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WORKING PAPER

FOURTEENTH AIR NAVIGATION CONFERENCE

Montréal, Canada, 26 August to 6 September 2024

Agenda Item 2: Timely and safe use of new technologies
2.1: Evolving aircraft technologies contributing to LTAG

FUTURE AERODROMES TO ACCOMMODATE NEW AIRCRAFT TECHNOLOGIES

(Presented by the Secretariat)

EXECUTIVE SUMMARY

The next generations of aircraft with new technologies are expected to enter into service in the foreseeable future to assist in achieving the Long-term Aspirational Goal (LTAG) of net zero emissions by 2050. The coexistence of aircraft powered by aviation kerosene, electricity and hydrogen and new aircraft with modified parameters such as a wider wingspan, will have an impact on aerodromes and may lead to operational and infrastructure changes.

ICAO and States need to coordinate and collaborate with the industry and other stakeholders to ensure aerodrome compatibility and to facilitate integration of these new aircraft technologies at aerodromes safely and in a timely and globally harmonized manner.

Action: The Conference is invited to agree to Recommendation 2.1/x – Future aerodrome infrastructure and operations to accommodate new aircraft technologies in paragraph 3.

Strategic Objectives:	This working paper relates to the Safety, Air Navigation Capacity and Efficiency, and Environmental Protection Strategic Objectives
Financial implications:	*Impact for the aviation community:* Proper airport planning and design with trained personnel and established operational procedures should bring significant benefits to the aviation community by facilitating effective entry of new aircraft technologies from day one. The financial implications for aerodrome operators, aircraft operators and ground handling service providers would be mainly associated with the varying levels of investment in infrastructure and training of personnel, as necessary. *Impact for ICAO (relative to the current Regular Programme Budget resource levels):* Additional resources are required to support ICAO initiatives to incorporate aircraft with new technologies such as use of new types of fuels, and aircraft with a wider wingspan, into aerodromes.
References:	Annex 14 — *Aerodromes*, Volume I – *Aerodrome Design and Operations* Doc 9137, *Airport Services Manual*, Part 1 – *Rescue and Fire Fighting*

	Doc 9184, *Airport Planning Manual*, Part I – *Master Planning* Doc 9774, *Manual on certification of Aerodrome* Doc 9977, *Manual on Civil Aviation Jet Fuel Supply* Doc 9981, *Procedures for Air Navigation Services (PANS) — Aerodromes* Doc 10121, *Manual on Ground Handling*

1. INTRODUCTION

1.1 The 39th Session of the ICAO Assembly (A39) recognized the importance of research and development in fuel efficiency and alternative fuels for aviation that will enable international air transport operations with a lower environmental impact, both in terms of local air quality and the global climate. The introduction of future aircraft powered by different fuel sources such as hydrogen and electricity will contribute to decarbonizing aviation, which will be critical to meeting the LTAG objectives.

1.2 The 41st Session of the ICAO Assembly (A41) requested the Council to continue to ensure all efforts to make further progress on aircraft technologies, operational improvements and sustainable aviation fuels be taken by Member States and reflected in their action plans to address CO_2 emissions from international aviation. Industry has been working on new aircraft technologies and propulsion types to enter into commercial service in civil aviation, in the foreseeable future.

1.3 Integration of new aircraft technologies may have an impact on various aspects of aviation disciplines, among which aerodrome compatibility is an essential element. Optimizing the use of the existing infrastructure and long-term infrastructure planning at aerodromes are fundamental to enable the integration of new aircraft technologies.

1.4 The ICAO Air Navigation World (ANW) held in Montréal from 28 to 31 August 2023, discussed the aerodrome and aircraft compatibility challenges and the need for aerodromes to facilitate the integration of aircraft powered by new or alternative fuels. The role of ICAO to ensure global standardization and the need for aerodrome-related provisions to accommodate the new aircraft were reiterated.

1.5 It is envisaged that by 2030, there will be coexistence of aircraft powered by new fuel sources such as electricity, hydrogen, along with aviation kerosene, including Sustainable Aviation Fuels (SAF). New types of aircraft with modified dimensions such as a wider wingspan are also emerging to enhance efficiency and to meet environmental requirements. The successful integration of these upcoming aircraft technologies would require a paradigm shift in aerodrome operations and infrastructure.

2. DISCUSSION

2.1 Every flight starts and ends at an aerodrome. The integration of new fuel sources and modified aircraft dimensions are expected to have a major impact on the existing aerodrome infrastructure and operational procedures. These impacts include areas such as:

a) airport master planning, which needs to take into account the integration of new fuel sources and aircraft with modified dimensions;

b) aerodrome capacity and operational procedures due to the coexisting operations of new and existing aircraft; and

c) training of aerodrome personnel; especially rescue and firefighting (RFF), aerodrome operations and ground handling personnel.

2.2 Based on the type of fuel source and extent of changes to aircraft dimensions, the safety and operational implications may vary at aerodromes and need to be treated differently as each one of them is unique.

2.3 **Sustainable Aviation Fuels (SAF)**

2.3.1 New generations of biofuels are currently being developed to address sustainability issues. SAF can reduce life cycle greenhouse gas (GHG) emissions dramatically compared to conventional jet fuel. Some emerging SAF pathways may even have a net-negative GHG footprint. Synthetic fuels under development avoid the intrinsic limitations of biomass. While there may be some initial challenges in the supply chain and into plane operations, all these SAF can be combined with conventional aviation fuels, and therefore have minimal expected impact on aerodrome infrastructure and operations.

