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AGENDA ITEM 7: AVIATION AND ENVIRONMENT

**PROACTIVE AVIATION NOISE MONITORING
FOR EMERGING URBAN DEVELOPMENT AREA
IN MACAO, CHINA**

(Presented by Macao, China)

INFORMATION PAPER

SUMMARY

This paper shares Macao, China's experience and strategic approaches in implementing proactive aviation noise monitoring for newly developed urban areas. It elaborates on the initiative's planning framework, underlying necessity, and technical methodologies, thereby demonstrating Macao, China's consistent commitment to adhering to and implementing ICAO standards and recommended practices.

PROACTIVE AVIATION NOISE MONITORING FOR IN EMERGING URBAN DEVELOPMENT AREA IN MACAO, CHINA

1. INTRODUCTION

1.1 ICAO Annex 16 Volume I sets forth Standards and Recommended Practices (SARPs) governing aviation environmental protection, and section III of this Annex prescribes recommended noise measurement protocols for monitoring applications, aiming to standardize measurement and surveillance methodologies worldwide.

1.2 ICAO Doc 9829 outlines the Organization's Balanced Approach to aircraft noise management, which comprises four core pillars: source noise reduction, land-use planning and administration, noise mitigation operational procedures, and operational limitations. Land-use planning and management serves as a key instrument to avoid incompatible construction in airport vicinities.

1.3 Zone A is a new residential area located near the inbound and outbound flight paths of Macau International Airport and in proximity to the Macau Heliport.

1.4 In compliance with the above ICAO regulatory frameworks, the Civil Aviation Authority of Macao, China (AACM) has launched a forward-looking baseline aviation noise measurement programme covering Zone A. This paper shares the planning, necessity, and technical methodology behind this initiative, demonstrating Macao's commitment to implementing ICAO standards and recommended practices.

2. DISCUSSION

Background

2.1 Macau International Airport constitutes core critical infrastructure under the Macao Special Administrative Region's economic ecosystem and sits in close proximity to the city centre. Since 2017, the Civil Aviation Authority of Macau (AACM) has maintained a network of permanent noise monitoring stations. This framework serves two key purposes: safeguarding harmonious coexistence between airport operations and community wellbeing, and evaluating the performance of aircraft noise mitigation measures.

2.2 In recent years, Zone A – a large-scale land reclamation scheme – has been developed to deliver new residential housing stock, alongside supporting public amenities including health centres, schools and community service facilities.

2.3 Ahead of locking in Zone A's formal designation for residential occupation, AACM conducted a Noise Exposure Forecast compatibility study in 2019, designed to measure how aircraft noise would affect the area's intended land-use function. The NEF metric integrates multiple variables: overflight duration, peak noise magnitudes, tonal signatures, and day/night aircraft movement volumes. The assessment concluded that noise exposure across Zone A falls beneath the NEF 25 threshold, an internationally recognised benchmark for noise-sensitive land uses such as residential housing, educational establishments and healthcare facilities. The NEF 25 standard aligns with best practices adopted across developed economies.

Objectives

2.4 With Zone A now partially occupied by residents – a significant share of housing units are inhabited, while most remaining planned residences are incomplete or unoccupied – AACM has launched a comprehensive aircraft noise baseline monitoring programme. This pre-emptive planning initiative addresses a suite of statutory and land-planning imperatives, detailed as follows:

1. Verification of NEF Modelling Outcomes

The monitoring campaign enables direct comparative analysis between field-measured noise data and the NEF predictive outputs generated during the original land-use planning stage. Although the initial NEF assessment confirmed residential compatibility, real-world operational parameters may have shifted in the intervening period, including flight track deviations, variable meteorological conditions and evolving aircraft fleet compositions. Cross-referencing modelled and empirical data preserves the accuracy and reliability of the noise forecasting model.

2. Development of a Scientific Baseline Noise Dataset

A continuous 30-day, 24-hour monitoring regime will be deployed to capture prevailing ambient noise levels and record individual aircraft overflight events. This creates a definitive time-zero reference dataset, underpinning long-term noise trend analysis and future post-implementation reviews of noise reduction measures.

3. Technical Support for Permanent Noise Monitoring Network Design

Insights gathered from the baseline survey will form the technical foundation for designing a network of fixed permanent noise monitoring stations throughout Zone A. Findings will inform strategic decisions on station placement, spatial layout and operational technical specifications, maximising data representativeness and overall monitoring efficiency.

2.5 Executing baseline noise measurements at this intermediate development stage represents a deliberate, forward-looking strategic measure.

Key Advantages

2.6 Under ICAO's Balanced Approach to aircraft noise management, land-use planning and oversight are identified as foundational tools to prevent conflicting urban development around airport boundaries. Conducting this baseline survey at this critical juncture – after the rollout of NEF-aligned land-use policies and amid partial residential settlement – delivers three distinct governance advantages that embed a preventive, forward-thinking regulatory approach:

1. Capture Authentic Real-World Ambient Acoustic Conditions

Partial residential occupancy and associated municipal activity generate a realistic ambient noise environment representative of everyday residential living. This ensures aircraft noise event detection thresholds accurately reflect lived community conditions – a critical advantage unavailable from readings taken on fully vacant sites or areas dominated by ongoing construction works.

2. Empirical Validation of Noise Forecasting Models

The monitoring exercise enables cross-verification of NEF noise projections against on-site measured data before the precinct reaches full residential occupancy. Any discrepancies between modelled noise exposure and real-world measurements can be identified at an early stage, in line with noise monitoring protocols specified in ICAO Annex 16 Volume I Part III.

3. Enable Pre-emptive Deployment of Noise Mitigation Solutions

By establishing a rigorous scientific baseline at this stage, authorities retain sufficient lead time to implement targeted noise abatement interventions prior to large-scale resident relocation. Potential remedial actions include acoustic retrofitting for unoccupied dwellings and revisions to aircraft operational procedures. This proactive approach avoids the far higher financial costs and public friction associated with retrofitting mitigation measures after

widespread resident noise complaints emerge.

2.7 This measurement framework shifts the regulatory focus from reactive resolution of community noise grievances to proactive stewardship of ambient environmental quality. It establishes a foundation for sustainable balance between aviation industry growth and urban residential development from the earliest phase of the district's residential occupancy cycle.

Deliverables

2.8 This undertaking embodies the Civil Aviation Authority of Macau (AACM)'s commitment to sustainable airport operations and forward-thinking environmental stewardship. Once the full measurement programme concludes, the project will yield the following concrete, evidence-based deliverables:

1. Thorough, open verification of the Noise Exposure Forecast (NEF) modelling outputs which formed the technical basis for Zone A's residential zoning clearance, confirming the soundness and dependability of the original land-use planning appraisal.
2. Holistic, data-backed insights into real-life aircraft noise conditions, faithfully mirroring the actual acoustic exposure encountered by residents within Zone A.
3. Substantial empirical data to inform the strategic rollout, placement and technical specifications of upcoming permanent noise monitoring infrastructure.
4. Clear, measurable noise reference benchmarks, supporting impartial, uniform appraisal of the effectiveness of any aircraft noise reduction interventions rolled out in subsequent years

2.9 Through this proactive and data-centric governance approach, AACM sets a robust benchmark for regulatory practice in the aviation sector. It demonstrates how systematic data collection and professional analytical mechanisms can facilitate harmonious and balanced development between aviation industry expansion and urban residential construction. Furthermore, this initiative advances the core vision of the DGCA/61 framework for a safer, greener, more sustainable and operationally efficient aviation ecosystem.

3. ACTION BY THE CONFERENCE

3.1 The Conference is invited to note the information contained in this Paper.

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