International Civil Aviation Organization
South American Regional Office
Twelfth Workshop/Meeting of the SAM Implementation Group (SAM/IG/12) - Regional Project RLA/06/901
(Lima, Peru, 14 to 18 October 2013)

SAM/IG/12-WP/15
23/09/13

Agenda Item 2: SAM airspace optimisation
b) PBN in terminal areas

PBN IN TERMINAL AREAS AT INTERNATIONAL AIRPORTS OF THE SAM REGION

(Presented by the Secretariat)

SUMMARY

This working paper presents a proposal to conduct courses/workshops for the implementation of PBN design of TMAs at the international airports of the Region, pursuant to Conclusion SAM/IG/11-1. It also submits to the consideration of the Meeting an action plan for PBN design of TMAs, as well as the results of PBN surveys conducted in the SAM Region.

REFERENCES

- Reports of the workshops/meetings of the SAM Implementation Group.

ICAO Strategic Objectives:	*A - Safety* *C - Environmental protection and sustainable development of air transport*

1. Background

1.1 The SAM/IG/11 meeting analysed the results of the Course/Workshop on PBN Design in Terminal Areas conducted in Miami in March 2012. Only experts from 5 States attended this course: **Argentina, Brazil, Colombia, Paraguay and Peru**.

1.2 Argentina submitted to the SAM/IG/11 meeting the redesign plans being developed by MITRE. In this regard, Uruguay informed that there was an initiative with this company to redesign the Carrasco TMA.

1.3 Brazil started to redesign its terminal areas a long time ago, and expects to complete this process in the medium term. In the case of Peru, a basic design was defined at the PBN course in Miami, and they are working towards its implementation.

1.4 The SAM/IG/11 meeting concluded that it would be advisable to complete the training of experts of SAM States, bearing in mind that not all the States participating in the Project could attend this course/workshop. Furthermore, the meeting considered that it would be essential to continue this process to assist States in the redesign of their TMAs applying PBN.

1.5 Based on the foregoing, and through Conclusion SAMIG/11-1, it was felt that the course/workshop on airspace design should be replicated at the Lima Regional Office, with an intensive work schedule, to train a team to assist a group of States with aligned traffic flows and develop a basic design for the main international airports, which could be further developed on site by State experts.

1.6 Through letter LT2/3A.39-SA204, the Secretariat sent a survey to SAM States to be responded by 8 May 2013. Using funds from its Regular Programme, the Regional Office hired an expert to analyse the information, complete the missing information, and develop a dynamic template to be used as the baseline for the status of implementation of improvements in regional efficiency.

1.7 Not all SAM States responded to the survey. Consequently, the information contained in the AIPs available at the Regional Office in electronic or physical format was used as official source. Likewise, and despite having the response from the States, the information was verified with that officially published in the respective AIPs. In other cases, information was reviewed based on publications of private aeronautical information providers.

2. Discussion

2.1 Although it has always been considered that PBN implementation in TMAs and the restructuring thereof, as well as the implementation of new RNAV/RNP approach procedures are activities that correspond to the States, it should be taken into account that the implementation of SIDs and STARs, and of CDO and CCO procedures have a direct impact on airspace optimisation and are closely related to ATS route network structure.

2.2 In the South American Region, the States that could not participate in the first course/workshop on PBN design of terminal areas were: **Bolivia, Chile, Ecuador, Guyana, Panama, Suriname, Uruguay, and Venezuela**.

Courses on PBN design of terminal areas in the SAM Region

2.3 Pursuant to Conclusion SAMIG/11-1 that saw the convenience of extending training in the Region in order to expedite this implementation, it is necessary to plan the activities under Project RLA/06/901 for 2014 and, in this sense, define how many courses/workshops on TMA design are necessary, in order to submit them to the approval of the next meeting of the Coordination Committee of the Project.

