



INTERNATIONAL CIVIL AVIATION ORGANIZATION

**SEVENTH MEETING OF THE PERFORMANCE BASED NAVIGATION
TASK FORCE (PBN/TF/7)**

Bangkok, Thailand, 1 – 3 September 2010

Agenda Item 4: PBN Implementation Issues

**ICAO ASSEMBLY – 37TH SESSION
WORKING PAPER A37-WP/13
PERFORMANCE BASED NAVIGATION – THE
IMPLEMENTATION CHALLENGE**

(Presented by Australia)

SUMMARY

The ICAO Assembly Resolution A36-23 (A36-23) sets out a program for the adoption and implementation of Performance Based Navigation (PBN) and the associated approaches with vertical guidance (APV). Much effort has gone into the implementation of this resolution including, in the Asia Pacific Region, the formation of the PBN Task Force and completion of the Regional PBN Implementation Plan.

Concern has been raised by APANPIRG over the capability of the Region to implement APV approaches to meet the scope and timing requirements of A36-23. Further, there does not appear to be widespread implementation of runway aligned approaches (i.e. “straight-in” approaches), which would provide a level of mitigation against controlled flight into terrain when compared to circling approaches.

The ICAO Council has proposed changes to A36-23 for adoption by member States as per the attached 37th Assembly working paper A37-WP/13.

This paper recommends that APANPIRG examine the draft Resolution proposed in A37-WP/13 in order to present a coordinated Asia Pacific Region advice to the Assembly if required.

1. INTRODUCTION

1.1 The current Assembly Resolution A36-23 sets out the goals and implementation targets for the introduction of PBN, including implementation of approach procedures with vertical guidance (APV) (Baro-VNAV and/or augmented GNSS) for all instrument runway ends, either as the primary approach or as a back-up for precision approaches by 2016 with intermediate milestones as follows: 30 per cent by 2010, 70 per cent by 2014.

1.2 The attached working paper A37-WP/13 and its draft Resolution A36/1 recognises that not all aircraft are currently capable of APV operations and recommends that any APV implementation should include lateral navigation (LNAV) only minima.

2. DISCUSSION

2.1 ICAO controlled flight into terrain (CFIT) studies have shown that runway aligned approaches (LNAV only) are some 25 times safer than circling approaches and that once some form of vertical guidance is added to these, then the safety margin is increased again by some 8 times.

2.2 There are a number of factors affecting APV implementation that limit the ability of States to comply with A36-23. Many aircraft are not equipped to fly either Baro-VNAV or Satellite Based Augmentation System (SBAS) based APV and many States do not have SBAS or aerodrome infrastructure to support APV operations. Resourcing and expertise shortages will also impact the ability of aviation authorities to put in place the necessary regulatory measures. As a consequence, the majority of Asia Pacific (APAC) States are unlikely to meet the scope or timing requirements for APV implementation required by A36-23.

2.3 Papers and discussions within the APAC Region PBN Task Force and CNS/MET SG have recognized that many States have not implemented any form of runway aligned approach and that many examples of circling approaches exist. Further, A36-23 does not explicitly include any requirement to develop LNAV approaches if APV cannot be achieved or as an intermediate step towards APV implementation. Accordingly, without a specific direction from ICAO to do so, many States are not taking advantage of readily available existing technologies and equipment to design and deploy runway aligned lateral guidance only approaches (RNP APCH-LNAV).

2.4 The Assembly working paper A37-WP/13 (attached) proposes an updated Resolution which recognizes (at the 7th preambulatory clause) that not all aircraft are capable of APV operations and requires that LNAV only minima to be included with APV (operative clause 2. a) 2)) However, the updated resolution retains the explicit requirements for APV implementation without addressing the inability of States to meet the requirement where aircraft, airport equipment or infrastructure gaps will delay compliance. Additionally, the updated resolution does not consider any alternative approach procedure (for example a runway aligned LNAV only procedure) either as an intermediate step or where APV cannot be achieved.

