International Civil Aviation Organization

THE SIXTH MEETING OF THE ASIA/PACIFIC GBAS/SBAS IMPLEMENTATION TASK FORCE (GBAS/SBAS ITF/6)

(Bangkok, 7- 9 May 2024)

Agenda Item 3: Updates from States/Administrations about GBAS/SBAS Implementation

GBAS status update and further operational experiences

(Presented by Ritesh Kapoor of Australia)

SUMMARY

This paper presents an update on Australia's GBAS status, information on in-service observations and an update on the number of GLS capable aircraft operating into Australian airports.

1. INTRODUCTION

1.1 Australia continues to operate two Honeywell SLS-4000 GBAS systems, at Sydney and Melbourne airports, supporting Category I GBAS Landing System (GLS) approaches to all runway ends (six (6) at Sydney and four (4) at Melbourne) and mirror straight-in approaches.

1.2 The GBAS Maximum Use Distance (Dmax) is set to 50 NM at both airports. Between 23 NM and 50 NM from the GBAS site, the GBAS information is advisory only.

1.3 GBAS Landing System (GLS) continues to be the expected approach method for capable aircraft flying into Sydney or Melbourne. Generally, the GLS approach is seen as a more stable approach to fly from a pilot perspective.

1.4 This Information Paper complements WP/05 presented by Australia at GBAS/SBAS ITF/5 and provides further information on Australia's experience.

2. OPERATIONAL EXPERIENCES

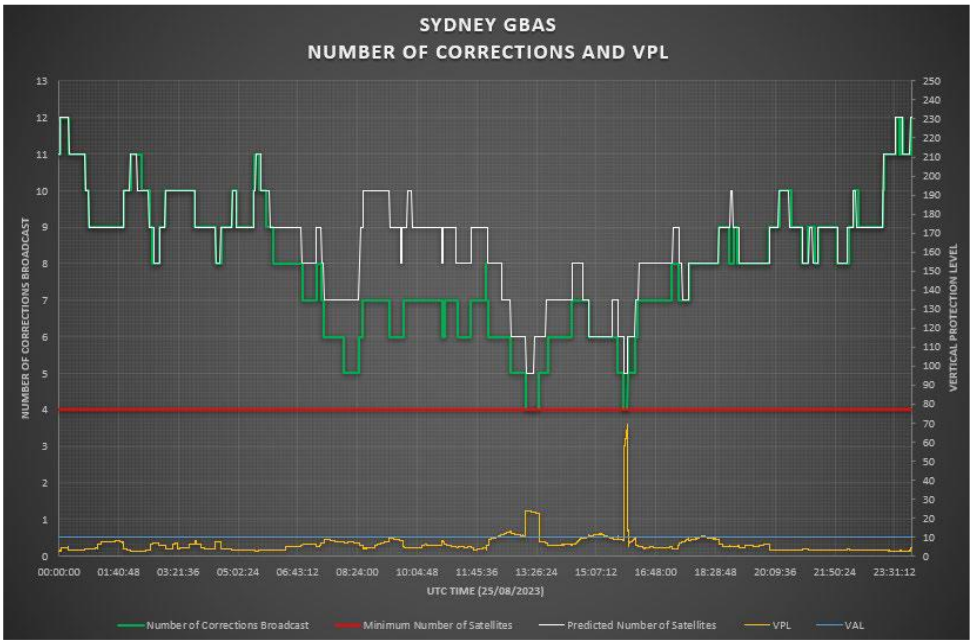
2.1 Australia continues to experience incidences of a reduction in GLS Service Availability due the prevailing Global Positioning System (GPS) satellite constellation in combination with the use of the Conterminous United States (CONUS) Ionosphere Threat Model. Furthermore, Australia continues to experience incidences of lightning induced damage to the GBAS equipment. These two factors have the largest impact on the availability of the GBAS in Australia, however, Availability requirements have continued to be met. Australia is exploring options to implement an

Australian specific Ionosphere Threat Model to enhance GBAS Availability and options to reduce the impact of lightning strikes.

