



**WORKING PAPER**

**ASSEMBLY — 42ND SESSION**

**TECHNICAL COMMISSION**

**Agenda Item 24 : Aviation Safety and Air Navigation Priority Initiatives**

**DEVELOPMENT OF SARPs TO UTILIZE UNMANNED AIRCRAFT SYSTEMS FOR GROUND CHECK OF NAVIGATION AIDS**

(Presented by African Civil Aviation Commission on behalf of 54 African States<sup>2</sup>)

**EXECUTIVE SUMMARY**

This working paper proposes the integration of unmanned aircraft systems (UAS) for ground checks of navigational aids (NAVAIDs) as a supplementary method, with the potential to extend the periodicity of manned aircraft flight tests. This addresses challenges in maintaining timely NAVAIDs testing in developing States, which have led to Significant Safety Concerns (SSCs) during Universal Safety Oversight Audit Programme -Continuous Monitoring Approach (USOAP-CMA) audits. Developing Standards and Recommended Practices (SARPs) for UAS-based checks offers a cost-effective, reliable solution that reduces operational costs, lowers CO<sub>2</sub> emissions, and enhances overall aviation safety.

**Action:** The Assembly is invited to direct ICAO to expedite the development of Standards and Recommended Practices (SARPs) and guidance material for unmanned aircraft systems (UAS)-based navigational aid (NAVAID) testing.

<i>Strategic Goals:</i>	This working paper relates to the Strategic Goals <i>Every Flight is Safe and Secure; and Aviation is Environmentally Sustainable</i> .
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<i>Financial implications:</i>	Initial investment in UAS infrastructure and training.
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<i>References:</i>	Annex 10 — <i>Aeronautical Telecommunications, Volume I — Radio Navigation Aids</i> Annex 10 — <i>Aeronautical Telecommunications, Volume VI — Communication Systems and Procedures Relating to Remotely Piloted Aircraft Systems C2 Link</i> Annex 6 — <i>Operation of Aircraft, Part IV — International - Operations Remotely Piloted Aircraft Systems</i> Doc 8071, <i>Manual on Testing of Radio Navigation Aids, Volume I — Testing of Ground-based Radio Navigation Systems</i> Circ 317, <i>Effects of PANS-OPS Noise Abatement Departure Procedures on Noise and Gaseous Emissions</i>
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<sup>1</sup> English and French versions provided by AFCAC.

<sup>2</sup> Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cabo Verde, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Democratic Republic of the Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Togo, Tunisia, Uganda, United Republic of Tanzania, Zambia, Zimbabwe.

## 1. INTRODUCTION

1.1 In its 41st Session, the ICAO Assembly endorsed the updated Sixth Edition of the Global Air Navigation Plan (GANP), emphasizing the integration of new technologies and methodologies to enhance global air navigation efficiency and safety.

1.2 Navigational Aids (NAVAIDs), which are tried and tested legacy systems, continue to remain relevant and critical to ensuring the safety, reliability and efficiency of aircraft operations.

1.3 The periodic testing (commonly referred to as flight calibration) of these essential NAVAIDs, such as instrument landing systems (ILS), VHF Omnidirectional Range (VOR), and distance measuring equipment (DME), is fundamental to ensuring aviation safety. Currently, these tests are traditionally conducted using manned flight inspection aircraft at prescribed intervals of six months for ILS and twelve months for VOR and DME in accordance with the requirements in Annex 10 — *Aeronautical Telecommunications, Volume I — Radio Navigation Aids* and Doc 8071, *Manual on Testing of Radio Navigation Aids, Volume I — Testing of Ground-based Radio Navigation Systems*. Additionally, special testing is required when corrective maintenance work has been carried out after a failure of a NAVAID.

1.4 The frequency of periodic testing and special testing are resulting in significant operational costs and environmental concerns. This leads to inconsistencies in the periodic flight tests of NAVAIDs at aerodromes and along air traffic services routes, posing a threat to aircraft operations and a major concern for most developing States. This issue is highlighted by the Universal Safety Oversight Audit Programme – Continuous Monitoring Approach (USOAP – CMA) where Significant Safety Concerns (SSCs) have previously been identified during USOAP activities.

