

International Civil Aviation Organization The First Meeting of South China Sea Major Traffic Flow Review Group (SCS-MTFRG/1) Kuala Lumpur, Malaysia, 19-20 January 2015

Agenda Item 5: Discuss strategy for development /realignment of routes and optimization of FLAS/FLOS and set implementation targets and timelines.

PBN ROUTE SPACING AND CNS REQUIREMENTS

(Presented by Secretariat)

SUMMARY

This paper presents the RNAV10, RNAV5, RNP4, RNAV2 and RNP2 navigation specification with special focus on the route spacing and associated implementation requirements, which could be used to optimize the current route structure.

1. INTRODUCTION

- 1.1 The current FLOS in the SCS area was implemented many years ago, with a purpose to address the then prevailing capacity issues. Since then, the PBN concept has been developed further and implemented extensively in recent years. There are now alternative ways of enhancing capacity, among which could be closely spaced PBN routes and the use of a more efficient ATS surveillance-based separation.
- 1.2 Although it is obvious that closely spaced parallel routes could enhance airspace capacity and increase the safety level of operations, we should take note that there are still some conventional routes and the major PBN NavSpec in the SCS area is still RNAV10. There is great potential for these to be upgraded in a phased manner.
- 1.3 Route Spacing and separation minima are the key indicators for PBN route structures and operations. The spacing between ATS routes may be determined, in part, by the navigation performance of the aircraft that are expected to use them, by anticipated aircraft density, and by the communication and ATS surveillance services that are available to those aircraft.
- 1.4 There is an important principle described in ICAO Doc4444 which is can be used to determine the appropriate route spacing:

5.4.1.2.1.5 RNAV operations where RNP is specified on parallel tracks or ATS routes.

Within designated airspace or on designated routes, where RNP is specified, lateral separation between RNAV-equipped aircraft may be obtained by requiring aircraft to be established on the centre lines of parallel tracks or ATS routes spaced at a distance which ensures that the protected airspace of the tracks or ATS routes does not overlap.

1.5 Within designated airspace or on designated routes, lateral separation between aircraft operating on parallel or non-intersecting tracks or ATS routes shall be established in accordance with the following:

a)For a minimum spacing between tracks of 93 km (50 NM) a navigational performance of RNAV 10 (RNP 10),RNP 4 or RNP 2 shall be prescribed;

b) For a minimum spacing between tracks of 55.5 km (30 NM) a navigational performance of RNP 4 or RNP 2 shall be prescribed;

c)For a minimum spacing between tracks of 27.8 km (15 NM) a navigational performance of RNP 2 or a GNSS equipage shall be prescribed. Direct controller-pilot VHF voice communication shall be maintained while such separation is applied;

d)For a minimum spacing between tracks of 37 km (20 NM), applied while one aircraft climbs/descends through the level of another aircraft whilst using other types of communication than specified in d) above, a navigational performance of RNP 2 or a GNSS equipage shall be prescribed.

2. **DISCUSSION**

2.1 RNAV10

- 2.1.1 Communications and ATS surveillance requirements
- a) Procedural-pilot position reports and voice communications through a third have been demonstrated to be acceptable in some implementations; however, DCPC may be required in certain areas, such as those of known convective weather.
- b) Communications and ATS surveillance requirements for distance-based longitudinal separation utilizing RNP10 are specified in PANS-ATM:

Separation Minima: 50NM

Communication Requirement: Direct controller-pilot communications which should be voice or CPDLC for distance verification at least every 24 minutes

Surveillance Requirement: Procedural position reports.

- 2.1.2 Route spacing and separation minima
- a) For a minimum spacing between tracks of 93 km (50 NM) a navigational performance of RNAV 10 (RNP 10) shall be prescribed.
- b) Distance-based longitudinal separation minima is 50NM.

2.2 RNAV5

2.2.1 Communications and ATS surveillance requirements

- a) Direct pilot to ATC (voice) communications is required. Radar monitoring by the ATS may be used to mitigate the risk of gross navigation errors, provided the route lies within the ATS surveillance and communications service volumes and the ATS resources are sufficient for the task.
- 2.2.2 Route spacing and separation minima
- a) According to ICAO PANS-ATM and PANS-OPS, the following method can be used to calculate the route spacing for RNAV5:

 $\frac{1}{2}$ W = XTT *1.5 + BV=2.51(GNSS)*1.5+2.0=5.77NM. Route spacing for RNAV5 parallel routes could be 11.54NM, roughly 12 NM. State should undertake the necessary safety assessments outlined in PANS-ATM (Doc 4444)