2.4 **Hydrogen-powered aircraft**

2.4.1 Hydrogen may be used in commercial aircraft either for conversion to electricity in fuel cells, or for combustion in gas turbine engines. Hydrogen as on-board fuel or energy will allow for the complete elimination of CO_2 emissions in flight, and along the entire energy life cycle if produced from renewable sources. Hydrogen-powered aircraft emit no carbon dioxide and would reduce or eliminate other emissions while maintaining existing routes.

2.4.2 Interest in hydrogen-powered aircraft is currently high, but they present technical challenges, especially while handling them at aerodromes. The difference in fuel properties between kerosene and hydrogen such as boiling point, flammability limits, minimum ignition energy, burning velocity, buoyancy, self-ignition temperature and fire heat radiative fraction, will have a significant influence on the equipment and procedures used during an aircraft turnaround, particularly during refuelling, defueling, or maintenance.

2.4.3 Safety of into-plane fuelling procedures for hydrogen-powered aircraft along with other ground handling activities will require additional considerations. The aerodrome emergency plan and rescue and firefighting procedures need to be reviewed with the introduction of hydrogen as a new fuel. The storage and transportation of hydrogen at or near aircraft operational areas may require additional aerodrome infrastructure and introduce additional risks into the aerodrome environment. New fuelling and ground handling procedures may impact the aircraft turnaround times, which in turn would have implications on the aerodrome capacity.

2.5 **Electric aircraft**

2.5.1 Electric aircraft can bring benefits to regional aviation such as reduced emission, accessibility, profitability, etc. This will encourage aircraft operators to expand regional networks. The electric aircraft may facilitate additional route-network development at aerodromes that are currently challenged by noise and other infrastructure restrictions.

2.5.2 Notwithstanding the above, the availability of electricity at airports can be a challenge. This is due to limited grid capacity, infrastructure needed for storage of batteries and ability to generate electricity at the airport by using green energy initiatives such as solar panels. Another challenge related to infrastructure is the requirement for charging the aircraft at aircraft operational areas.

2.5.3 The aerodrome emergency plan and rescue and firefighting procedures need to be reviewed with the introduction of electric aircraft. The storage and transportation of batteries at or near aircraft operational areas may introduce additional risks into the aerodrome environment, requiring additional aerodrome infrastructure and safety precautions. The charging duration or battery replacement may impact aircraft turnaround times. This would have implications on the aerodrome capacity.

2.6 **Hybrid aircraft**

2.6.1 Hybridizing an aircraft has the potential to improve the overall efficiency of the propulsion system. Using electric motors to provide additional power during take-off and climb reduces the overall fuel consumption during these phases of flight, which are typically the most fuel-intensive.

2.6.2 Nevertheless, hybrid aircraft may pose significant challenges to aerodrome rescue and firefighting as the aircraft will have both kerosene and batteries. Additionally, ground handling procedures may impact aircraft turnaround times, which in turn would have implications on the aerodrome capacity.

2.7 **New types of aircraft with modified dimensions**

2.7.1 Evolution of aircraft wings has been an indispensable part of aircraft design for decades, reducing fuel consumption and increasing range for more efficient travel. In general, aircraft with a larger wingspan are more fuel efficient. However, aerodrome infrastructure could be a constraining factor due to the difficulty in modifying its layout to be compatible with the changing aircraft characteristics. In recent years new technologies such as folding wingtip have been deployed to ensure aerodrome compatibility. With the development of new aircraft design the challenge of aerodrome and aircraft compatibility will persist.

2.7.2 Although wingspan dimensions are not expected to change drastically in comparison with the current code F aircraft, certain types of aircraft such as code C/D aircraft may be modified with larger wingspans to gain efficiency. In this context, aerodromes initially designed for the mentioned aircraft types may encounter challenges in accommodating them with existing infrastructure and operational procedures. In addition, longer fuselage for certain aircraft for new fuels could bring challenges in respect of safe separation distances between runways, taxiways and aircraft parking areas. These aircraft may require larger apron and aircraft stand areas for their operations. Furthermore, new concepts of future fuel-efficient aircraft such as “blended wing body” (BWB), an unconventional configuration of aircraft, may bring new challenges to aerodromes.

3. **CONCLUSION**

3.1 New aircraft technologies, such as use of new fuels and modified aircraft dimensions, will have an impact on aerodrome infrastructure and operations. ICAO, States and industry need to work together to plan ahead for the safe and timely integration of these new technologies into aerodromes, to assist in achieving the LTAG.

3.2 In light of the foregoing, the Conference is invited to agree to the following recommendation:

Recommendation 2.1/x – Future aerodrome infrastructure and operations to accommodate new aircraft technologies

That States:

a) working with industry, assess the compatibility of existing aerodrome infrastructure and operational procedures with the upcoming new aircraft technologies and identify the changes that would be required to achieve full integration;

b) collect and share information with ICAO on the possible impact of new aircraft technologies on aerodrome infrastructure and operations; and

c) initiate planning for aerodrome infrastructure and operational changes, where necessary, to integrate new aircraft technologies;

that ICAO:

d) work with States and industry to analyse, identify and plan for global provisions, where necessary, to facilitate the safe and timely integration of new aircraft technologies at aerodromes.

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