reliability of humans in aircraft systems has not changed. As a result, human factors comprise a significant element of risk in today’s aviation systems. Risks and hazards that medical standards and certification processes help to mitigate include:

2.1.1 Human health risks (medical):

a) physical examination by a medical professional with specific training in aerospace medicine evaluates whether the pilot/operator meets (or will meet) medical standards at the time of the physical examination and for the duration of the certification period; and

b) the age and medical condition of the individual are key factors in medical risk—traditionally, the specific testing and frequency of evaluation are tailored accordingly.

2.1.2 Reliability of technology

2.1.3 System-level risk

2.1.4 Questions to drive development of future risk-based medical standards:

a) How should airman health data be captured to facilitate analysis? (Aeromedical analysis may include electronic health record, medical claims, and agency (regulator) data sets, among potential other data sources).

b) How do we evaluate aeromedical risk?

c) How do we determine an acceptable aeromedical risk threshold?

d) How do we calculate system level risk?

2.2 Reduced Crew & Single Pilot Operations for Commercial Transport

2.2.1 A first step may be the relaxation of certain rules during less-critical elements of flight (cruise).

2.2.2 A next step could allow single-pilot operations for the entire flight, which would represent a significant relaxation of traditional piloting rules.

2.2.3 Advanced autonomous systems would need to be in place to “fly the aircraft without a pilot being in command”, in case of human pilot incapacitation. Clearly, stringent safeguards are necessary to preclude a unauthorized takeover of aircraft operations.

2.2.4 Engineering risk associated with advanced autonomous systems will need to be mitigated by complementary certification standards.

2.3 Pilot Physiological Monitoring in Civil Aviation

2.3.1 Pilot monitoring may be used to detect incapacitation, fatigue, and areas of concern.

2.3.2 A pilot monitoring system can detect a pilot incapacitation event and engage the autopilot to reach a final or intermediate destination.

2.3.3 Potential regulatory concerns include the need to understand industry’s concepts of operations, whether monitoring is better isolated on pilot vs. coupled to autopilot, what technologies are likely coming next, and how to calculate system-level risk for conditional aeromedical certification with consideration given to aircraft technology.

2.3.4 A potential regulatory opportunity may be routine or periodic pilot monitoring between aeromedical examinations to serve as a basis for allowing a pilot to return to flying duties earlier than would otherwise be possible.

2.3.5 Use of monitoring systems changes how we consider pilot medical risk, but also introduces the need to consider engineering risk associated with monitoring system reliability.

2.4 Safety risks associated with remotely piloted aircraft stem from physiological/psychological, physical, and occupational hazards to operators, physical hazards to 3rd parties, and human factors for air traffic controllers.

2.4.1 Physiological/psychological hazards to remote pilots include many of the same individual hazards that traditional on-board pilots face, including: Psychological Fitness, Alcohol Consumption,

Medication Use, Illicit Drug Use, Diseases and Illnesses, Fatigue, Nutrition and Hydration, and Emotional Stress.

2.4.2 Operational hazards impacting both remote and on-board pilots include: Workload and Performance, Decision-Making and Judgement, Spatial Disorientation (visual), and Human-Machine Interface.

2.4.3 Remote pilot fatigue research is needed to understand the impacts of scheduling, duty time, shift work (and rotations), workload, and other Human Factors concerns to minimize risk, maximize safety, and improve operators' performance during remotely-piloted operations. Research questions with direct safety impacts include:

a) Are there different rates of fatigue accumulation in various remotely piloted aircraft operational environments?

b) Does operator fatigue differ from piloted operations?

c) Does automation improve or worsen operator fatigue? Does it introduce complacency?

d) What fatigue and performance tradeoffs come with different requirements?

2.4.4 Physical hazards for remote operators result from intimate contact with moving parts that can result in lacerations or other more severe bodily harm.

2.4.5 Occupational hazards to remote pilots include workstation-related and handheld control ergonomic issues. Control stations can be similar to office workstations, and user ergonomic injuries are also similar (e.g. repetitive motion disorders and carpal tunnel syndrome).

2.4.6 Fully autonomous and remotely piloted operations eliminate many medical, physiological, physical and occupational hazards present in operations with a pilot on board the aircraft; however, additional hazards may be introduced from system vulnerabilities. Neither fully autonomous nor remotely piloted operations prevent hazards to third parties among and over which these aircraft operate.

2.4.7 Physical hazards to third parties are similar to those faced by the remote operators themselves, and may be greater due to unfamiliarity with the hazard.

2.4.8 Human Factors issues for air traffic controllers associated with remotely piloted aircraft include visibility from the air traffic control tower, and especially the ability to visually detect remotely piloted aircraft of various types, sizes, and performance envelopes, all of which travel at different speeds along different flight paths and for various distances. Research seeks to identify impacts to:

a) controller workload and task flow from integration of remotely piloted aircraft into controlled airspace;

b) traffic flow management workload and task flow of remotely piloted operations in En Route and Terminal airspace; and

c) communication pathways and their effectiveness (particularly for one-to-many operations).

2.5 The applicability of current medical standards for safety-critical roles in the evolving aircraft operational environment are challenged, as are the traditional categories of safety-critical roles.

2.5.1 For onboard pilots – What is the impact of simplification or elimination of traditional aircraft control tasks?

2.5.2 As the role of the pilot evolves to a role of remote operator/monitor:

a) What is the safety threat of remote operator incapacitation or degraded performance?

b) How does the availability of other remote operators mitigate incapacitation risk?

2.5.3 For the medically monitored remote operator:

a) What are the monitoring and automated control performance requirements, for en route/cruise and in terminal operations?

2.6 Full integration of remotely piloted aircraft of all sizes into the global airspace system is more complicated because there are other participants and third parties to consider.

3. CONCLUSION

3.1 The Assembly and interested States are invited to consider areas of interest to the FAA in contemplating necessary medical standards for the evolving aircraft operational environment:

a) developing medical standards in response to advances in technology depends on what risk tolerance is acceptable;

b) pilot or operator incapacitation poses a safety risk to the global aerospace system, whether the human is on the ground or at altitude; and

c) today and in the future, the global aerospace system must safely accommodate legacy aircraft operations and operations developing with rapidly advancing technology.

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