

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 6: Aeronautical navigation issues

- 6.1 Global navigation satellite system (GNSS) development status based on
: reports from States, service providers and industry organizations**

IMPLEMENTATION OF GNSS APPROACHES IN FRANCE

(Presented by France)

SUMMARY

This paper describes the work done by France to evaluate and implement the following types of GNSS approaches: non-precision approaches (NPA) using the global navigation satellite system (GNSS) with an aircraft-based augmentation system (ABAS); approaches with vertical guidance (APV) based on the use of ABAS GNSS and using barometric vertical guidance; and lastly, approaches with vertical guidance (APV) using GNSS-type absolute vertical guidance, based on a satellite-based augmentation system (SBAS), EGNOS in Europe.

On the basis of the methodology used and the main lessons learned from this work, France supports the recent strategic recommendations on the deployment of APV approaches proposed by the ICAO GNSS Panel (GNSSP) and the Council of ICAO.

Action by the conference is in paragraph 8.

1. INTRODUCTION

1.1 The improvement of air transport safety and regularity for all airspace users is the major challenge facing the civil aviation authorities of ICAO Contracting States. In respect of the implementation of GNSS for the approach and landing phases, France recently approved the deployment of non-precision approaches (NPA) using ABAS GNSS technologies, and is actively preparing for implementation of the approaches with vertical guidance (APV), in particular to respond to the recommendations of the ICAO Global Aviation Safety Plan (GASP). In addition, France is also taking part in the testing of the CAT I ground-based augmentation system (GBAS) and in CAT II and CAT III GBAS studies.

1.2 ICAO's Annex 6 defines two types of APV approaches using vertical guidance:

- a) approaches using vertical guidance provided by processing of barometric information by the flight management system (FMS); such approaches require the presence of a sufficiently sophisticated airborne computer; and
- b) approaches using guidance provided by an SBAS GNSS system, EGNOS in Europe, that will soon be available for all users of French airspace.

1.3 In 2005 to 2006, the EGNOS SBAS GNSS system will offer a robust and safe navigation service for en-route phases up to operations of the type approach with APV II level vertical guidance (as defined in ICAO's Annex 10) in European airspace (ECAC land area). An approach guidance service that is of very high quality in both the vertical and horizontal planes and that complements the one offered currently by the conventional landing aid infrastructure (ILS/MLS) will then be available. For several years now, the expected benefits of these services have prompted the Office for Air Navigation (DNA), in partnership with the French Space Agency (CNES) and the main European civil aviation administrations, EUROCONTROL and the European Space Agency (ESA), to take part actively in developing the EGNOS SBAS project.

1.4 As for GBAS, France, with over 100 ILS, considers that in its metropolitan territory its requirements for precision approaches are for now being met. Nevertheless, it is monitoring the implementation of the CAT I GBAS, as this system could be of interest for sites outside metropolitan France.

2. DEPLOYMENT OF GNSS NON-PRECISION APPROACHES

2.1 The first work on the deployment of GNSS approaches began in France in 1999, as part of a non-precision approach study programme using the ABAS GNSS (GPS/NPA). This programme covered all aspects: flight tests, procedure design, safety studies, and the involvement of operational services. It made it possible to define a methodology that led to the operational approval of GNSS approaches. This method, and the experience gained by France in deploying GPS/NPA approaches, serves as a model for the implementation of APV approaches based on the EGNOS SBAS GNSS.

2.2 The method used is based on three main phases: phase 1: technical studies, safety studies and testing; phase 2: drawing up of specifications defining all the conditions to be met for an approach to be approved at a given site; and phase 3: the pre-operational phase with operations limited to a small number of sites and air operator partners.

2.3 In phase 1 a certain number of points specific to the implementation of GPS/NPA approaches were studied, in particular the availability of integrity monitoring of the positioning service ensured on board. For some users, this concept gives rise to a significant number of unavailable approaches every year.

2.4 Phase 2 is now completed, and specifications are available for the candidate sites and air operators.

2.5 As for phase 3, an NPA/GPS approach trial is under way with Air France at Paris-Charles de Gaulle airport. In addition, procedures are being developed for some other French airports.

3. BARO-VNAV TYPE APV APPROACHES

3.1 The objective of the testing under way with Air France and Aéroports de Paris is to evaluate the benefits of these approaches at Paris-Charles de Gaulle airport as a complement to the ILS approaches that are currently the only approach procedures published. This testing also makes it possible to test APV approaches with barometric vertical guidance, as the Air France aeroplanes taking part in the testing can use lateral guidance provided by the airborne computer by hybridizing the GPS sensor and information from the inertial navigation system, as well as barometric vertical guidance. One of the points demonstrated by the testing is that the lateral guidance's integrity availability is subject to the presence of a sufficient GPS constellation geometry, as in the case of GPS non-precision approaches, which in some cases can lead to start-up delays, or even to a missed approach (one case has been reported). Such limitations will be removed with the use of EGNOS-based GNSS APV.

