

## **SECOND PBN WORKSHOP**

### **Summary**

The Second workshop on PBN airspace design was held in Lima, Peru, on 8-12 September 2014, under the auspices of the ICAO South American Office and with the support of Regional Project RLA/06/901 – “*Assistance for the implementation of a regional ATM system based on the ATM operational concept and the corresponding CNS technological support*”, pursuant to ICAO Assembly Resolution A37-11 whereby the global implementation of performance-based navigation (PBN) was approved.

Pursuant to Conclusion SAM/IG/11-1 (*Support to SAM States for the redesign of their TMAs*), it was deemed advisable to plan Project RLA/06/901 activities for 2014 in order to define the needs and broaden the training of ATM experts in the SAM Region with a view to supporting and expediting the regional PBN implementation plan, thus increasing the knowledge of participants concerning the use of PBN.

The SAM/IG/12 meeting (Lima, Peru, 14-18 October 2013) agreed on the convenience of conducting the required training in three consecutive phases:

- The first phase consisted on distance training, in which participants had to learn about PBN basics through the ICAO website (<http://www.icao.int/safety/pbn/SitePages/PBN%20ikit.aspx>) and study the following PBN-related manuals: the PBN Manual (Doc 9613), Manual on the Use of Performance-Based Navigation (PBN) in Airspace Design (Doc 9992), Continuous Descent Operations Manual (Doc 9931), and Continuous Climb Operations Manual (Doc 9993).
- The second phase consisted in participation in the First workshop on PBN airspace design, for a period of two weeks, the purpose of which was to provide theoretical/practical training on PBN design of terminal areas, using 1 highly complex TMA and 1 less complex TMA for the practical exercise, for which the terminal areas of Bogota and Asuncion were selected, respectively.
- The third phase involved participation in the Second workshop on PBN airspace design, for a period of 1 week, where all the participants from the first workshop had to submit the preliminary basic design for 1 TMA selected for each State, and the proposed designs were to be harmonised and optimised during the workshop, applying the techniques learned at the first workshop, integrating the points of entry and exit of these TMAs with a view to developing version 3 of the SAM route network.

The second PBN workshop for the South American Region was attended by 34 experts from 11 States and 9 experts from the industry (IATA and Jeppesen), representing aeronautical authorities, air navigation service providers, and civil and military aircraft operators of the South American Region. In general, they were experts in areas such as air traffic control, airspace planning, instrument approach procedure design, airline pilots and operations technicians/engineers, aircraft dispatch, air navigation inspectors, and aeronautical mapping.

During the opening of the PBN workshop, Mr. Julio Pereira, ATM Officer of the ICAO South American Regional Office briefly explained the objectives of the workshop and acknowledged the effort made by aeronautical authorities of the SAM Region to send their experts to this important event, which falls within the framework of the regional strategy for attaining the goals of the Bogota Declaration.

The following aspects were noted during the presentation of the preliminary design and action plan by each SAM State.

### **Argentina**

One of the main objectives of PBN implementation at the Baires TMA is to minimise interference between arrivals and departures at the main airports of the TMA: Aeroparque, Ezeiza, and San Fernando.

Taking into account the interface among the route networks of Argentina, Brazil, and Uruguay, the need was identified for closer coordination among these States during the PBN planning, design, validation, and implementation phases, including the conduction of specific trilateral meetings.

A more comprehensive data collection and analysis is required in order to develop a PBN airspace design that can move into the validation phase.

The PBN design of the Baires TMA that was presented at the workshop was constrained by the structure of the TMA and the existing routes, and had 9 points of entry and exit. Consequently, it was recommended to study the feasibility of dividing the Baires TMA project into two phases:

- Phase 1 - Current route structure, analysis of a new TMA and new entry and exit points;
- Phase 2 - Version 3 of the SAM route network.

Given the significant flow between SAEZ and SUMU, it was suggested that this segment be subject to a specific analysis, including the possibility of eliminating the ATS routes and replacing them with RNAV1/RNP 1 departure and arrival procedures that would permit a 7 NM lateral separation.

### **Bolivia**

The main challenge of the Bolivian administration will be the implementation of a PBN airspace concept in a TMA lacking ATS surveillance.

