



INTERNATIONAL CIVIL AVIATION ORGANIZATION

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ASSEMBLY — 35TH SESSION

TECHNICAL COMMISSION

- Agenda Item 24: ICAO Global Aviation Safety Plan (GASP)**
24.2: Progress of the ICAO programme for the prevention of controlled flight into terrain (CFIT)

IMPLEMENTATION OF APV OPERATIONS

(Presented by Italy)

SUMMARY

In the frame of the GASP, since the Resolution A32-15 of the 32nd General Assembly (1998), the Organisation has been promoting a policy supporting the widespread introduction of approaches with vertical guidance (APV), as a mitigation factor of the CFIT.

The present Working Paper highlights some issues which still need the development of further technical standards and operational procedures for the introduction of APV operations.

At this purpose, one methodology for the validation of APV operations is presented. It is based upon the "Risk Assessment and Mitigation in ATM" (ESARR 4), which is mandatory to EUROCONTROL Member States. Further, the proposed methodology includes the considerations of relevant inputs related to the electromagnetical characterization of GNSS scenarios, derived through an "a priori" verification process.

Action by the Assembly is in paragraph 3.

1. INTRODUCTION

1.1 The ICAO Global Aviation Safety Plan (GASP) addresses the implementation of approach procedures with vertical guidance (APV) as one of the factors mitigating the risk of controlled flight into terrain (CFIT) occurrences, at those runways currently served by non precision approaches (NPA). In fact, the Assembly firstly encouraged the solution offered by APV (Resol. A32-15, 1998), then requested the Council (Resol. A33-16, 2001) to develop a programme to encourage States to implement such operations.

1.2 ICAO Annex 6 defines two types of APV operations:

- a) approaches using vertical guidance provided by processing of barometric information (baro-VNAV) by the flight management system (FMS); and
- b) approaches using guidance (horizontal plus vertical) provided by Satellite Based Augmentation Systems (SBAS).

1.3 During the 11th Air Navigation Conference (ANC/11, 2003), it was recognized that SBAS was being commissioned in the United States (WAAS) and was coming into operation in: Europe, Japan and India in the 2004-2006 timeframe, through other implementations (EGNOS, MSAS, GAGAN). As a result, the Recommendation 6/1 was issued, encouraging inter alia, that:

- a) air navigation service providers to move rapidly, in coordination with airspace users, with view to achieving, as soon as possible, worldwide capability to at least APV I performance; and
- b) States and airspace users to take note of the available and upcoming SBAS navigation services providing for APV operations, and take necessary steps towards installation and certification of SBAS capable avionics.

2. TECHNICAL AND OPERATIONAL ISSUES

2.1 In order to implement Recommendation 6/1 of the ANC/11, a number of steps have to be undertaken. Some of them are highlighted below.

2.1. APV I Performance

2.1.1 Performance requirements for APV I operations, for which both the SBAS and baro-VNAV might be suitable, should be set. In order to achieve a cost-effective exploitation of APV I operations, this activity should avoid to over-specify the requirements, both in terms of navigation system performance and flight technical error.

2.1.2 The design criteria of APV I procedures, based upon Required Navigation Performance (RNP), rather than sensor-oriented, should be set. This approach would take the following major benefits:

- a) the minima associated to each flight procedure will not depend on the sensor; and
- b) the operators will have the choice about the preferred avionics configuration.

2.2. Visual aids configuration for APV I operations

2.2.1 The appropriate configuration of visual aids supporting APV I operations should be set. In order to be cost-effective, the number and requirements for APV I lighting systems should be no more stringent than those associated to NPA operations.

2.3. Operational approval of APV I operations

2.3.1 Any APV I operation should be introduced upon approval of a "Safety Case", resulting from a safety assessment activity related to each operational scenario. Based upon the "Risk Assessment and Mitigation in ATM" (ESARR 4) requirements, which are part of the more general EUROCONTROL Safety Regulatory Requirements (ESARR) mandatory to its Member States, a total aviation system approach should be adopted, covering: the human, procedural and equipment (hardware and software) elements, as well as its environment of operations.

2.3.2 The relevant outcomes of the electromagnetical analyses and flight inspection missions should contribute to provide the safety assessment activity with an exhaustive set of inputs.

2.3.3 Taking into account of the limited data set collected during flight inspection missions, as opposed to the infinite number of states of the GNSS constellations, an appropriate electromagnetical characterization of the operational scenarios should address the objectives of each flight inspection mission.

2.3.4 The flight procedures design phase should be complemented by appropriate simulations, supporting an "a priori" performance verification within the operational scenario, which takes into account of the possible degradation of the GPS+SBAS signal-in-space, incurred by local effects (such as interference and/or multipath). In fact, local effects are not actually covered by the verification processes carried out at system level.

2.3.5 The proposed "a priori" performance verification approach appears to be consistent with the resolution of the 33rd Assembly (2001), asking the Council (Appendix R):

- a) to investigate, in consultation with Contracting States that are engaged in the development and manufacture of radio navigation systems, all possible means of improving ground testing facilities so as to minimize the need for periodic flight testing; and
- b) to circulate to Contracting States information concerning significant developments respecting improvements to radio navigation ground equipment, including associated ground testing and monitoring facilities, to the extent that those developments will serve to minimize the need for flight testing.

2.4. APV II operations

2.4.1 APV II SBAS operations should be addressed at a later stage than APV I. Further, they should be implemented at specific airports, as resulting from: the available SBAS infrastructure and the quality of the GPS+SBAS signal-in-space in the interested airspace. However, even for them the same principles as for APV I should apply, including:

- a) minimum lighting requirements, less stringent than those associated with Cat 1 operations, in order not to create unfair economical burden;

- b) "a priori" electromagnetic analyses and flight inspection missions to contribute to the safety assessment activity with an exhaustive set of inputs; and
- c) application of the RNP concept.

2.5. RNP concept and aircraft equipment

2.5.1 The use of RNP concept allows, to decouple the design of the procedures from the configuration of navigation equipment on-board of the aircraft. This is particularly true in a environment where navigation is based on GNSS signals.

2.5.2 Nevertheless the experience gained through the introduction of RNP or RNAV in different areas (see ANC AN-Conf/11-WP/90), showed a basic difficulty for a large number of operators to show the compliance with RNP requirements. In particular the difficulties have been experienced for small operators and operators of aircraft with old or intermediate generations of FMS.

2.5.3 In addition the GNSS augmentation systems are based on different satellites, which may lead to different equipment requirements, depending on the world region where flight operations take place.

2.5.4 Therefore, while the concept of RNP may be retained as the driving airspace requirement, when designing procedures each State - or better if it happens on a regional basis - should take into account the following:

- a) a realistic configuration of aircraft equipment;
- b) the average configurations of equipment among the airspace users; and
- c) the publication among guidance material, of the most common equipment configurations which meet the RNP for the intended airspace.

3. **ACTION BY THE ASSEMBLY**

3.1 The Assembly is invited to:

- a) take note of the need to develop further technical standards and operational procedures for the introduction of APV I & II operations;
- b) take note of the methodology for the safety assessment of ATM operations, adopted by the EUROCONTROL Member States;
- c) take note of the methodology to provide the safety assessment activities with inputs related to the electromagnetical characterization of GNSS scenarios, proposed by Italy; and
- d) task the Organisation to activate the appropriate bodies to develop the relevant standards and guidance material.

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