2.4 The ideal duration of courses/workshops is 10 days (2 weeks), with an intensive schedule from 08:30 to 16:30, with the corresponding breaks. They would be carried out at the ICAO Regional Office in Lima. The objective is to develop theoretical/practical training on PBN design in terminal areas, which could take on two modalities.

2.5 The courses/workshops on PBN design of TMAs could be generic or customized. In the generic modality, the course/workshop would provide theoretical training, with practical examples of PBN redesign, for experts of the States who are interested in restructuring their terminal areas. In the customized modality, certain TMAs of the Region are selected and worked on to generate an advanced design project for further development, adjustment and implementation by the States.

2.6 For the customized modality, the course/workshop may consider up to 3 TMAs, depending on the number of experts attending the training. The participants should be experts deeply involved in the practical design of airspace in their respective State and it is felt that two fellowships

should be granted to each State participating in the Project. Experts and States should undertake to execute the PBN design project in the TMAs immediately after the course.

2.7 Taking into account the high cost of these courses/workshops, States participating in the customized modality shall submit a tentative action plan for the implementation of the selected TMAs before the course/workshop, take a preparatory on-line course on PBN and pass it, and provide the traffic data and AIP information that may be requested for the preparation of the instructors. The action plan format is shown in **Appendix A** to this working paper.

Standard arrivals and departures (STARs and SIDs)

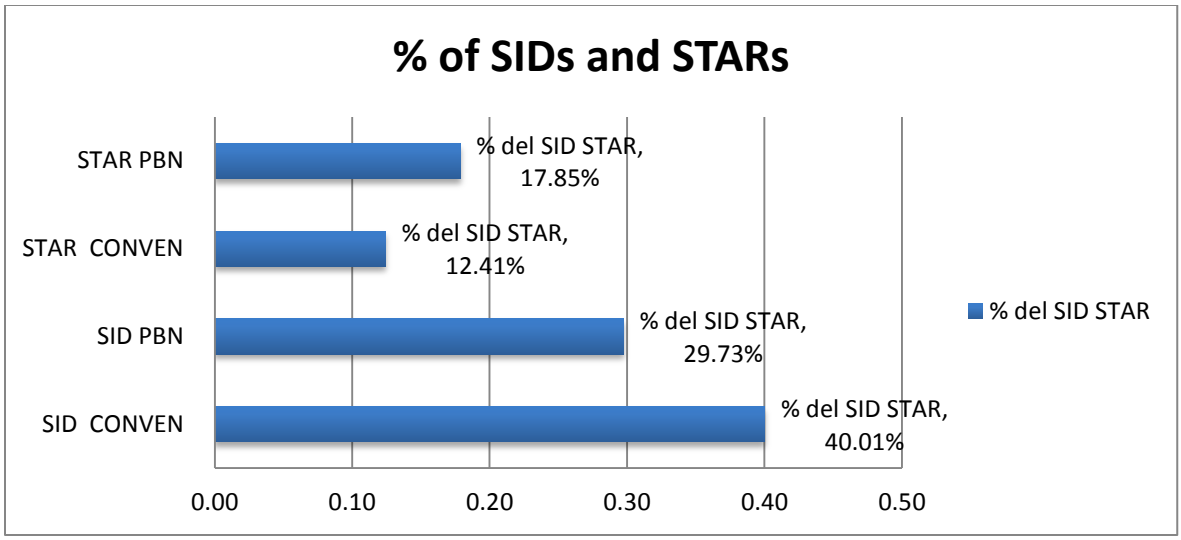
2.8 The results of the study conducted by the consultant on standard arrivals and departures are as follows:

a) Regarding standard arrival procedures (STARs), out of a total of **512 procedures**, 210 are conventional procedures (41%) and 302 are PBN procedures (59%);

b) Regarding standard departure procedures (SIDs), out of **1,180 procedures**, **677** are conventional procedures (57%) and 503 are PBN procedures (43 %). The following breakdown identifies the number and percentage of SIDs and STARs in the Region:

Percentage of SIDs and STARs	Conventional SIDs	PBN SIDs	Conventional STARs	PBN STARs	
Total	677	503	210	302	**Total 1680**
% of SIDs and STARs	40.0	29.7	12.4	17.8	

2.9 The following figure illustrates the different categories of SIDs and STARs:



2.10 In summary, a total of 1,680 STAR and SID procedures have been designed and published for 99 international airports in the SAM Region, out of which 878 (52%) are conventional, and 802 (48%) are PBN.

