International Civil Aviation Organization

ELEVENTH MEETING OF THE SURVEILLANCE IMPLEMENTATION COORDINATION GROUP (SURICG/11)

Bangkok, Thailand, 25 – 27 March 2026

Agenda Item 8: Update on surveillance activities and explore potential cooperation opportunity

A METHOD FOR AZIMUTH AND RANGE MONITORING AND CALIBRATION OF SECONDARY SURVEILLANCE RADAR SYSTEM

(Presented by China)

SUMMARY

This paper introduce an SSR azimuth and range monitoring and calibration method, to standardize relevant work and ensure the accuracy and reliability of SSR for civil aviation ATM.

1. INTRODUCTION

1.1 During the operation of a Secondary Surveillance Radar (SSR), parameter drift deviating from the initial calibration values and cumulative increase of measurement errors may occur due to equipment aging, environmental changes and other factors. To ensure the measurement accuracy and operational reliability of SSR, CAAC has researched and formulated the Technical Guidance Material for Azimuth and Range Monitoring and Calibration of Secondary Surveillance Radar Systems in the Civil Aviation ATM System.

2. DISCUSSION

2.1 The ATM automation system keep the deviation of the combined track within a reasonable range through bias adjustment in the fusion algorithm. However, excessive angular deviation of the SSR or changes in deviation, will affect the aircraft's position calculated by the ATM automation system and other related systems.

2.2 In accordance with ICAO ANNEX 10 Volume IV, ICAO Doc 9924 and ICAO Doc 9684, the systematic measurement error of SSR angle measurement shall be less than 0.022° , and the random measurement error of angle measurement shall be less than 0.068° . The systematic measurement error of SSR range measurement shall be less than 1/128 nautical mile (approximately 14 meters); the random measurement error of range measurement for Mode A/C SSR shall be less than 30 meters, and that for Mode S SSR shall be less than 15 meters.

2.3 To ensure the quality of radar signals, CAAC has proposed a method for radar azimuth and range monitoring.

2.4 Monitoring Methods

a) A test transponder should be set up within an SSR. The test transponder antenna shall be in line-of-sight (LOS) with the radar antenna, with a straight-line distance of no less

than 1 kilometer. Global Navigation Satellite System (GNSS) equipment shall be used to measure the GNSS coordinates of the installation positions of the SSR antenna and the test transponder antenna respectively, and the actual azimuth and range of the test transponder relative to the SSR antenna shall be calculated as the reference values for calibration.

b) The built-in functions of the radar monitoring system or manual calculation shall be used on a regular basis to calculate and record the average values of the azimuth and range of the test transponder track measured by the SSR within 50 antenna scanning cycles. The values shall be compared with the historical average values. If the azimuth deviation exceeds 0.1° or the range deviation exceeds 15 meters, the azimuth and range of the SSR shall be re-calibrated.

c) A quantitative analysis of the deviation between the single-radar track and the fused track at typical positions (target altitude greater than 6000 meters, distance from the radar station greater than 150 kilometers) shall be conducted monthly through the ATM automation system and recorded. If there is a significant difference from the previous measured deviation, the causes shall be analyzed in a timely manner, and the azimuth and range of the SSR shall be re-calibrated when necessary.

2.5 Calibration Methods

a) Flight inspection shall be conducted to calibrate the accuracy and performance of the SSR prior to its commissioning; in addition, it shall be carried out after the radar undergoes major maintenance, renovation, or upgrading.

b) The SSR shall be subject to regular azimuth and range calibration. The calibration cycle shall be determined according to the equipment performance, operating environment and service conditions. In principle, the SSR shall undergo azimuth and range calibration at least once every six months. After maintenance or replacement of the mechanical structure parts such as the antenna encoder, hinge or antenna pedestal, or after encountering extreme conditions such as strong wind or earthquake, the azimuth and range of the SSR shall be re-calibrated.

c) Use the built-in functions of the radar monitoring system or manual calculation to calculate and record the average values of the azimuth and range of the test transponder track measured by the SSR within 50 antenna scanning cycles, obtain the deviation between the azimuth and range of the test transponder measured by the SSR and the reference values, and implement the correction on the SSR.

d) Repeat the above steps after switching the primary channel and azimuth encoder of the SSR system respectively.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matter as appropriate

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