



International Civil Aviation Organization
The Second Meeting of South China Sea Major Traffic Flow Review Group
(SCS-MTFRG/2)
Haikou, China, 22-24 July 2015

Agenda Item 5: Discussion on PBN Routes Development and FLAS/FLOS Optimization

PBNICG/2 Meeting Outcomes

(Presented by Secretariat)

SUMMARY

This paper presents PBN route planning and implementation related outcomes of the second meeting of PBN Implementation Coordination Group, which was held in Bangkok, Thailand, 11-12 June, 2015.

1. INTRODUCTION

1.1 The Second Meeting of Performance Based Navigation Implementation Coordination Group (PBNICG/2) was held at the ICAO Asia-Pacific Regional Office, Bangkok, Thailand, on 11th & 12th Jun 2015.

2. DISCUSSION

2.1 2 Draft Decisions and 21 Action Items were recorded as outcomes of PBNICG/2. Some of these have implications to the work of the SCS MTFRG in relation to the use of PBN in en-route airspace. These can be used as a basis for the consideration and planning of PBN routes in SCS area that is of relevance in addressing solutions to mitigate MTFs

2.2 **Draft Decision 2/1 - PBN in a page:** That, the PBN-in-a-page document be adopted as regional supporting material and be published on the ICAO RO website after the review by relevant Panels and Study Group as well as ICAO.

2.2.1 PBN-in-a-page is a compilation of various standards and provisions from the many relevant ICAO documents. It aims to provide PBN implementers a compact reference document for consulting different ICAO documents by summarising relevant standards and provisions from Doc9613, PANS-OPS, and PANS-ATM and tabulates them into one page. PBN-in-a-page includes the information on PBN NavSpecs. and related infrastructure, application, route spacing and associated CNS requirements .

2.2.2 With regard to route spacing, this table includes criteria other than ICAO criteria. Therefore this table is now being reviewed by ICAO HQ and an approved version is expected to be ready before the CNS SG/19 in the end of July 2015.

2.3 Draft Decision 2/2 - PBN Procedure Safety Assessment Checklist and Record of Hazard Template: That:

1. The PBN Procedure Safety Assessment Checklists and Record of Hazard Template be adopted as regional supporting material; and
2. The checklists and template be published on the ICAO RO website.

2.3.1 This Safety Assessment Checklists could be used for the preparation of a PBN procedure safety assessment. The checklist consists of three parts, namely RNP Approach, SIDs/STARs and ATS Route that could be used when identifying hazards in the procedures. The Record of Hazard Template are could be used to record the safety assessment process, which includes the summary of hazard identification, analysis and mitigation. When implementing PBN routes, States are recommended to use this Safety Assessment Checklist (Part3 ATS Routes).

2.4 Other Related Action.

2.4.1 Two critical concerns were raised during the PBNICG/2: One of these concerns was that there was insufficient guidance material to support the implementation of the newer navigation specifications, such as RNP2 and Advanced RNP, and that States would not be able to achieve the timelines recommended by either ICAO or those specified in the Asia/Pacific Seamless ATM Plan. The other concern was insufficient information on fleet capability, which was an important factor for States to determine the appropriate navigation specifications and implementation timelines.

2.4.2 In this regard, PBNICG decided the following actions

2.4.2.1 Action 2/6 IATA to provide the estimated population and the forecast growth for every 5 years period of all new navigation specifications.

2.4.2.2 Action 2/11 ICAO to deliver PBN Operational Approval training material for new PBN navigation specifications RNP 2 and Advanced RNP, by September 2015 and training delivery by Dec 2015 .

3. ACTION BY THE MEETING

- 3.1 The meeting is invited to:
 - a) note the information contained in this paper.