A more comprehensive data collection and analysis is required in order to develop a PBN airspace design that can move into the validation phase.

The development of a PBN airspace design based on “four corners” has been recommended, seeking a conventional aircraft flow that is consistent with the PBN design.

It was suggested that the “user case” technique be used, which consists in developing several scenarios to verify the feasibility of adopting PBN and non-PBN air traffic routing and separation procedures, based on the existing conventional separation techniques, taking into account the usual air traffic flow of the Santa Cruz TMA.

Taking into account the goal of implementing APV procedures in all thresholds operating under IFR, it was recommended that this type of procedure be implemented as soon as possible in threshold 16 of the Santa Cruz Airport.

The Workshop suggested that the implementation of the PBN concept at the Santa Cruz TMA be done in 2 phases:

- Phase 1 - Without ATC surveillance;
- Phase 2 - With ATS surveillance, taking into account the existence of an ATS surveillance implementation project in Bolivia.

### **Brazil**

The Brazilian delegation did not submit the preliminary design of the Southern PBN (PBN SUR) as scheduled, since efforts were focused on:

- Issues identified during monitoring following PBN implementation in Sao Paulo;
- The need for adjustments in the BH and BR TMAs.

The Southern PBN implementation dates (second semester of 2016 or first semester of 2017) will have a significant impact on PBN implementation in the Montevideo and Buenos Aires TMAs. Accordingly, the meeting recommended that PBN implementation in these TMAs be divided into 2 phases, before and after the implementation of Version 03 of the route network, taking into account that it may be affected by the deadlines set by Brazil. It is important to highlight that the dates established by the Brazilian administration might affect the attainment of the Bogota Declaration goals, due by the end of 2016.

Taking into account the interface amongst the route networks of Argentina, Brazil, and Uruguay, the need was identified for close coordination among these three States during the PBN planning, design, validation, and implementation phases, including the conduction of specific trilateral meetings.

The Brazilian delegation has submitted an airspace planning data collection and processing model (city pair flow - “temperature”), which should be used by the other States.

### **Chile**

The PBN design of the Santiago TMA was considered to be consistent and ready for the validation process. The design was enabled by the implementation of the PAMPA Project, due on 18 September 2014. The validation process may be considered as started, since tests of the new proposed sectors have already been conducted.

The tentative implementation date of the PBN project at the Santiago TMA is September 2015.

The PBN design for RWY 17 was assigned priority in view of the absolute prevalence of operations in this threshold (98% of operations).

According to data collected on the navigation capacity of the fleet, a significant difference was found between the operators approved for using GNSS en-route and those approved for using GNSS in the TMA. Accordingly, it was recommended that an in-depth analysis be conducted on the subject, bearing in mind the importance of this sensor for PBN operations in the TMA.

An initiative of the Chilean administration has been to use FOQA data for the design and monitoring of PBN operations. It is recommended that, if proven feasible, this technique be used by the other States.

The following has been suggested for a second PBN implementation phase at the Santiago TMA:

- Assess the feasibility of conducting independent and/or segregated operations in SCEL, if necessary using RNP and ILS;
- Use of Version 03 of the SAM Route Network.

### **Colombia**

The Workshop noted that no progress had been made in the preliminary PBN design of the Bogota TMA, based on the one developed during the first PBN workshop. The Colombian administration has decided to set the institutional foundation for the Bogota TMA PBN project, with the following documents: project guide, project letter, and AIC announcing PBN implementation. Other States could use these documents for their implementation projects.

It was felt that the project might have been oversized, since it included some activities directly related to PBN implementation, such as: Bogota Airport Master Plan, and Plan for the construction of other airports. This oversizing could have a negative impact on, and unnecessarily delay, PBN implementation in the Bogota TMA.

The representative of Colombia informed about the need for coordination between the Bogota TMA PBN implementation project and the project for the new ATC control and systems centre, taking into account that the two changes must be sufficiently spaced in time so as to avoid operational problems resulting from the proximity of the dates. In this sense, it was suggested that the Colombian administration continue with the various phases of the Bogota TMA PBN project, taking into account that only upon completion of all the foreseen stages will it be possible to define an actual implementation date and use it as a basis for coordinating dates with other projects.