4. SBAS GNSS-TYPE APV APPROACHES (EGNOS IN EUROPE)

4.1 To improve safety and regularity, the French strategy is aimed in particular at replacing currently approved non-precision approach procedures by SBAS GNSS APV approaches (EGNOS in Europe). This strategy will make it possible, as recommended in the ICAO Global Aviation Safety Plan (GASP), to introduce APV approaches with continuous vertical guidance on the final segment, thus improving air transport safety at all runway ends that do not currently have a precision approach service. Furthermore, the improvement of the guidance quality on APV approaches with GNSS vertical guidance, ensured thanks to the very high accuracy of EGNOS and the use of protection surfaces for obstacles near those of the ILS, will in general allow for better operational minima than those of existing non-precision approaches or of APV approaches with barometric vertical guidance. Lastly, the crew will no longer have to verify that there will be appropriate GPS satellite geometry at the scheduled approach time.

5. EGNOS, A SOLUTION FOR ENVIRONMENTAL PROBLEMS AND FOR AREAS LACKING INFRASTRUCTURE

5.1 EGNOS will also make it possible to develop new operational applications addressing environmental situations for which continuous horizontal and vertical guidance must be ensured on flight paths so as to avoid densely populated areas. In Nice, testing of such procedures has produced some promising results.

5.2 It should also be noted that EGNOS is currently the only system that makes it possible to carry out approaches with vertical guidance for landings at heliports where no conventional infrastructure can be installed (such as at hospitals). Specific helicopter APVs will be used.

6. ACTIVITIES CARRIED OUT IN FRANCE TO IMPLEMENT EGNOS SBAS GNSS APV APPROACHES

6.1 By applying the method developed for NPA/GPS ABAS GNSS approaches, France is preparing to implement EGNOS SBAS GNSS approaches with vertical guidance. A working group was established in 2002. It includes experts from all the DGCA services competent in procedures, aeronautical information and certification of airborne systems. The group's work is aimed in phase 1 (end 2003) at identifying a list of sites where APV approaches would be of significant operational interest as a complement to already installed ILS systems, designing experimental procedures at these sites and evaluating the associated minima. This work will also permit improved consultation with the potential users of these new procedures.

6.2 At the same time, tools have been developed that make it possible to generate APV guidance information in the cockpits of aeroplanes engaged in flight checking. These tools were used during a first series of in-flight APV procedure tests conducted in cooperation with ASECNA in France and Africa.

6.3 Other tests are scheduled for 2004 on a subset of sites identified in phase 1. Operational implementation will take place progressively in 2005 to 2006 as part of phases 2 and 3 of the methodology chosen by the DNA.

6.4 Lastly, it is worth mentioning that the experience gained in developing the procedures associated with this study and in implementing and approving these new approaches based on EGNOS will make it possible to accelerate significantly the operational adoption of the approach procedures with vertical guidance that will be provided by Europe's second-generation GNSS, Galileo. The associated time saving will make it possible to benefit more quickly from the redundancy provided by the Galileo and GPS satellite navigation systems, complemented by EGNOS. This situation will permit the launch of a conventional infrastructure rationalization plan in France and in Europe, thus allowing for the withdrawal of certain conventional aids.

7. CONCLUSION

7.1 In 1999 France launched a programme to study and deploy GNSS approaches in order to improve the safety and service offered to users. This programme has made it possible to define a methodology to prepare for the deployment of such approaches in phases. The work is being carried out with a view to complementing conventional approach and landing aids, in particular ILS, and makes it possible:

- a) to approve the deployment of non-precision approaches based on the use of ABAS GNSS;
- b) with Air France, to test the use of APV procedures with barometric vertical guidance;
- c) lastly, to quantify the operational benefits provided through the use of APV approach and landing procedures with EGNOS SBAS GNSS vertical guidance for all users of French airspace.

7.2 In the light of the promising results of the work presented above, France supports:

- a) the recommendations of the ICAO Global Aviation Safety Plan (Assembly Resolution-A33-16) on the development of APV approaches to improve safety by reducing the risk of CFIT on runways lacking precision approaches;
- b) the proposals presented to this conference for the amendment of Annex 10, Volume I, Attachment B, “Strategy for introduction and application of non-visual aids to approach and landing”, that recommend the use of APV procedures with GNSS vertical guidance to improve aerodrome safety and capacity.

7.3 Lastly, France considers that the operational use of EGNOS as from 2005 and subsequently of Galileo combined with EGNOS around 2010 will make it possible to implement these new approaches in these systems’ service areas.

8. ACTION BY THE CONFERENCE

8.1 The conference is invited to:

- a) take note of the methodology employed and the studies carried out in France;
- b) encourage the States covered by an SBAS GNSS service to implement it by publishing the SBAS GNSS APV procedures upon operational approval.

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