PBN NavSpecs and Route Spacing (PBN Manual Doc 9613 Volume II, Attachment B & PANS-OPS Doc 8168 Volume II, Part III)

Nav Specs	Flight Phase								Supporting Nav. Infrastructure	Route Spacing (NM)	Additional Functionality (Required or Optional)					Operational Requirements			
	En-route Remote	En-route Continental	Arrival	Approach				Departure			RF	FRT	TOAC ²⁾	Baro VNAV	Nav DB	Communication	Navigation	Surveillance	Others
				Initial	Intermediate	Final	Missed ¹⁾												
RNAV 10	10								Not require ground-based Naviad Dual LRNS (INS, IRS FMS, GNSS)	50			TBD ²⁾		O	Voice com through 3rd party, DCPC in some areas	RNAV 10 (RNP 10) Approval, lateral deviation less than 7NM (same direction)/6NM (opposite direction)	Procedural pilot position reports	System safety must be monitored, TLS 5X10 ⁻⁹ accident per flight hour
RNAV 5		5	5 ³⁾						VOR/DME DME/DME INS or IRS GNSS	16.5 - straight unidirectional racks (same direction route-ECAC) 18 - straight bidirectional tracks (opposite direction route- ECAC) 10 - ATC intervention capability (ECAC) 30 - No ATS Surveillance in high traffic density (ECAC)			TBD		O	DCPC- VHF	RNAV 5/RNP 5 OPS Approval (BRNAV)	Procedural pilot position report (RNP 5) Radar surveillance (RNAV 5)	
RNAV 2		2	2					2	GNSS DME/DME DME/DME/IRU	8 to 9 - straight tracks in high traffic density (en-route) (FAA)			TBD		R	DCPC- VHF	RNAV 2 OPS Approval (PRNAV, US RNAV AC 90-100)	Radar surveillance	
RNAV 1		1	1	1	1		1	1	GNSS DME/DME DME/DMe/IRU	8 - straight tracks in high density (terminal, Eurocontrol) 7 for SIDs/STARs (PANS-ATM)			TBD	O	R	DCPC- VHF	RNAV 1 OPS Approval (PRNAV, US RNAV AC 90-100)	Radar surveillance	
RNP 4	4								Not require ground-based Naviad GNSS	30 (part of the Pacific airspace) 50 or 30 * (PANS-ATM) *23NM proposed by SASP (applicable date : 10 November 2016)		O	TBD		R	DCPC or CPDLC	RNP 4 OPS Approval	ADS with a lateral deviation contract having 5NM	System verification assuring lateral deviation less than 15NM
RNP 2	2	2							GNSS	50, 30 or 15 (PANS-ATM) 7 for climb/descend through other aircraft with VHF DCPC 20 for climb/descend through other aircraft with other type of com.		O	TBD		R	Depend on operational considerations (route spacing, traffic density, complexity, contingency procedures)	RNP 2 OPS Approval (Oceanic/Remote/continental)	Not required except reduced route spacing	
RNP 1			1	1	1		1	1	GNSS	5 for SIDs/STARs (PANS-ATM)	O		TBD	O	R	DCPC (RNP 1 SIDs/STARs)	RNP 1 OPS Approval	Not required except reduced route spacing	
A RNP ⁴⁾	2	2 or 1	1 - 0.3	1 - 0.3	1 - 0.3	0.3	1 - 0.3	1 - 0.3	GNSS Multi-DME may be provided	7 - straight and turning tracks (<90°) in high traffic density (en-route, Terminal, Eurocontrol) 6 to 7 NM with an RNP 0.5 (terminal, Eurocontrol)	R	O	TBD	O	R	DCPC- VHF	A-RNP OPS Approval (Navigation accuracy at least ±1NM, 95% of the flight time)	Radar surveillance (may not be required to certain navigation application)	
RNP APCH (Part A) ⁵⁾				1	1	0.3	1		GNSS (Missed App - RNAV or Conv.)	5 for SIDs/STARs (PANS-ATM)	O		TBD	O	R	Not required	RNP APCH OPS Approval	Not required	
RNP APCH (Part B) ⁵⁾				1	1	Angular	1 or 0.3 (Initial Straight MISAP)		GNSS	5 for SIDs/STARs (PANS-ATM)	O		TBD		R	Not required	RNP APCH OPS Approval	Not required	
RNP AR APCH				1 - 0.1	1 - 0.1	0.3 - 0.1	1 - 0.1		GNSS (DME/DME may be authorized)	5 for SIDs/STARs (PANS-ATM)	R ⁶⁾		TBD	R ⁶⁾	R	Not required	RNP AR APCH OPS Approval	Not required	
RNP 0.3		0.3	0.3	0.3	0.3		0.3	0.3	GNSS		O		TBD	O	R	Not required	RNP 0.3 OPS Approval	Not required	

1) RNP requirements do not apply to initial and intermediate missed approach segments.