The representative of Colombia also noted that a desirable requirement of the project should be the acquisition of software for the development of instrument procedures and the implementation of the new ATC simulator, both already contemplated by the Colombian administration.

During the presentation of the Bogota TMA PBN project, it was noted that a survey had been used to collect data on controller and aircraft operator requirements. Although this was considered to be a good initiative, it should be used with caution, given its natural limitations given the fact that such requirements are based on the current airspace structure and its corresponding operational flaws. The best strategy to meet the requirements of air traffic controllers and aircraft operators is to ensure their participation from the onset of the PBN implementation process, starting in the planning phase.

A more comprehensive data collection and analysis is required in order to develop a PBN airspace design that can move into the validation phase.

### **Ecuador**

The Workshop took note that the Ecuadorian authority had made a significant investment in air navigation, including the following: ATC simulator, flight inspection aircraft, procedure design course, new navigation and surveillance equipment, etc.

A more comprehensive data collection and analysis is required in order to develop a PBN airspace design that can move into the validation phase.

The Workshop recommended that consideration be given to the feasibility of simplifying the PBN design of the new TMA, reducing the number of crossings between departure and arrival paths. It was also suggested that departures and arrivals in Sector E of the Guayaquil airport be assessed, taking into account the prohibited area of the Ecuadorian Air Force (SEP1).

The need was identified to expand the flexible use of airspace at the Guayaquil TMA and its surroundings, in view of the existence of a significant number of restricted and prohibited areas, their significant size and their interference with civil air traffic, making it extremely difficult to optimise aeronautical operations in the region.

It was also recommended that Class E be adapted to the current and the new Guayaquil TMA, taking into account that a VFR aircraft may fly in this airspace without ATC clearance and without establishing bilateral communication.

The tentative implementation date of the Guayaquil TMA PBN project is 26 May 2016.

### **Panama**

The Workshop noted that operations in the Panama TMA were already based on RNAV. Accordingly, the implementation process -especially the validation phase- should be carried out in greater depth, taking into account the need for the proposed design to be safer and more efficient than the existing one.

A more comprehensive data collection and analysis is required in order to develop a PBN airspace design that can move into the validation phase.

The configuration of the Tocumen Airport (location of passenger terminals and movement between frequently used thresholds – RWY 03) favours segregated and independent operations. In a first phase, the recommendation is to assess segregated operations under IMC and independent approaches under VMC, applying RNP approaches.

It was also recommended that instrument procedure alternatives be sought in order to reduce the impact of obstacles and terrain on the take-off sector of RWY 03, possibly enabling segregated operations and/or independent approaches.

Taking into account the existence of a new DME in the Panama TMA, it has been recommended that a technical (coverage and geometry) and operational (fleet capacity and need for a backup RNAV system) assessment be made for DME/DME operations.

The tentative date of implementation of the Panama TMA PBN project is 17 Sep 2015.

### **Paraguay**

Regarding the PBN design of the Asuncion TMA, it was noted that the “four corners” technique had been fully applied and that the arrival and departure paths of the Asuncion Airport had been improved, giving priority to the main flows. The meeting recommended that the airspace volume of the new proposed TMA be assessed based on departure and arrival paths. The PBN design of the Asuncion TMA was considered to be consistent and ready for validation. However, the need for more comprehensive data collection and analysis was considered with a view to confirming and consolidating the PBN design of the Asuncion TMA.

Taking into account that radar vectors would be used to guide non-PBN approved aircraft on paths similar to those used by PBN-approved aircraft, radar rating of air traffic controllers of the Asuncion ACCs and APPs was considered a critical requirement of the project and a determining factor for defining the tentative date of implementation: 23 June 2016.

It was recommended that the feasibility of implementing an RNP AR approach procedure be analysed in order to shorten arrivals, based on the characteristics of the Asuncion TMA (low air traffic volume and absence of obstacles and significant terrain). However, procedure designers of the Paraguayan administration need to be trained in RNP AR.

Likewise, based on the aforementioned characteristics of the Asuncion TMA, it was recommended that the implementation of a direct omnidirectional departure be considered for times when traffic volume is low.

### Peru

The Workshop took note of the broad scope of phase 2 of the PROESA project, which covers 4 TMAs: Arequipa, Cuzco, Juliaca, and Puerto Maldonado.