- b) The State is responsible for route spacing and should have ATS radar surveillance and monitoring tools to support detection and correction of navigation errors. The State should refer to applicable ICAO guidance material regarding route spacing between RNAV 5 routes or between RNAV 5 routes and conventional routes see Attachment A to Annex 11 Air Traffic Services, and Attachment B to this volume. One State demonstrated a route spacing of 30 NM to meet the safety targets of 5^* 10⁻⁹ fatal accidents per flight hour in the absence of ATS surveillance and in a high traffic density environment.
- c) Where traffic density is lower, route spacing may be reduced. In an ATS radar surveillance environment, the route spacing will depend on acceptable ATC workload and availability of controller tools. One regional RNAV 5 implementation adopted a standard route spacing of 16.5 NM for same-direction traffic and 18 NM for opposite-direction traffic in a radar environment. Moreover, route spacing as low as 10 NM has been used where ATC intervention capability permits. (See Attachment B Volume 2, Doc 9613.)
- d) The route design should account for the navigation performance achievable using the available NAVAID infrastructure, as well as the functional capabilities required by the navigation specification. Two aspects are of particular importance: spacing between routes in turns and along track distance between leg changes.
- e) Automatic leg sequencing and associated turn anticipation is only a recommended function for RNAV 5. The track followed in executing turns depends upon the true airspeed, applied bank angle limits and wind. These factors, together with the different turn initiation criteria used by manufacturers, result in a large spread of turn performance. Studies have shown that for a track change of as little as 20 degrees, the actual path flown can vary by as much as 2 NM. This variability of turn performance needs to be taken into account in the design of the route structure where closely spaced routes are proposed.
- f) The turn can start as early as 20 NM before the waypoint in the case of a large track angle change with a "fly-by" turn; manually initiated turns may overshoot the following track.

g) The track structure design needs to ensure leg changes do not occur too closely together. The required track length between turns depends upon the required turn angle

(*Ref: Doc 9613, Volume II, Part B. Implementing RNAV Operations, Chapter 2. Implementing RNAV 5, 2.2.3.2 - 2.2.3.4.2*)

2.3 RNP 4

- 2.3.1 Communications and ATS surveillance requirements
- a) Direct pilot to ATC (voice) or CPDLC communications is required, plus ADS-C surveillance, utilizing waypoint/periodic reporting and lateral deviation event contracts. These requirements are normally determined in the implementation process taking into account any local and regional characteristics.
- b) The requirements for longitudinal separation, communications and ATS surveillance distance based longitudinal separation utilizing RNP 4 are specified in PANS-ATM. Note.— An existing application of 30 NM lateral and 30 NM longitudinal separation minimum requires a communications capability of DCPC or CPDLC and an ATS surveillance capability by an ADS system in which an event contract must be set that includes a lateral deviation event report whenever a deviation from track centre line greater than 9.3 km (5 NM) occurs.

(*Ref: Doc 9613, Volume II, Part C. Implementing RNP Operations, Chapter 1. Implementing RNAV 5, 2.2.3.2 - 2.2.3.4.2*)

- 2.3.2 Route spacing and separation minima
- a) According to ICAO PANS-ATM and PANS-OPS, the following method can be used to calculate the route spacing of RNP4:

 $\frac{1}{2}$ W = XTT *1.5 + BV=4.0*1.5+2.0=8 NM. Route spacing for RNP4 parallel routes could be 16 NM. State should undertake the necessary safety assessments outlined in PANS-ATM (Doc 4444).

b) The separation minima are described in Section 5.4 of the PANS-ATM (Doc 4444): for a minimum spacing between tracks of 55.5 km (30 NM) a navigational performance of RNP 4 shall be prescribed. RNP 4 may be used to support the application of separation standards/route spacing less than 30 NM in continental airspace provided a State has undertaken the necessary safety assessments outlined in PANS-ATM (Doc 4444). However, the communications and ATS surveillance parameters that support the application of the new separation standards will be different from those for a 30 NM standard.

2.4 RNAV2

- 2.4.1 Communications and ATS surveillance
- a) Where reliance is placed on the use of radar to assist contingency procedures, its performance should be adequate for that purpose, i.e. radar coverage, its accuracy, continuity and availability should be adequate to ensure separation on RNAV 2 ATS

route structure and provide contingency in cases where several aircraft are unable to achieve the navigation performance prescribed in this navigation specification.

- 2.4.2 Route Spacing and Separation Minima
- a) According to ICAO PANS-ATM and PANS-OPS, the following method can be used to calculate the route spacing of RNP4:

 $\frac{1}{2}$ W = XTT *1.5 + BV=2.0*1.5+2.0=5 NM. Route spacing for RNP4 parallel routes could be 10 NM. State should undertake the necessary safety assessments outlined in PANS-ATM (Doc 4444).

b) Route spacing for RNAV 2 depends on the route configuration, air traffic density and intervention capability Until specific standards and ATM procedures are developed, RNAV 2 applications can be implemented based on ATS radar surveillance.

2.5 RNP2

- 2.5.1 Communications and ATS surveillance requirements
- a) This navigation specification is primarily intended for environments where ATS surveillance is either not available or limited. Communications performance on RNP 2 routes will be commensurate with operational considerations such asroute spacing, traffic density, complexity and contingency procedures.
- 2.5.2 Route spacing and separation minima
- a) According to ICAO PANS-ATM and PANS-OPS, the following method can be used to calculate the route spacing of RNP2:

 $\frac{1}{2}$ W = XTT *1.5 + BV=2.0*1.5+2.0=5 NM. Route spacing for RNP2 parallel routes could be 10 NM. State should undertake the necessary safety assessments outlined in PANS-ATM (Doc 4444).

b) The route spacing will be determined by a safety study for the intended operations which will depend on the route configuration, air traffic density and intervention capability. For a minimum spacing between tracks of 27.8 km (15 NM) a navigational performance of RNP 2 or a GNSS equipage shall be prescribed. Direct controller-pilot VHF voice communication shall be maintained while such separation is applied.

3. ACTION BY THE MEETING

- 3.1 The meeting is invited to:
 - a) note the information contained in this paper; and
 - b) discuss any relevant matters as appropriate.