2) TOAC (Time of Arrival Control), TBD (To Be Determined)

3) RNAV 5 may be used for initial parts of STARs outside 30 NM from the ARP.

4) Advanced RNP core requirements are limited to RNP 1 in all flight phases except final approach (RNP 0.3) and RNP 2 in oceanic/remote and en-route continental. A scalability option will allow accuracy values between 0.3 and 1.0, in 0.1 NM increments, in all flight phases except oceanic/remote/en-route continental (RNP 1 and RNP 2) and final approach (RNP 0.3).

5) Part A and B refer to the Performance-based Navigation (PBN) Manual (Doc 9613), Volume II, Part C, Chapter 5, Part A — RNP APCH operations down to LNAV and LNAV/VNAV minima and Part B — RNP APCH operations down to LP and LPV minima, respectively.

6) Specific requirement for RF and VNAV

3. ATS Route

PBN Safety Assessment Initial Checklist – ATS Route				
Assessor		<input type="checkbox"/> New	<input type="checkbox"/> Amended	
Route Designator		Date		
S : Satisfactory, U : Unsatisfactory, N/A : Not Available				
No.	Check Items	S	U	N/A
1	Is the safety assessor independent of the flight procedure team and has s/he been involved with the process? Comments :			
2	Has proposed ATS route been reviewed independently by a qualified route designer? Comments :			
3	Did procedure designers coordinate with related entities such as ATC, Operators, etc., regarding the new and/or amended ATS route? ▪ Comments :			
4	Did related ATC facilities review new and/or amended procedures based on the Letter of Agreement (LOA) between facilities? Is the amended LOA published and effective? ▪ Comments :			
5	Are the locations of waypoint and restrictions (e.g. speed, altitude, etc.) appropriate for the aircraft that is expected to use the ATS route? ▪ Comments :			
6	Are there any expected difficulties or the possibility of confusion on the name of waypoints phonetically? It is recommended that proximity check for like-sounding codes should be done within 500NM for en-route waypoints using ICARD system. ▪ Comments :			
7	Is the designator of ATS route appropriate for its application, i.e. domestic or international? Is the duplicity of the name confirmed with neighbouring States? ▪ Comments :			
8	Are there any parts that may lead to mistakes or difficulties while using the proposed ATS routes (e.g. separation from other ATS routes and/or airspace including military controlled airspace, coordination with other facilities including military, identification of navigation specification, difference of turn performance, introduction of FRT, etc.)? ▪ Comments :			
9	In case of procedure amendment, was a review of safety incidents/accidents concerning the existing procedure conducted, with the view of mitigating them? ▪ Comments :			
10	Referring to ICAO Annex 4, 15 and Doc 8697, are there any errors on the AIP publication? (check items : magnetic bearing/true heading, distance, coordinates, restrictions, directions, etc.) ▪ Comments :			

PBNICG/2
Appendix D to the Report

11	<p>Were all obstacles evaluated in the proposed ATS route and properly documented?</p> <p>▪ Comments :</p>			
12	<p>Were coverage and limitations of available avionics, ground navigational aids and GNSS considered while designing and validating the proposed procedures?</p> <p>▪ Comments :</p>			
13	<p>Does separation applied between instrument flight procedures of neighbouring airport(s), airspaces including special use airspaces (SUAs), neighbouring ATS routes and the proposed ATS route satisfy separation criteria specified in ICAO PANS-ATM (Doc 4444) and PANS-OPS (Doc 8168)?</p> <p>▪ Comments :</p>			
14	<p>Do the proposed ATS route consider separation between aircraft using PBN procedures and aircraft using other procedures specified in ICAO PANS-ATM (Doc 4444)?</p> <p>▪ Comments :</p>			
15	<p>Did the proposed ATS route consider current and expected future airspace capacity?</p> <p>▪ Comments :</p>			
16	<p>Are there any alternative methods when an aircraft flying the proposed ATS route is unable to maintain the requirement of the route because of ground/satellite/airborne system failures, technical problems or other difficulties?</p> <p>▪ Comments :</p>			
17	<p>Is there any training plan for air traffic controllers on the proposed ATS route? Has the training been conducted?</p> <p>▪ Comments :</p>			
18	<p>Are there any items requiring special authorization on the use of the proposed ATS route, e.g. reduction of lateral separation between ATS routes? If any, were sufficient reviews on criteria conducted and was rationale for requiring special authorization reasonable?</p> <p>▪ Comments :</p>			