A more comprehensive data collection and analysis is required in order to develop a PBN airspace design that can move into the validation phase.

Initially, it was thought that the project was oversized, since it included ATFM implementation and the Chinchero Airport. However, during the debate, it was explained that the cited projects were only mentioned as a reference.

It was noted that phase 2 of the PROESA project would use parallel routes between most of the TMAs involved. Accordingly, a more in-depth assessment was recommended, taking into account that unidirectional routes could result in a loss of operational efficiency under low air traffic volume conditions. Nevertheless, unidirectional routes can be efficient in such environments in cases of significant concentration of air traffic during certain hours of the day. In order to mitigate a possible loss of efficiency due to the use of unidirectional routes, the Peruvian representative stated that the shorter segments between TMAs would be subject to a specific analysis in order to assess the possible elimination of ATS routes and their replacement with RNAV1/RNP 1 departure and arrival procedures to enable a 7NM lateral separation.

The Workshop was informed on RNP AR operations being carried out at an angle of 2.8° in Cuzco, because of the high altitude and high temperatures during certain times of the year, whereas Doc 9905 standards and criteria not necessarily apply in very high aerodromes, resulting in an approach slope steeper than desired. In this regard, it was recommended that SAM States study the Peruvian experience with the use of approach angles other than those foreseen in Doc 9905, especially at aerodromes located at very high altitudes and/or with high temperatures.

RNP AR will be used for take-off operations in the PROESA 2 project. Although the effective date for the use of this type of procedure has been set to November 2016 in Doc 8168 (PANSOPS), the workshop saw no problem in it being used, provided safety was ensured and the civil aviation authority approved the criteria for the approval of aircraft and operators and the criteria for the development of instrument procedures.

It was recommended that the holding points proposed in the project be assessed, taking into account that they might be too close to the Cuzco Airport.

The tentative date of implementation of the PROESA PBN project is February 2015.

## Uruguay

The preliminary design of the Montevideo TMA submitted during the workshop sought to cover, during the first phase, 60% of the air traffic that makes use of the TMA.

As in the case of Argentina and Brazil, and taking into account the interface amongst the route networks of Argentina, Brazil, and Uruguay, the need was identified for close coordination amongst these States during the PBN planning, design, validation, and implementation phases, including the conduction of specific trilateral meetings.

A more comprehensive data collection and analysis is required in order to develop a PBN airspace design that can move into the validation phase.

It was recommended that, in a second phase, the Uruguayan administration take into account the following aspects:

- The remaining 40% of air traffic;
- Version 03 of the route network;
- Use of RNP AR in order to shorten arrivals.

As in the case of the Baires TMA, and taking into account the significant flow between SAEZ and SUMU, which, in the case of the Montevideo TMA accounts for 50% of air traffic volume, it was suggested that a specific analysis be made of this segment, including the possibility of eliminating ATS routes and replacing them with RNAV1/RNP 1 departure and arrival procedures to enable the use of a 7 NM lateral separation.

## Venezuela

The Workshop recommended that an assessment be made of reducing the number of entry and exit points at the Maiquetia TMA, taking into account that the proposed design contained 9 entry and exit points.

Another important aspect is the low percentage of PBN-approved aircraft and operators, which could affect the project. In this regard, the recommendation was to conduct a more in-depth assessment of the PBN approval potential of the fleet, with a view to urging operators to move forward in the PBN approval process.

It was also recommended that an assessment be made of the allocation of class B to the TMA, taking into account that aircraft separation of VFR flights was a complex activity for air traffic controllers and was normally applied only in airspaces with high air traffic density.

The workshop recommended that, in a second implementation phase, an assessment be made of the need and feasibility of conducting segregated operations for approach in RWY 10 and for take-off in RWY 09.

### *Data collection and processing model (add city pairs)*

The presentation by the Venezuelan delegation showed the existence of DME arc-based arrival and approach procedures that were significantly inefficient. The Workshop took note that, in practice, the procedures were not being applied, precisely because of their inefficiency. Accordingly, it recommended that an assessment be made of the modification or cancellation of the procedures not being used.

