International Civil Aviation Organization

The Tenth Meeting of the ICAO Asia/Pacific Performance-Based Navigation Task Force (PBN/TF/10)

Nadi, Fiji, 11-13 December 2012

Agenda Item 7: Any Other Business

PERFORMANCE BASED NAVIGATION (PBN) PROCEDURE DESIGN ISSUES

(Presented by the Republic of Korea)

SUMMARY

This paper addresses some issues which were encountered during PBN procedure design using PANS-OPS (Doc 8168) as follows:

a) Minimum Stabilization Distance (MSD) application for course changes less than 50°;

b) Buffer Value (BV) application crossing the 30NM boundary from ARP; and

c) Designation of Minimum Sector Altitude (MSA) reference point for PBN procedures.

The meeting is invited to review the contents in this paper and to agree to the action in paragraph 3.

1. INTRODUCTION

1.1 The 36th ICAO General Assembly resolved to develop Performance Based Navigation (PBN) implementation plan by 2009 and to develop RNAV and RNP procedures by 2016 (A36-23) and this was confirmed by the 37th ICAO General Assembly (A37-11).

1.2 In accordance with the PBN Implementation Plan which was presented to the ICAO Asia-Pacific Office, the Republic of Korea is carrying out the plan faithfully. As a result, in 2011, RNAV 1 navigation specification was applied to all arrival and departure procedures serving two major airports- Incheon and Gimpo airport- in Seoul TMA.

1.3 During designing the PBN Procedures, ROK addressed a couple of issues relating to PANS-OPS (Doc.8168 Vol. II) criteria, especially MSD, Buffer value and MSA. Etc.

2. DISCUSSION

Determining Minimum Stabilization Distance (MSD) for Course Changes less than 50°

2.1 ICAO PANS-OPS Vol. II stipulates that the minimum stabilization distance (MSD) is equal to the value calculated for a course change of 50° for course changes less than 50°(refer to *PANS-OPS Part III, Section2, Chapter1, 1.4.1.3 'Bank angle of flyover turn' and 1.4.2.2 'Bank angle of fly-by turn'*).

2.2 Following this, procedure designers have to apply the value of 50° for the small amount of course changes, for example less than 30°. This means instrument flight procedures apply longer MSD than actual MSD for the flight. This is a critical issue, especially there is no enough airspace for the flight procedure design.

2.3 However, there are the models to calculate MSD for the flyover turn and the fly-by turn in the PANS-OPS (refer *to PANS-OPS Part III, Section2, Chapter1, 1.4.1.2 'Model of the flyover turn' and 1.4.2.1 'Model of the fly-by turn'*). In addition, flight procedure designers can determine the parameters which are needed to calculate the MSD in the model using other formula and tables in the PANS-OPS (refer to *PANS-OPS Part I, Section2, Chapter3, Table I-2-3-1. 'Turn construction parameter', Table I-2-1-App-1, Table I-2-1-App-2. 'Conversion table'*).

2.4 Using the models and parameters, flight procedure designers can calculate the real MSD for the small amount of turns, which is not listed on the tables in the PANS-OPS. This means flight procedure designers can design flight procedures more efficient manner within small and congested airspace and can facilitate the flight procedure developments. Therefore, these criteria should be reviewed and be amended to accommodate various airspace situations.

Application of Buffer Value Crossing the 30NM Boundary from Airport Reference Point (ARP)

2.5 The buffer values are a critical factor to be considered while developing RNAV and RNP flight procedures because it provides the RNAV and RNP cross track tolerance with additional values to secure an aircraft within designed protected airspace of the flight procedures. They have different values depending on the phase of flight (En-route, SIDs, STARs, initial, intermediate and final approach, missed approach) and the distance from airport reference point (ARP) (30NM, 15NM). In addition, they are applied in RNP4, Basic RNP-1, RNP APCH, RNAV1, RNAV2 and RNAV5 application (refer to *PANS-OPS Vol II. Part III, Section1, Chapter1, 1.3.2 and Table III-1-1-2. 'Buffer values'*).

2.6 When applying these criteria to the RNAV and RNP flight procedure design, flight procedure designers encounter one simple question; which buffer value have to be applied if the planned course crosses 30NM boundary line from ARP repeatedly? (See Appendix A).

2.7 If airspace is enough and there is no restriction such as other procedures, special use airspaces, airports, etc, there will be no problem to follow the criteria. On the contrary, they will cause serious headache to the flight procedure designers if there is a restriction within the proposed protected area when bigger buffer value is applied.

2.8 In terms of real flight environment with Flight Management System (FMS), pilot usually turns FMS to terminal mode and maintains this until passing final approach fix in the terminal area regardless of the distance from the ARP, even though they well recognize these criteria.

2.9 Considering this practice, there is no need to apply bigger buffer values once aircraft is entered into the terminal airspace and is changed to terminal mode for the arrival. Therefore, these criteria should be reviewed and be clarified or amended to facilitate the development of the PBN flight procedures.

Designation of Minimum Sector Altitude (MSA) Reference Point for PBN Procedures

2.10 ICAO allows States to establish minimum sector altitude (MSA) instead of terminal arrival altitudes (TAAs) for an RNAV instrument approach procedures (refer to *PANS-OPS Part III, Section 2, Chapter 4, 4.1.2*).

2.11 MSA is calculated by taking the highest elevation in the sector concerned, adding a clearance of at least 1,000ft and rounding up to the next higher 100ft increment within a radius of 25NM of the homing facility on which the instrument approach is based (refer to *PANS-OPS Part I, Section 4, Chapter 8, 8.1*) or within a sector of a circle of 25NM radius centered on a radio aid to navigation (*PANS-OPS Part I, Section 1, Chapter 1, Definition*).

2.12 However, in terms of PBN procedures, every component which is used for RNP approaches or RNP AR approaches, such as waypoint, variation, track and buffer value etc. is based on the airport reference point (ARP). Therefore, it is more reasonable that MSA for PBN Procedures should be centered on the airport ARP, instead of the navigational aids.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) discuss any relevant matters as appropriate; and

c) request ICAO to review and to amend the PANS-OPS and relevant materials which are used for PBN procedure design.

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Appendix A. Standard Arrival Procedure Crossing 30NM Boundary Line from ARP repeatedly