Appendix. Record on Identification, Analysis and Mitigation of Hazard

Identification No		Source	<input type="checkbox"/> Safety Report <input type="checkbox"/> Safety Review <input type="checkbox"/> Safety Assessment <input type="checkbox"/> Safety Audit <input type="checkbox"/> Safety Observation <input type="checkbox"/> Safety Survey <input type="checkbox"/> Sampling Survey <input type="checkbox"/> Others
Assessment Date	YYYY.MM.DD		
Assessment Items	Name of IFP/SID/STAR/ATS route		
Category of Hazard	<input type="checkbox"/> Human Factors <input type="checkbox"/> Equipment <input type="checkbox"/> Operational <input type="checkbox"/> Environment		
Identification of Hazard(s)	Subject :		
	Details (includes a review of safety incidents of the existing procedure(s), if any) :		
Risk Analysis	Probability	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	
	Severity	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D <input type="checkbox"/> E	
Outcome of Risk Analysis	Assessed Risk Index	<input type="checkbox"/> Unacceptable <input type="checkbox"/> Acceptable based on risk mitigation <input type="checkbox"/> Acceptable	
	(Probability & Severity, e.g. 3C)		
Mitigation Measures			
Outcome of Safety Reassessment			
Comments by Safety Assessment Team (If necessary)			
Date Completed	YYYY.MM.DD		

Safety Risk Probability Table (SMM Manual (Doc 9859) Figure 2-11)

Likelihood	Meaning	Value
Frequent	Likely to occur many times (has occurred frequently)	5
Occasional	Likely to occur sometimes (has occurred infrequently)	4
Remote	Unlikely to occur, but possible (has occurred rarely)	3
Improbable	Very unlikely to occur (not known to have occurred)	2
Extremely Improbable	Almost inconceivable that the event will occur	1

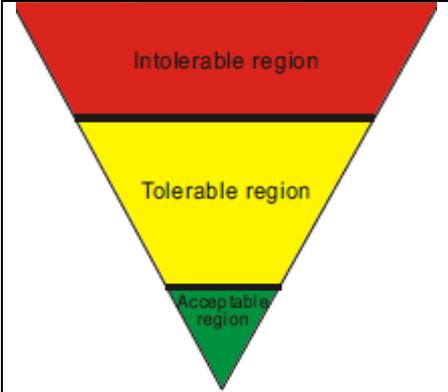
Safety Risk Severity Table (SMM Manual (Doc 9859) Figure 2-12)

Severity	Meaning	Value
Catastrophic	<ul style="list-style-type: none"> • Equipment destroyed • Multiple deaths 	A
Hazardous	<ul style="list-style-type: none"> • A large reduction in safety margins, physical distress or a workload such that the operators cannot be relied upon to perform their tasks accurately or completely • Serious injury • Major equipment damage 	B
Major	<ul style="list-style-type: none"> • A significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of an increase in workload or as a result of conditions impairing their efficiency • Serious incident • Injury to persons 	C
Minor	<ul style="list-style-type: none"> • Nuisance • Operational limitations • Use of emergency procedures • Minor incident 	D
Negligible	<ul style="list-style-type: none"> • Few consequences 	E

Safety Risk Assessment Matrix (SMM Manual (Doc 9859) Figure 2-13)

Risk Probability	Risk Severity				
	Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent 5	5A	5B	5C	5D	5E
Occasional 4	4A	4B	4C	4D	4E
Remote 3	3A	3B	3C	3D	3E
Improbable 2	2A	2B	2C	2D	2E
Extremely Improbable 1	1A	1B	1C	1D	1E

Safety Risk Tolerability Matrix (SMM Manual (Doc 9859) Figure 2-14)

Tolerability Description	Assessed Risk Index	Suggested Criteria
 <p>Intolerable region</p>	<p>5A, 5B, 5C, 4A, 4B, 3A</p>	<p>Unacceptable under the existing circumstances</p>
<p>Tolerable region</p>	<p>5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D 2A, 2B, 2C, 1A</p>	<p>Acceptable based on risk mitigation. It may require management decision.</p>
<p>Acceptable region</p>	<p>3E, 2D, 2E, 1B, 1C, 1D, 1E</p>	<p>Acceptable</p>