International Civil Aviation Organization

Twenty Eighth Meeting of the Communications/ Navigation and Surveillance Sub-group (CNS SG/28) of APANPIRG

Bangkok, Thailand, 01-05 July 2024

Agenda Item 6: Navigation

6.5 Other navigation related matters

FEASIBILITY STUDY AND TRIALS OF USING DRONE TO ENHANCE EFFICIENCY IN FLIGHT INSPECTION AT HONG KONG INTERNATIONAL AIRPORT

(Presented by Hong Kong, China)

SUMMARY

Following the successful completion of the first trial of flight inspection using drone at Hong Kong International Airport (HKIA) in August 2023, Hong Kong, China completed the second trial of flight inspection by drone at HKIA in May 2024. The trial, covering both the Instrument Landing System and Doppler Very High Frequency Omnidirectional Range, was successfully completed with promising outcomes. The paper aims to share experience of Hong Kong, China in conducting feasibility study and trials of using drone to enhance efficiency in flight inspection, and encourage States/Administrations to share relevant experience and lesson learnt.

1. INTRODUCTION

1.1 According to the ICAO standards, radio navigation aids available for use by aircraft engaged in international air navigation shall be subject to periodic flight and ground inspection. Conventional manned flight inspection and ground inspection on navigational aids have their respective limitations. For manned flight inspection, it normally requires day light operation. Despite substantial coordination among air traffic control, airport operator and flight inspection service provider are done in prior, disturbance to air traffic control and airport operations is sometimes unavoidable. For ground inspection, the reachable distance and height for measuring antenna has restrained effectiveness in ground measurement on signal-in-space.

1.2 The ICAO has encouraged States/Administrations to explore feasibility of making use of innovation and emerging technology, such as drone technology, to enhance efficiency in conduct of flight inspection for navigational aids.

1.3 In August 2023, Hong Kong Civil Aviation Department (HKCAD), with support of the Flight Inspection Center of Civil Aviation Administration of China (CAAC FIC), took an initiative in exploring feasibility of carrying out part of the flight inspection with the first trial of flight inspection

using drone successfully completed at the HKIA. Following the success of the first trial, HKCAD kept collaborating closely with the CAAC FIC on the study of flight inspection using drone. To further explore and assess the feasibility of drone flight inspection on different navigational aids, the second trial was conducted in Hong Kong in May 2024 for a total of three days, covering flight inspection profiles for both the Instrument Landing System (ILS) and Doppler Very High Frequency Omnidirectional Range (DVOR).

2. DISCUSSION

2.1 The first trial, which took place in August 2023, primarily focused on evaluating the use of drone to inspect the Localizer (LOC) signal of ILS and Precision Approach Path Indicator (PAPI) lights on the runway. The objective of the second trial was to further validate the 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. Additionally, the second trial also included 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 designed for the drone to measure ILS signal parameters, such as LOC alignment, GP angles, signal structures, symmetry and DVOR bearing error.

2.2 The trial employed a four-rotor drone equipped with a specially designed signal receiver. The drone was capable of flying for around 30 minutes up to a speed of 20 m/s for inspecting ILS and DVOR signals. To ensure safe operation, a Notice to Airmen (NOTAM) was 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 flying route below 1,000ft with the aids of differential GPS to enhance position accuracy. The drone followed the pre-programmed routes flying stably at around 5m/s to conduct measurements with real-time monitoring by the drone operator throughout the whole inspection process. Real-time measurements captured by the drone were accessible on-site through a remote monitoring system.

Fig. 1 – The four-rotor drone equipped with specially designed signal receiver for flight inspection trial

Fig. 2 – Drone to perform orbiting to measure DVOR bearing error

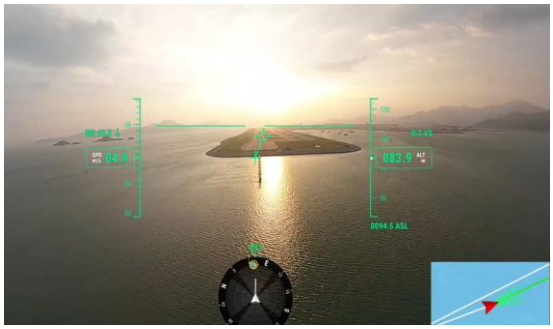

Fig. 3 – Drone performing low approach profile to inspect the ILS signal

Fig. 4 – Drone operator preparing for drone take-off near GP

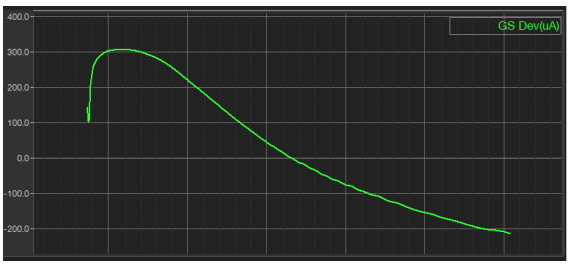

Fig. 5a – Measurement results of GP signals

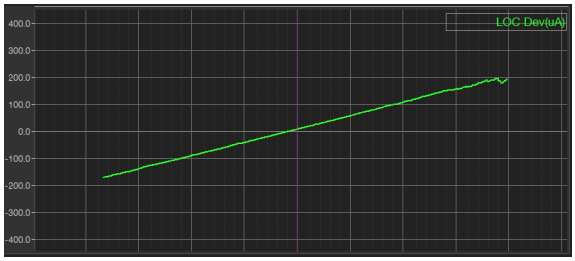

Fig. 5b – Measurement results of LOC signals

2.3 The trial demonstrated that utilizing drones for part of flight inspection on navigational aids is more efficient in deployment with greater flexibility in flight manipulation while achieving zero carbon emission. These advantages are particularly significant for HKIA as the flight inspection aircraft of CAAC FIC is based far from Hong Kong, with long deployment time. 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 conducting the inspection.

2.4 The inspection results obtained from the drone generally aligned with those obtained from traditional flight inspection aircraft. This indicates that drones have the capability to effectively perform flight inspection, providing data quality and accuracy 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 during windy days, as wind can affect flying stability of drone and subsequently accuracy of its measurements. During the trials, situations were encountered where the drone was influenced by unpredicted wind gusts. As a result, several re-checks were performed to ensure that the drone remained in stable flying state during the measurement.

2.5 Drawing on successful experience of the two trials, HKCAD will continue to collaborate with the CAAC FIC and relevant stakeholders to conduct further studies on utilization of drone to carry out part of the flight inspection, complying with the relevant standards and requirements. HKCAD will also closely monitor the development of relevant ICAO standards and guidelines to leverage the benefits of drones in conducting flight inspection with greater 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 minimize emissions in flight inspection, and conducting feasibility study and trials on carrying out part of flight inspection by drone;

b) encourage CAAs/ANSPs who have undertaken similar feasibility studies, trials and flight inspection using drone to share their experience and lesson learnt; and

c) discuss any relevant matters as appropriate.

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