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Agenda Item 3: **Performance Framework for Regional Air Navigation Planning and Implementation**

3.4: **CNS**

FEASIBILITY STUDY AND TRIAL OF USING DRONE TO ENHANCE EFFICIENCY IN FLIGHT INSPECTIONS AT THE HONG KONG INTERNATIONAL AIRPORT

(Presented by Hong Kong, China)

SUMMARY

As drone technology rapidly progresses and gains prevalence, flight inspection service providers are actively conducting trials using drones to conduct flight inspections, with the goal of enhancing efficiency, reducing cost and fostering environmental sustainability. This paper presents the initiative from Hong Kong, China, supported by the Flight Inspection Center of Civil Aviation Administration of China, in exploring use of drone technology to carry out part of flight inspections at the Hong Kong International Airport.

1. INTRODUCTION

1.1 According to ICAO standards, radio navigation aids used by aircraft in international civil aviation must undergo periodic flight and ground inspections. Conventional manned flight inspections and ground inspections of navigational aids have inherent limitations. Manned flight inspections, despite extensive coordination with air traffic control (ATC) and airport operators beforehand, can still disrupt ATC and airport operations at times. Ground inspections are limited by the reach and height constraints of measuring antennas, impacting effectiveness of signal-in-space measurements.

1.2 The ICAO has encouraged States/Administrations to explore feasibility of leveraging innovative technologies to enhance safety and efficiency in providing air navigation services. Hong Kong, China has taken the lead in exploring feasibility of carrying out part of flight inspections at the Hong Kong International Airport (HKIA) using drones. In general, employing drones for flight inspections offers enhanced deployment efficiency, increased flexibility in flight maneuvers and environmental benefits. The measurement on signal-in-space using drone capable of vertical manipulation could be more accurate. This approach is also more cost effective, requiring less operational and maintenance efforts, crew resources, as well as reduced en-route and parking charges compared to traditional method.

1.3 The Flight Inspection Center of Civil Aviation Administration of China (CAAC FIC), being the flight inspection agent for the HKIA, is a highly competent organization in providing flight inspection services. Leveraging their knowledge and experience from intensive research, development efforts and trials, CAAC FIC has formulated technical specifications for drone flight inspection systems and presented them at the ICAO Navigation Systems Panel (NSP) meetings. During the ICAO fourteenth Air Navigation Conference (ANC/14), China shared its experience in trials and progress in standards development through a working paper, advocating the use of drones in flight inspections and calling for development of ICAO standards and guidance materials. The ANC/14 agreed to disseminate the contents of the working paper to relevant ICAO expert groups (e.g. NSP, Advanced Air Mobility Study Group, etc.) for their consideration.

2. DISCUSSION

2.1 Two trials were conducted at the HKIA in August 2023 and May 2024 with support of CAAC FIC. The first trial focused on Instrument Landing System (ILS) and Precision Approach Path Indicator (PAPI) lights, while the second trial focused on ILS and Doppler Very High Frequency Omnidirectional Range (DVOR) equipment.

2.2 In the first trial, a drone was employed to conduct part of the flight inspection along the North Runway of the HKIA for one Localizer (LOC) of ILS and one set of PAPI lights. Specific profiles were conducted for the drone to measure key parameters of the equipment, such as LOC alignment, structures, PAPI angles, etc. during the inspection.

2.3 The second trial aimed to further validate feasibility of utilizing drone to conduct flight inspection on one set of ILS, including Glide Path (GP) and LOC, at the North Runway of HKIA, and the inspection of the DVOR equipment at an outstation situated at an outlying island in Hong Kong. In comparison to the first trial, more flight profiles were conducted for the drone to measure ILS signal parameters, such as LOC alignment, GP angles, signal structures, symmetry and DVOR bearing error.

2.4 To ensure aviation and public safety, the law for drone activities in Hong Kong, namely the “Small Unmanned Aircraft Order”, was strictly adhered to during the trials. Notice to Airmen (NOTAM) were issued to avoid any aircraft or helicopters from flying near the designated flying zone by the drone. The drone operations were programmed with pre-defined flight route, aided by differential GPS to enhance position accuracy. The drone followed these pre-programmed routes steadily to conduct measurements, with real-time monitoring and visual line-of-sight maintained by the drone operator throughout the inspection process. Real-time measurements captured by the drone were accessible on-site through a remote monitoring system.

2.5 The trials showcased that utilizing drone for part of flight inspection on navigational aids is more efficient in deployment with increased flexibility in flight maneuvers, and reduced carbon emissions. In addition, during unpredictable weather conditions in the wet season of Hong Kong, drones demonstrated their versatility by quickly adapting to the limited time window and effectively executing the mission.

2.6 The inspection results obtained from the drone align closely with those obtained from traditional flight inspection aircraft. This indicates that drones have the capability to effectively perform flight inspection, providing high-quality and accurate data comparable with traditional flight inspection. During the flight inspection by drone, it is crucial to closely monitor the wind conditions along the flight paths and avoid performing inspection on windy days, because wind can impact flying stability of drone and subsequently accuracy of its measurements. During the trials, situations were encountered that the drone was influenced by unpredicted wind gusts. As a result, several re-checks were performed to ensure that the drone maintained its stability during the measurement.

2.7 Drawing on successful experience of the two trials, Hong Kong, China would continue to collaborate with the CAAC FIC and relevant stakeholders to conduct further studies on utilization of drone to carry flight inspection, complying with the relevant standards and requirements.

2.8 Hong Kong, China will also closely monitor the development of relevant ICAO standards and guidance materials to leverage the benefits offered by drones in conducting flight inspection with enhanced efficiency and flexibility.

3. ACTION BY THE MEETING

3.1 The Meeting is invited to:

a) note the initiative by Hong Kong, China in exploring use of drone technology to enhance efficiency and reduce carbon emissions in flight inspection;

b) encourage CAAs/ANSPs who have undertaken similar initiative to share their experience and lesson learnt; and

c) support the relevant ICAO expert groups to take forward development of relevant standards and guidance materials.

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