Total number of airports	Total SIDs/STARs	Total PBN SIDs/STARs	ICAO Indicator % PBN SIDs/STARs
99	1680	805	**48 %**

CDOs and CCOs

2.11 Although information has been obtained about continuous descent and continuous climb operations in PBN STARs and SIDs in the SAM Region, no CDOs and CCOs have been published to date in the respective AIPs.

2.12 In this regard, and based on reports, the 56 PBN STARs of SBBS (Brasilia) and the 24 PBN STARs of SBRF (Recife) were developed using CDO techniques. Likewise, STARs are expected to be implemented with CDOs in the arrivals at SBSP, SBGR, SBKP, SBSJ, SBGL, and SBRJ by the end of 2013.

Total number of airports	Total CDOs	ICAO indicator % CDOs per airport
99	0	**0 %**

Total number of airports	Total CCOs	ICAO indicator % CCOs per airport
99	0	**0 %**

NOTE: With respect to how CDOs and CCOs are to be published, see the corresponding working paper (SAM/IG/12-WP/05).

3. **Suggested action:**

3.1 The Meeting is invited to:

a) recommend the most convenient modality for the course/workshop;

b) suggest the TMAs to be redesigned under the customized modality in 2014 and those that could be redesigned in 2015;

c) define how many courses/workshops would need to be conducted in 2014 and 2015;

d) review the action plan contained in Appendix A, define the duration of each task, and make the recommendations and adjustments it may deem appropriate;

e) review the surveyed information on arrival and departure procedures and recommend the actions it may deem appropriate.

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APPENDIX A

ACTION PLAN FOR THE IMPLEMENTATION OF PERFORMANCE-BASED NAVIGATION (PBN) IN TMAs

State:			***TMA:***		
TASKS	**Start**	**End**	**Responsible party**	**Time**	**Status**
1. **Planning phase**					
1.1 Identify and agree on the operational requirements (RNAV 1/RNP1 in SIDs/STARs, etc.)					
1.2 Identify the requirements for the implementation of CDOs/CCOs in the TMA under study					
1.3 Establish the working group (WG) for airspace design and development of the operational concept					
1.4 Identify the objectives, scope, and work programme					
1.5 Collect traffic data for the TMA in order to understand the flows in the particular airspace					
1.6 Obtain traffic statistics and forecasts					
1.7 Collect information on aircraft fleet navigation capabilities					
1.8 Analyse the reference scenario, assessing the following aspects: a) Traffic data b) Traffic forecasts c) Aircraft fleet					
1.9 Define system safety and performance criteria and policies					
1.10 Analyse the means of ground communication, navigation (VOR, DME), and surveillance at the TMA to meet navigation specifications and the navigation reversal mode, if applicable					
1.11 Conduct the obstacle survey in the area, as required, based on priorities, to achieve 100% coverage of airports in the TMA in question.					
1.12 Assess national PBN regulations					

State:			***TMA:***		
TASKS	**Start**	**End**	**Responsible party**	**Time**	**Status**
1.13 Establish a collaborative decision-making process (CDM)					
1.14 Coordinate planning and implementation requirements with air navigation service providers, regulators, users, aircraft operators, and military authorities					
1.15 Establish an acceptable percentage of approved operations for the implementation of RNAV SIDs/STARs based on statistics					
1.16 Establish the date and time of implementation in agreement with service providers, aircraft operators, airports, etc.					
2. **Design phase**					
2.1 Define SIDs/STARs to be optimised, based on statistics					
2.2 Define whether CDOs/CCOs will be implemented in the TMA under consideration					
2.3 Design the procedures to be applied first					
2.4 Assess airspace volume and sectorisation, if necessary					
2.5 Select ICAO navigation specifications to be used (RNAV 1/RNP1, as required)					
2.6 Establish the documentation format in the Administration's PBN website					
2.7 Assess PBN implementation in ATC automated systems (check new FPL format)					