1.5 With advancements in unmanned aircraft systems (UAS) technology, there is an opportunity to integrate ground-based testing using UAS to complement traditional flight tests. Empirical studies have demonstrated the effectiveness of UAS use to enable more frequent testing while ensuring compliance with ICAO Standards and Recommended Practices (SARPs).

1.6 This working paper proposes the need for the development of SARPs to standardize the use of UAS for NAVAIDs ground checks and extending periodicity requirements once the correlation between UAS ground checks and flight test results is validated.

## 2. DISCUSSION

### 2.1 Current challenges

2.1.1 The cost of procuring flight calibration aircraft services is increasingly becoming exorbitant due to several factors, including aircraft and/or its availability, fuel, maintenance, and qualified personnel, among others. This is particularly affecting the ability of developing States and air navigation service providers to calibrate installed NAVAIDs in accordance with the requirements.

2.1.2 This financial burden is particularly challenging for developing States and air navigation service providers (ANSPs), as it affects their ability to calibrate installed NAVAIDs in compliance with regulatory requirements. The environmental impact of frequent flight inspections contributes significantly to aviation-related carbon emissions, undermining global efforts to combat climate change.

2.1.3 Limited availability of flight inspection aircraft often results in scheduling delays and operational inefficiencies. There are no SARPs or guidance material issued by ICAO on the use of UAS for the ground check of NAVAIDs.

2.1.4 A working paper on a similar topic was presented by China during the Fourteenth Air Navigation Conference (AN-Conf/14) as AN-Conf/14-WP/67. Among its recommendations, the paper urged the Conference to call on ICAO to accelerate the development of Standards and guidance material, in collaboration with relevant stakeholders, to support the implementation of UAS-based flight inspection. The outcome of the Conference's discussion on this matter is reflected in Doc 10209, *Report of the Fourteenth Air Navigation Conference (AN-Conf/14)* (blue cover) and Supplement No. 1 as follows: "2.23 With regard to the need for additional guidance on the use of UAS for flight inspection activities, the Conference noted the ongoing work and the suggestion to include other aerodrome inspection activities. The Conference agreed to provide the contents of the working paper to the appropriate expert groups for their consideration."

## 2.2 Proposed UAS-based testing framework

2.2.1 The integration of UAS for ground-based checks of NAVAIDs is proposed. UAS can be utilized to capture essential performance parameters such as signal strength, beam alignment and modulation, providing a reliable means of assessing NAVAID functionality. This will enhance the efficiency and cost-effectiveness of NAVAID flight calibration. A validation process is needed to correlate UAS-based check results with conventional flight calibration data.

2.2.2 The development of ICAO SARPs to define the methodology, equipment requirements, and operational procedures for UAS-based NAVAID ground checks is thus required. This would enable the extension of periodicity requirements for essential NAVAIDs (beyond the stipulated periods of six months or twelve months, depending on the type of NAVAID), where UAS tests consistently align with manned aircraft flight test results, as stipulated by Doc 8071, Volume I.

## 2.3 Benefits of UAS-based testing

2.3.1 Reduced operational costs by minimizing the frequency of expensive flight calibration activities. Improved testing efficiency with more frequent and flexible UAS-based inspections.

2.3.2 Enhanced environmental sustainability by reducing emissions associated with flight inspections. By reducing reliance on manned aircraft for routine NAVAID checks, the adoption of UAS supports more sustainable practices in line with the United Nations' Sustainable Development Goals (SDGs), particularly Goals 9 (Industry, Innovation, and Infrastructure) and 13 (Climate Action). There is need to ensure increased availability of calibration aircraft for States with limited resources, ensuring compliance with ICAO SARPs.

## 3. CONCLUSIONS

3.1 In response to the Assembly's call for the development of regulatory frameworks for the safe integration of UAS into controlled airspace, the use of UAS for ground check of NAVAIDs presents a significant opportunity to enhance aviation safety, reduce costs, and improve operational efficiency.

3.2 A standardized global framework for UAS-based NAVAIDs ground checks will ensure consistency, reliability, and regulatory compliance.

3.3 ICAO should lead the development of SARPs to formalize UAS ground check methodologies and extend periodicity requirements based on validated test correlations.

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