The preliminary PBN design of the Maiquetia TMA was based on a comprehensive process of data collection and processing, in which only flows between city pairs and air traffic volume graphs were missing, much the same as the one presented by the delegation of Brazil.

### **Next activities of the SAM TMA PBN project**

The next activity of the SAM TMA PBN project will be the third PBN workshop, the main purpose of which is to validate the PBN designs for the TMAs and/or airspaces selected by SAM States.

It is important to highlight that, to date, only two TMAs have been considered sufficiently mature to start the validation process: Asunción and Santiago. The other States are in different stages of the planning and design process, at different levels of maturity, and each administration will have to make a greater or lesser effort in order to be ready to demonstrate, at the third PBN workshop, that the proposed design is suitable, especially from the safety and efficiency point of view.

It is also important to highlight that the implementation of Version 3 of the route network depends on consistent and harmonised implementation in SAM TMAs and that any delay in one or more States could affect the other States and the Regional Project as a whole.

Accordingly, SAM States shall carry out the following activities in preparation for the third PBN workshop:

- a) Develop an action plan for the implementation of the PBN airspace concept in the selected airspace, as an input for the SAM PBN project.
- b) Complete data collection and processing, with a view to giving consistency to the PBN design of the TMA and/or airspace selected by the State.
- c) Develop, as necessary, a new PBN airspace concept, based on the collected and processed data, and on the recommendations of the second PBN workshop.
- d) Complete the validation stage of the preliminary design, taking into account the following minimum requirements:
  - work on the white board;
  - IFSET;
  - ground validation of IFR procedures and VFR corridors;
  - independent review of IFR procedures, charts, and coding tables;
  - SMS.
- e) Review the airspace concept as needed, based on validation results, until a satisfactory PBN design is obtained for implementation, which shall be submitted at the third PBN workshop.
- f) Send the PBN design of the selected TMA and/or airspace to the SAM Regional Office before 20 February 2015.
- g) Participate in teleconferences in preparation for the third PBN workshop, to be carried out on the following tentative dates:
  - 02 October
  - 23 October

- 19 November
- 18 December
- 05 February
- 25 February

### **Assessment of the Workshop**

A survey was conducted to measure participant satisfaction with the workshop. Survey details are contained in **Appendix A**. In summary, the results showed that 89% of participants rated the workshop as excellent, while 11% rated it as good.



**APPENDIX A**

**SECOND WORKSHOP ON THE USE OF PBN IN  
AIRSPACE DESIGN IN THE SAM REGION**

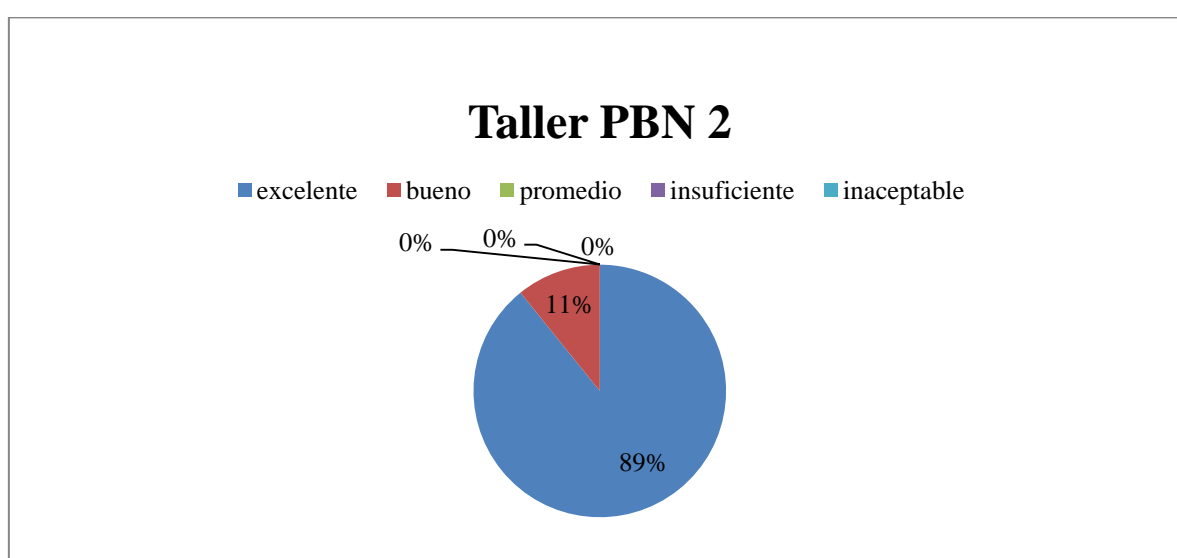
(Lima, Peru, 08 to 12 September 2014)

