International Civil Aviation Organization

Twenty Seventh Meeting of the Communications/ Navigation and Surveillance Sub-group (CNS SG/27) of APANPIRG

Bangkok, Thailand, 28 August – 01 September 2023

Agenda Item 6: Navigation

6.4 Other navigation related matters

MANAGING CHALLENGES OF IN-SITU REPLACEMENT FOR INSTRUMENT LANDING SYSTEMS AT THE WORLD'S BUSIEST CARGO AIRPORT

(Presented by Hong Kong, China)

SUMMARY

The Hong Kong International Airport (HKIA) has been the world's busiest cargo airport since its opening in 1998. To support safe and efficient landing of aircraft onto the HKIA under the dynamics in wind direction and speed causing changes in runway landing direction in the same day, operations of the Instrument Landing Systems (ILS) at all runway ends have to be maintained. Taking opportunity of Three Runway System Project at the HKIA, replacement of existing ILS has to be carried out in an in-situ manner for an operating runway. Risk assessment and mitigating measures were implemented to ensure new ILS installation, testing and flight check works would not affect existing ILS and runway operations.

1. INTRODUCTION

1.1 The HKIA was opened in 1998 and has since developed into an international aviation hub and the world's busiest cargo airport. Despite challenges of the global pandemic, the HKIA maintained to handle 4.4 and 5.0 million tonnes of cargo in 2020 and 2021 respectively. In 2022, the HKIA handled 4.2 million tonnes of cargo, continuing at number one position in cargo handling despite disruptions to global trade and supply chains that caused decrease in overall cargo volume globally.

1.2 Under the Three Runway System (3RS) Project at the HKIA, a new North Runway has been built with the original north runway renamed as the Centre Runway. After the new North Runway was launched for operational familiarization in July 2022, the Center Runway had been closed for re-configuration with target for opening in 2024 to support 3RS operations. Despite the existing ILS serving South Runway has been operating for some 25 years and maintaining in good conditions under an innovative proactive maintenance scheme implemented by the Hong Kong Civil Aviation Department (HKCAD), it is opportune to replace the ILS to ensure its sustainability for 3RS operations. The HKCAD thus commissioned a project to replace the ILS for South Runway.

1.3 With the dynamics in wind direction and speed causing changes in runway landing direction in the same day, it is of vital importance for the ILS at all runway ends to stand ready to support the HKIA's round-the-clock operations. However, this imposes great challenges to ILS replacement works. Considering the need to maintain ILS operations for both ends of South Runway, in-situ ILS replacement is the only feasible option, in which co-existence of existing and new ILS is required, i.e. existing ILS need to maintain operations while new ILS are being installed and tested.

2. DISCUSSION

2.1 Despite there is advantage in such in-situ replacement approach, challenges and risks were identified during risk assessment process in the project planning stage. Corresponding mitigation measures were derived and implemented to manage the risks for ensuring the replacement works would not affect existing ILS operations. The details are elaborated as follows.

Design Stage

2.2 Choosing locations of new ILS equipment and corresponding civil provisions was constrained due to limited space on an operating runway with existing ILS equipment. New metallic ILS structures may potentially affect existing ILS signals and runway approach lights, and vice versa.

2.3 To ensure design of new and existing ILS are fully compatible with each other, specialized computer modelling studies and simulations were carried out to ensure –

a) new and existing ILS would not interfere with each other affecting the respective signal-in-space performances in compliance with ICAO requirements; and

b) new ILS structures would not unduly block visual view from pilot on existing runway approach lights.

2.4 Flight checks mentioned in paragraph 2.7 were conducted to verify the computer modelling and simulation outcomes.

Implementation Stage

2.5 Works inside the runway strip of an operating runway was identified as high risk. Nearby civil works, such as drilling, excavation, concrete pouring and soil backfilling, might impose potential risks in affecting existing ILS operations. On the other hand, construction of new ducts to underground Glide Path buildings might induce water seepage issues.

2.6 In addition, limited runway closure periods, i.e. two nights per week (approximately 12 hours per week) for South Runway, were available for civil works and equipment installation, resulting in long implementation period causing difficulties in human resource deployment, not to mention impacts of adverse weather having further affected implementation works during runway closure. To cope with these challenges, the following mitigation measures were implemented –

a) close monitoring on existing ILS performance during civil works and new equipment installation;

b) setting monitoring check points on existing ILS structures to ensure there is no intolerable vibration, settlement and tilting during civil works affecting existing ILS operations;

c) monitoring potential water seepage issues during adverse weather with frequent site inspections;

d) project scheduling and human resource planning in collaboration with airport operator, air traffic control and ILS contractor to maximize use of limited runway closure periods for the project works;

e) arranging works with low risks in causing impacts to existing ILS and runway operations during runway operating periods;

f) depending on runway landing direction, works were flexibly arranged on the non-operating side of equipment buildings to avoid impacts on existing ILS and runway operations; and

g) arranging off-site ILS structure mockup (e.g. Glide Path mast) prior to site works, so that the contractor staff could get familiar with the assembly/installation procedures, before they start working inside the runway strip.

Testing Stage

2.7 At least three rounds of flight checks were arranged to verify full compliance with the ICAO requirements and full compatibility between existing and new ILS –

a) Right after erecting the new ILS antennae and associated structures:
   (i) flight check on existing ILS to verify signal-in-space; and
   (ii) flight check on existing runway approach lights to verify they are not unduly blocked by new ILS structures

b) After full installation and site acceptance tests of new ILS, flight check on new ILS, with existing ILS in place, to verify signal-in-space

c) After dismantling of existing ILS, flight check on new ILS to verify signal-in-space

2.8 As of today, flight checks as per paragraph 2.7 (a) and (b) above have been completed in March and June 2023 respectively with satisfactory results. For paragraph 2.7 (c), the new ILS have passed acceptance tests and are pending for final flight check after dismantling of existing ILS targeted for November 2023 before putting into operation.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note Hong Kong, China's experience in managing risks and challenges of in-situ ILS replacement while keeping existing ILS operations to support HKIA's round-the-clock operations as an international aviation hub and world's busiest cargo airport;

b) encourage CAAs/ANSPs who have undertaken similar in-situ ILS replacement works to share their experience and risk mitigating measures; and

c) discuss any relevant matters as appropriate.

– – – – – – – – – – – –