2.2 To facilitate a GLS precision approach to runway 34 at Melbourne Airport, a portion of airspace South of the Melbourne Control Zone had to be lowered from 2500 feet to 2000 feet. This change was necessary to allow aircraft arriving to runway 34 at Melbourne Airport to maintain the correct altitude prior to intercepting the GLS vertical approach path. Note, prior to the implementation of GBAS, there was no precision approach to runway 34 and hence the higher Control Zone.

2.3 On the 25 and 26 August 2023, both the Sydney and Melbourne GBAS installations did not broadcast pseudo-range corrections for all satellites in view. This resulted in significant inflation to the Vertical Protection Level (VPL) with several aircraft reports of a loss of GLS vertical deviation indications at both sites. Figure 1 depicts the variation in the VPL (yellow) and number of satellites for which pseudo-range corrections were broadcast (green) by the Sydney GBAS on the 25 August 2023. The figure additionally depicts the number of satellites expected to be in view at the time (white). Between approximately 05:30 and 19:30 UTC, the GBAS did not broadcast pseudo-range corrections for specific satellites that were in view. There was no consistency in the satellites for which pseudo-range corrections were not broadcast between Sydney and Melbourne. Investigations into the event are ongoing and outcomes will be communicated at subsequent meetings. From the 27 August 2023 onwards, the GBAS re-commenced broadcasting pseudo-range corrections for all satellites in view with a corresponding reduction in the VPL.

Figure 1: Sydney GBAS - 25 August 2023 - Number of Corrections and VPL



2.4 On the 26 February 2024, a limited number of aircraft observed a loss of GLS Vertical deviation indications between 200 to 500 feet whilst performing a GLS approach into Melbourne Airport. Subsequent analysis identified that pseudo-range corrections were not being broadcast for GPS satellite PRN21 due to an Out-of-View Maneuver (Ephemeris) for this satellite in February 2024. The unanticipated loss of pseudo-range corrections for GPS satellite PRN21 in combination with a planned outage of GPS satellite PRN08 inflated the VPL to a level above the Vertical Alert Limit (VAL) resulting in the loss of GLS vertical deviation indications on the aircraft. An Out-of-View Maneuver (Ephemeris) event is nominally raised when there is a maneuver performed on a satellite and the satellite is out of view. The GPS Service provider will normally issue

a notification if there is a planned GPS satellite maneuver, planned GPS satellite maintenance or unplanned GPS satellite outage. Australia actively monitors notified changes to the GPS satellite constellation configuration and will remove the GBAS from service (through a NOTAM) during periods where the Vertical Dilution of Precision (VDOP) is inflated. However, in this specific instance there was no corresponding notification issued for GPS satellite PRN21. The GBAS recommenced broadcasting pseudo-range corrections for GPS satellite PRN21 shortly after the observations with a subsequent reduction in the VPL. Furthermore, the GBAS has continued to broadcast pseudo-range corrections for satellite PRN21.

2.5 On the 19 April 2024, multiple aircraft observed a loss of GLS vertical deviation indications whilst performing a GLS approach at both Sydney and Melbourne Airports. Subsequent investigations identified that the GBAS ground station was not broadcasting pseudo-range corrections for GPS satellites PRN10 and PRN32. The unanticipated loss of pseudo-corrections for these satellites also resulted in the VPL exceeding the VAL. As with the PRN21 event detailed in paragraph 2.4, there was no corresponding notification issued for changes to GPS satellites PRN10 and PRN32. Investigations into this event are ongoing and outcomes will be reported at subsequent meetings. Both the Sydney and Melbourne GBAS ground stations recommenced broadcasting pseudo-range corrections for PRN10 and PRN32 approximately 48 hours after the initial loss of pseudo-range corrections with a subsequent reduction in the VPL below the VAL.