**SURVEY RESULTS**

## **ASSESSMENT OF COURSE CONTENTS**

(**Rating: 5 = Excellent / 4 = Good / 3 = Fair / 2 = Insufficient / 1 = Unacceptable**)

	Average
Were the topics relevant?	4.89
How do you rate the PBN workshop training programme?	4.76
How do you rate the training material?	4.43
Is theory reinforced with practical exercises?	4.70
Are topics correlated with reality and/or with their application in real cases?	4.95
How do you rate the level of information?	4.89
Did the workshop meet your expectations?	4.76
Was the information provided sufficient to develop the PBN implementation plan in your State or company?	4.65
Would the material and information provided in the workshop permit the conduction of a similar course/workshop in your State or company?	4.54
Overall average	4,73



### **Can you offer any suggestions to improve the workshop?**

- ICAO should urge States to send the group of designers to all events related to this great PBN project, since many times they only send one or two and exclude other procedure designers who are doing the work.
- These workshops should continue, since each country has a different reality and this allows participants to gain much experience and to avoid possible incidents or accidents.
- Take maximum advantage of the website to disseminate these topics.
- Do it more often.
- Conduct frequent meetings of procedure design personnel to exchange design criteria in view of altitude differences amongst the various States.
- Better preparation; delivery of preliminary papers prior to the next workshop; and convene the next workshop sufficiently in advance to ensure participation.
- More active participation of operators. Commitment to remove obstacles. Try to guide actions towards RNP-AR procedures.
- ICAO to coordinate the tripartite Brazil-Argentina-Uruguay meeting.
- Coordinate trilateral meetings amongst Uruguay, Brazil, and Argentina. The ICAO Regional Office could convene these meetings.
- It is difficult to improve upon the workshop; it is already very good. Send ICAO Circular 324 to the participants.
- Less discussions on unrelated topics.
- Periodic refresher and update courses on Doc 8168.
- Include a post-monitoring plan in the PBN project.
- I would like more practice in design. In addition to presenting the work done, the workshop would benefit from some supplementary activity.
- I suggest that interpretation be provided for presentations made in a language other than Spanish. I thought the Brazilian presentation was very interesting but, unfortunately, I could not fully understand it.
- Sometimes, discussions extend beyond schedule and some issues are left pending, especially with the rest of the participants. The topics of the agenda are fully and properly covered during the course, but it would also be useful to discuss the experiences of other members and have more time for such discussions.
- Through the Regional Office, as an activity under Project RLA/06/901, a meeting of procedure designers working in the TMA project of each country should be scheduled before or after the workshop to harmonise concepts, especially between adjacent States.

## **Comments**

- The PBN work team should be consolidated with the support of State authorities.
- Excellent seminar aimed at improving the route network in the States, not only to benefit passengers, who arrive faster to their destination, but also the environment, since CO<sub>2</sub> emissions will be reduced. Airlines will also save on fuel.
- Just my acknowledgment for the workshop.
- The States should designate the same delegates to participate in the meetings, since constant changes are detrimental to the attainment of goals.
- It helped me clarify many doubts and my colleagues helped me understand many of the concepts to be applied.
- Excellent group convened by ICAO. Great organisation and coordination of the subject matter. Congratulations: it is not easy to make progress on a topic as complex as TMA-PBN.
- Congratulations to all the States that are making the sacrifice of improving their airspace, and to ICAO and IATA.
- Excellent workshop.
- Congratulations.
- Promote meetings of procedure design experts once or twice a year.
- Very grateful for allowing me to participate as an observer; it allowed me to expand my horizons and analyse the possibility of specialising in other fields.
- A meeting of procedure designers (PANSOPS) should be organised once or twice a year to exchange experiences within the context of the SAM Region.

12 September 2014

-END-