2.5 The following alternative text for the updated resolution in A37-WP/13 has been submitted by Australia to the Assembly and is provided here for discussion:

Preamble:

Delete:

~~“Recognizing that not all aircraft are currently capable of APV operations but can perform approaches with only lateral guidance based on RNP specifications.”~~

Insert

“Recognizing that not all States have a GNSS augmentation capability, not all airports have the infrastructure to support APV and not all aircraft are currently capable of APV operations

Recognizing that many States already have the requisite infrastructure and aircraft capable of performing approaches with lateral guidance based on the RNP specifications;”

Operative :

“Resolves that:

a) States complete a PBN implementation plan as a matter of urgency to achieve:

1) implementation of RNAV and RNP operations (where required) for en route and terminal areas according to established timelines and intermediate milestones; and

2) implementation of approach procedures with vertical guidance (APV) (Baro-VNAV and/or augmented GNSS), including LNAV only minima, for all instrument runway ends, either as

the primary approach or as a back-up for precision approaches by 2016 with intermediate milestones as follows: 30 per cent by 2010, 70 per cent by 2014; and

3) implementation of runway aligned LNAV only procedures where APV cannot be implemented due to the lack of infrastructure or suitably equipped aircraft.

APANPIRG members should also consider advising ICAO to review the timetable for APV implementation retained in the draft resolution given that the first milestone of 30 per cent coverage by the end of 2010 is unlikely to be met by a majority of States in the APAC region.

3. **ACTION BY THE MEETING**

3.1 The meeting is invited to:

- a) Note that Australia has submitted the text above to the 37th General Assembly as proposed amendments to the draft Resolution in A37-WP/13.

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Attachment: Assembly Working Paper A37-WP/13 (see separate paper for full attachment)

— END —



International Civil Aviation Organization

WORKING PAPER

A37-WP/13
TE/4
3/8/10

ASSEMBLY — 37TH SESSION

TECHNICAL COMMISSION

Agenda Item 36: NextGen and SESAR as part of the Global ATM system

PERFORMANCE-BASED NAVIGATION – THE IMPLEMENTATION CHALLENGE

(Presented by the Council of ICAO)

EXECUTIVE SUMMARY

Performance-based navigation (PBN), as part of the *Global Air Navigation Plan* (GANP, Doc 9750) initiatives, supports increased accessibility and flexibility in terminal airspace thereby enhancing safety, efficiency and the environment. The 36th Session of the ICAO Assembly resolved that States and planning and implementation regional groups (PIRGs) should complete a PBN implementation plan by 2009. Resolution A36-23, *Performance-based navigation global goals*, requested ICAO to develop a coordinated action plan to assist States in the implementation of PBN and to report back to the next ordinary Session of the Assembly. ICAO continued its efforts towards establishing an effective PBN programme with a view to assisting States and measuring implementation success. Although PIRGs completed the regional implementation plans by the target date of 2009, there remain implementation challenges due to resource and expertise shortages.

Action: The Assembly is invited to review the modifications proposed and adopt the Resolution in the Appendix, on performance-based navigation, to supersede Resolution A36-23.

<i>Strategic Objectives</i>	This working paper relates to Strategic Objectives A, D, and E with regard to all phases of flight.
<i>Financial implications:</i>	Resources for the activities referred to in this paper are included in the proposed budget for 2011 to 2013.
<i>References:</i>	Doc 9613, <i>Performance-based Navigation Manual, Third Edition</i> Doc 9902, <i>Assembly Resolutions in Force</i> (as of 28 September 2007)

1. INTRODUCTION

1.1 Performance-based navigation (PBN) provides the global framework of harmonized modern navigation requirements, which did not exist previously or existed on a regional basis only, and provides the platform to implement and benefit from existing and future area navigation technologies. It includes two key “building blocks”: area navigation (RNAV) and required navigation performance (RNP), the application of which encompasses all phases of flight from en-route to approach. PBN enhances safety by providing improved flight guidance to pilots. It enables operational improvements including shortened routes, continuous climb and descent operations and enhanced approach procedures, all of which reduce fuel consumption thereby reducing aviation’s environmental impact and improving safety.

2. REPORT ON PBN PLANNING AND IMPLEMENTATION

2.1 The ICAO coordinated effort for “rolling out” PBN contains three main elements which form an integral package: improving awareness and education; coordination and facilitation of implementation; and strengthening implementation Standards and Recommended Practices (SARPs) and guidance material. Statistics on the success rate of implementing PBN approaches, standard instrument departures (SIDs) and standard instrument arrivals (STARs) as well as the availability of national implementation plans are provided below.