2.6 Australia routinely flight inspects the GBAS signal in space to verify the VHF Data Broadcast (VDB) Field Strength is within ICAO tolerances. The Routine Flight Inspection Regime involves flying a single approach to each runway end supported by the GBAS ground station. From January 2023, Australia increased the Routine Flight Inspection interval for the GBAS from 12 months to 60 months. Since the introduction of the new interval, there has been no observable effect on GBAS performance. Australia's justification to increase the interval from 12 months to 60 months was based on:

- the stability and repeatability of historical VDB Field Strength measurements recorded during a Routine Flight Inspection;
- the completion of annual Routine Maintenance activities to verify the VDB is operating within Standard Operating Conditions established at Commissioning. This includes checks of the VDB Transmitter power, Transmitter Frequency and Voltage Standing Wave Ratio (VSWR);
- the implementation of appropriate safeguarding practices to protect the VDB signal in space from new developments;
- no observed or reported interference to the VDB signal in space; and
- SLS-4000 GBAS having built-in monitors to detect internal changes which may impact the VDB Field Strength.

3. UPDATED FLEET EQUIPAGE ANALYSIS

3.1 An analysis of Field 10A (Communications and Navigation Equipment) of Flight Plan data for Sydney and Melbourne was performed to identify the number of GLS capable aircraft flying into these locations. An operator will annotate Field 10A with "A" to indicate GLS capability.

3.2 For 2023, 37% of Sydney arrivals (73,310) and 44% of Melbourne arrivals (62,259) indicated GLS capability in their Flight Plan which is consistent with numbers observed in 2022. Figure 2 and Figure 3 depicts the increase in GLS capable aircraft arriving at these aerodromes.

3.3 The increase in GLS capable aircraft is primarily attributed to an increase in the number of domestically registered 737 aircraft and internationally registered A320, A350 and 787 aircraft arriving at these locations.

3.4 Engagement with Australian carriers have indicated that they will continue to acquire aircraft with GLS capabilities.

4. ACTION REQUIRED BY THE MEETING

4.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matters as appropriate.

Figure 2 - Melbourne Airport - Number of GLS Capable Aircraft

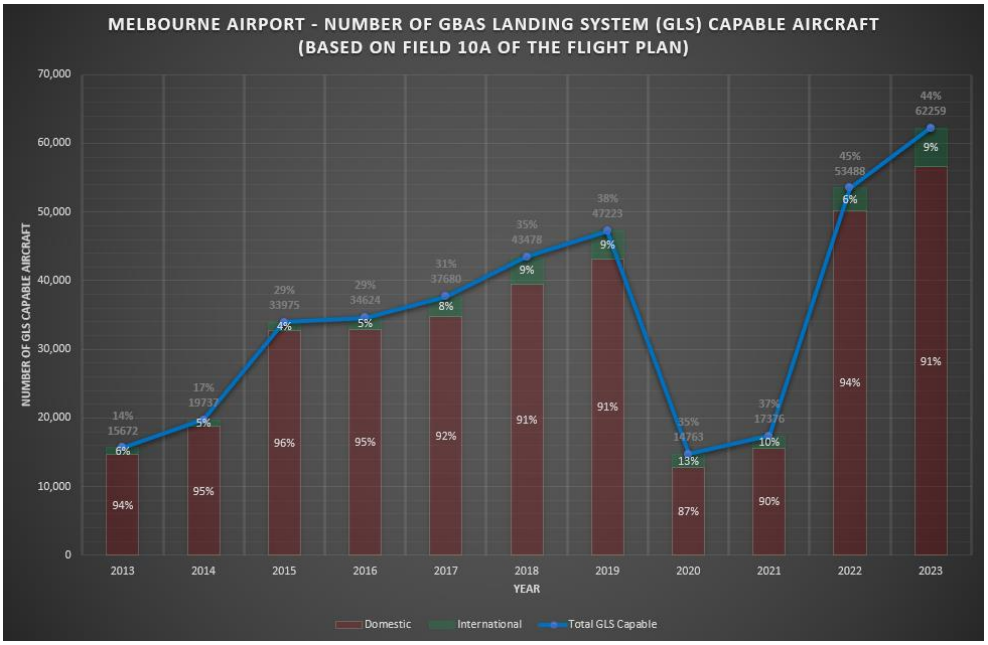


Figure 3 - Sydney Airport - Number of GLS Capable Aircraft