State:			***TMA:***		
TASKS	**Start**	**End**	**Responsible party**	**Time**	**Status**
3. **Validation phase**					
3.1 Validate the airspace concept for the TMA concerned					
3.2 Airspace modelling to be used in the simulation					
3.3 Fast-time simulation (FTS) (if feasible and if the means and tools are available)					
3.4 Real-time simulation (RTS)					
3.5 *In vivo* trials (only when the aforementioned methods cannot be used)					
3.6 Flight simulation					
3.7 Noise modelling to ensure that paths do not affect sensitive areas					
3.8 Completion of SID/STAR procedures to be used					
3.9 Validation of the SID/STAR procedures developed					
3.10 Risk analysis of the new airspace design, applying a qualitative methodology based on SMS					
4. **Implementation phase**					
4.1 Analyse aircraft and operator (pilots, dispatchers, and maintenance personnel) approval requirements, as established in the PBN manual, and develop the necessary documentation					

State:			***TMA:***		
TASKS	**Start**	**End**	**Responsible party**	**Time**	**Status**
4.2 Publish the national regulations for the implementation of the RNAV1/RNP1 navigation specification, if applicable, and/or CDOs/CCOs					
4.3 Start the aircraft and operator approval process					
4.4 Establish and maintain an updated registry of approved aircraft and operators					
4.5 Assess State regulations on the use of GNSS and, if applicable, proceed to their publication					
4.6 Complete the implementation of WGS-84 where required					
4.7 Prepare the model AIC to inform about PBN implementation plans					
4.8 Publish the AIC informing about PBN implementation plans					
4.9 Develop the model amendment of the AIP/AIP supplement, including applicable standards and procedures, the corresponding in-flight contingencies, information on RNAV1/RNP1, as well as applicable sensor limitations and critical radio aids for each route segment					
4.10 Publish AIP supplement containing applicable standards and procedures, including the corresponding in-flight contingencies					
4.11 Review the Procedures Manual of the ATS units involved					
4.12 Update letters of agreement between ATS units (if necessary)					

State:			***TMA:***		
TASKS	**Start**	**End**	**Responsible party**	**Time**	**Status**
4.13 Develop a training and documentation programme for operators (pilots, dispatchers, and maintenance)					
4.14 Develop a training and documentation programme for air traffic controllers and AIS operators					
4.15 Develop a training programme for regulators (aviation safety inspectors)					
4.16 Conduct training programmes					
4.17 Conduct seminars for operators, describing plans and foreseen operational and economic benefits					
4.18 Develop a post-implementation SID and STAR monitoring programme					
4.19 Implement changes in ATC automated systems, as required					
4.20 Prepare trigger NOTAM					
4.21 Post all the required information on the Administration's PBN website					
5. **Implementation decision phase**					
5.1 Assess the available operational documentation (ATS, OPS/AIR)					
5.2 Assess the percentage of approved RNAV1/RNP1 operations (non-exclusionary airspace).					

State:			***TMA:***		
TASKS	**Start**	**End**	**Responsible party**	**Time**	**Status**
5.3 Review safety assessment results, applying the SMS methodology					
5.4 Go/no go decision					
5.5 Publish trigger NOTAM					
6. **Performance monitoring phase**					
6.1 Implement a post-implementation monitoring programme for TMA operations					
6.2 Assess the percentage of RNAV1/RNP1 operations conducted in the airspace of the TMA concerned following implementation					
Pre-operational implementation date	AIRAC date …/…/….				
Definitive implementation date	AIRAC date …/…/….				

- END -