2.2 Planning

2.2.1 All ICAO regional offices have been coordinating with States with a view to completing implementation plans through regional performance-based navigation/global navigation satellite system (PBN/GNSS) task forces. To assist in implementation efforts, educational tools have been offered in the form of airspace workshops, approach procedure with vertical guidance (APV) design courses and PBN implementation seminars. ICAO regional officers coordinated activities by providing progress reports and feedback to Headquarters to ensure globally harmonized PBN implementation through the planning and implementation regional groups (PIRGs).

2.2.2 Much regulatory and guidance material has been updated to include PBN provisions. SARPs provide the necessary legal framework under the Convention and the referenced manuals provide support to States and stakeholders in the PBN implementation process.

2.2.3 All ICAO regions have approved, through the PIRG process, regional implementation plans for PBN. Based on these regional plans (www.icao.int/pbn), a growing number of States (126) have developed their national plans. All member States were expected to have completed these plans by the end of 2009 but due to resource and expertise shortages, the target date could not be met.

2.2.4 Eleven PBN seminars were conducted between 2007 and 2009 throughout the ICAO regions aimed at increasing awareness and understanding of PBN among all operational stakeholders. This was done in coordination with the Federation Aviation Administration (FAA) of the United States and EUROCONTROL.

2.2.5 A minimum of eight PBN airspace workshops are planned between 2010 and 2011, also in coordination with EUROCONTROL and the FAA. These workshops will provide insight and a basic understanding of introducing PBN into an airspace concept. The seminars will address the methodology

to be used in developing such concepts and will allow for group work in the application of this methodology by providing unique hands-on experience.

2.2.6 As part of the Cooperative Development of Operational Safety and Continuing Airworthiness Programmes (COSCAPs) activities, PBN operational approvals courses are planned for all regions in order to provide guidance to States on air operator airworthiness and operational approvals for all navigation specifications contained in the *Performance-based Navigation (PBN) Manual* (Doc 9613).

2.2.7 It was reported by at least one ICAO region that not all aircraft can be readily equipped for APV procedures but could fly the same track with lateral guidance only. Therefore, a lateral navigation (LNAV) option should be included in the development of the APV procedure.

2.3 Implementation

2.3.1 ICAO, the International Air Transport Association (IATA) and representatives of States, industry and international organizations came together to establish the Global PBN Task Force (GPBNTF). The objectives are to build upon the global and regional structures already in place and to produce tools and enablers to facilitate and expedite PBN implementation. The first meeting resulted in an agreement on the need for such a global effort and divided the task force into teams working on specific areas as follows:

- a) *Promotion Team*. A global industry declaration to support PBN was signed on 1 April 2009. A quarterly newsletter (waypoints) was established. Various promotional flyers were produced;
- b) *Implementation Support Team*. The team established a detailed action plan template for States as a tool to plan PBN implementation; and
- c) *GO-Team*. PBN Global Task Force Go-Team visits are planned for every region to perform gap analyses and give practical advice on PBN and continuous descent operations (CDO) implementation to States. Four visits were scheduled for 2010.

2.3.2 In March 2010, the Asia-Pacific (APAC) Flight Procedure Programme (FPP) Office was opened in Beijing. This office targets accelerated implementation of PBN flight procedures by using expertise from the region to assist States in their implementation activities. The work programme concentrates on training, quality assurance and assistance of procedure design. This initiative was made feasible courtesy of China which is hosting the programme with direct financial contributions from States of the region. Building on the experience gained in the APAC Region, a similar initiative is being considered in the Africa Region.

2.3.3 Pursuant to Resolution A36-23, ICAO started a mechanism for measuring actual PBN implementation worldwide. The global number of PBN approaches implemented between January 2008 and January 2010 totalled 2 534 (a 38% increase). The number of PBN SIDs and STARs implemented during the same period totalled 1 617 (a 41% increase). It should be noted that these figures reflect an average implementation rate and that there is a marked disparity in individual implementation rates. The delay in implementation by some States can be attributed to the complexity of PBN and the time required for States to gain proper understanding of the implementation issues.

3. CONCLUSION

3.1.1 As a result of ICAO efforts guided by Resolution A36-23, States started implementation of PBN; however, shortage of resources and expertise precludes optimum implementation of the programme. Therefore, strong ICAO leadership is essential to maintain implementation momentum.

3.1.2 To improve assistance States and PIRGs should provide annual updates on implementation issues and progress made. States should complete the development of national implementation plans and ensure compliance with the dates indicated in the plans. This will be a significant step toward a global performance-based air navigation system for the future.

APPENDIX

DRAFT RESOLUTION FOR ADOPTION BY THE 37TH SESSION OF THE ASSEMBLY

Resolution 36/1: Performance-based navigation global goals

Whereas a primary objective of ICAO is that of ensuring the safe and efficient performance of the global Air Navigation System;

Whereas the improvement of the performance of the air navigation system on a harmonized, worldwide basis requires the active collaboration of all stakeholders;

Whereas the 11th Air Navigation Conference recommended that ICAO, as a matter of urgency, address and progress the issues associated with the introduction of area navigation (RNAV) and required navigation performance (RNP);

Whereas the 11th Air Navigation Conference recommended that ICAO develop RNAV procedures supported by global navigation satellite system (GNSS) for fixed wing aircraft, providing high track and velocity-keeping accuracy to maintain separation through curves and enable flexible approach line-ups;

Whereas the 11th Air Navigation Conference recommended that ICAO develop RNAV procedures supported by GNSS for both fixed and rotary wing aircraft, enabling lower operating minima in obstacle rich or otherwise constrained environments;

Whereas Resolution A33-16 requested the Council to develop a programme to encourage States to implement approach procedures with vertical guidance (APV) utilizing such inputs as GNSS or distance measuring equipment (DME)/DME, in accordance with ICAO provisions;

Recognizing that ~~implementation of approach with vertical guidance (APV) is still not widespread~~ not all aircraft are currently capable of APV operations but can perform approaches with only lateral guidance based on the RNP specifications;

Recognizing that the Global Aviation Safety Plan has identified Global Safety Initiatives (GSIs) to concentrate on developing a safety strategy for the future that includes the effective use of technology to enhance safety, consistent adoption of industry best practices, alignment of global industry safety strategies and consistent regulatory oversight;

Recognizing that the Global Air Navigation Plan has identified Global Plan Initiatives (GPIs) to concentrate on the incorporation of advanced aircraft navigation capabilities into the air navigation system infrastructure, the optimization of the terminal control area through improved design and management techniques, the optimization of the terminal control area through implementation of RNP and RNAV SIDs and STARs and the optimization of terminal control area to provide for more fuel efficient aircraft operations through FMS-based arrival procedures; and

Recognizing that the continuing development of diverging navigation specifications would result in safety and efficiency impacts and penalties to States and industry;

Noting with satisfaction that planning and implementation regional groups (PIRGs) have completed regional PBN implementation plans;

Recognizing that not all States have developed a PBN implementation plan by the target date of 2009;

The Assembly:

1. *Urges* all States to implement RNAV and RNP air traffic services (ATS) routes and approach procedures in accordance with the ICAO PBN concept laid down in the *Performance-based Navigation (PBN) Manual* (Doc 9613);
2. *Resolves* that:
 - a) States ~~and planning and implementation regional groups (PIRGs)~~ complete a PBN implementation plan ~~by 2009~~ as a matter of urgency to achieve:
 - 1) implementation of RNAV and RNP operations (where required) for en route and terminal areas according to established timelines and intermediate milestones; and
 - 2) implementation of approach procedures with vertical guidance (APV) (Baro-VNAV and/or augmented GNSS), including LNAV only minima, for all instrument runway ends, either as the primary approach or as a back-up for precision approaches by 2016 with intermediate milestones as follows: 30 per cent by 2010, 70 per cent by 2014; and
 - b) ICAO develop a coordinated action plan to assist States in the implementation of PBN and to ensure development and/or maintenance of globally harmonized SARPs, Procedures for Air Navigation Services (PANS) and guidance material including a global harmonized safety assessment methodology to keep pace with operational demands;
3. *Urges* that States include in their PBN implementation plan provisions for implementation of approach procedures with vertical guidance (APV) to all runway ends serving aircraft with a maximum certificated take-off mass of 5 700 kg or more, according to established timelines and intermediate milestones;
4. *Instructs* the Council to provide a progress report on PBN implementation to the next ordinary session of the Assembly, as necessary; ~~and~~
5. *Requests* the Planning and Implementation Regional Groups (PIRGs) to include in their work programme the review of status of implementation of PBN by States according to the defined implementation plans and report ~~annually~~ to ICAO any deficiencies that may occur; ~~and~~
6. *Declares* that this resolution supersedes Resolution A36-23.