



Agenda Item 2: Optimization of SAM airspace

a) Progress in the PBN Regional Implementation

CRITERIA FOR SID RNP AR IMPLEMENTATION IN BRAZIL

(Presented by Brazil)

SUMMARY

This working paper presents the initiative of the Department of Airspace Control (DECEA), through an ad hoc group of the Air Space Planning Study Group (GEPEA), to implement IFR departure procedures based on RNP AR concept.

REFERENCES

- SAM/IG meetings
- SAM/PANS-OPS/3 workshop
- Doc 9905, Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual

1. Background

1.1 Doc 9905, Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual, includes design criteria to aid States in the implementation of RNP AR approach procedures in accordance with the PBN Manual, Volume II, Part C, Chapter 6, Implementing RNP AR APCH.

1.2 RNP AR procedures can provide significant operational and safety advantages over other area navigation (RNAV) procedures by incorporating additional navigational accuracy, integrity and functional capabilities to permit operations using reduced obstacle clearance tolerances that enable approach and departure procedures to be implemented in circumstances where other types of approach and departure procedures are not operationally possible or satisfactory.

1.3 Many States started to publish RNP AR approach procedures to overcome difficulties with challenging terrain and raise accessibility to some airports. This is possible because RNP AR allows exploitation of high-quality, managed lateral and vertical navigation (VNAV) capabilities that provide improvements in operational safety and reduced controlled flight into terrain (CFIT) risks¹.

¹ Doc 9905, Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual

1.4 Although this is an important advantage over other kind of IFR procedures, there is one aspect that compromises the benefits with the RNP AR concept: There is still no criteria for departures procedures. According to Doc 9905:

The manual includes design criteria (...) for RNP AR approach procedures. Similar criteria for departure procedures will be incorporated when developed.

1.5 The responsibility for developing design criteria for RNP AR departures lies with the Instrument Flight Procedure Panel (IFPP) of ICAO. Nevertheless, this task is on hold waiting for the results of the work performed by PBN Study Group (PBNSG) to develop navigation specification for RNP AR departures.

1.6 In the PBNSG 17th meeting, held in November 2017, it was provided an update on the progress of the work of the PBN SG's RNP AR WG, both for approach and departure criteria. The main topics presented about departure criteria were:

- a) An RNP AR DP must use RNP 0.3 or higher accuracy values;
- b) Every RNP AR DP path must begin with a fix at the approach end of the takeoff runway (i.e. the first segment must overly the entire length of the runway centerline from the runway threshold to the departure end of the runway);
- c) The RNP AR DP path should use RF path terminators (RF legs) to the maximum extent practical for all turns. The procedure may use fly-by turns when minimizing the turn protection area is not essential. The RNP AR DP nav specs also assume the procedure design criteria will prohibit use of fly-over turns on an RNP AR DP;
- d) An RNP AR DP may use nonstandard climb gradients above 200 feet per nautical mile (200'/NM). When practical, the RNP AR DP should avoid climb gradients above 500 feet per nautical mile (500'/NM);
- e) The first turn for an RNP AR DP must begin no lower than 500' above ground level (AGL);
- f) The RNP AR DP procedure design's path definition must limit the application of track and leg transitions to those defined in Volume II, Chapter 6, paragraph 6.3.3.4.1.1, of the current PBN Manual (the revised 4th edition, dated Sep '14);
- g) The RNP AR DP procedure design criteria should apply the historic winds for the airport;
- h) The RNP AR DP procedure design criteria must limit RF turns to a maximum bank angle of 25 degrees (25⁰). When the procedure design requires RNP values below RNP 1.0 (RNP<1.0), the procedure design must limit RF turns to a maximum bank angle of 20 degrees (20⁰);
- i) The RNP AR DP procedure design shall assume normal performance of the aircraft; and
- j) When placing the first turn of an RNP AR DP close to or at the departure end of the runway, to ensure accurate turn anticipation calculations by the aircraft's RNP system, the procedure designer should consider publishing a limiting airspeed for the first turn (i.e. 210 KIAS). It is recommended to use a limiting airspeed anytime the first turn is within 1 NM of the departure end of the runway.

2. **Brazilian RNP AR Departures initiative**

2.1 Considering the increasing demand of airspace users for RNP AR departures, and based on the initial requirements developed by the group, Department of Airspace Control (DECEA), through an ad hoc group of the Air Space Planning Study Group (GEPEA), decided to start studies to develop national criteria, design and charting, for RNP AR departures.

2.2 This initiative also considered the best international practices used by some States to publish their own procedures, also taking into account the need to increase accessibility at airports where RNP AR approaches were already being performed.

2.3 This project started on July 2018 and the airport chosen to be the first one to receive RNP AR departures was Santos Dumont (SDU) airport, because it's the biggest challenge to overcome, in terms of obstacle, and the one that will bring the most benefits for airlines that operate in this airport.



Figure 1 – Santos Dumont Airport

2.4 After almost one year of work, the following tasks were performed so far to implement RNP AR departures:

- a) Coordination and consultations with experts from other countries where RNP AR departures are already being carried out;
- b) Implementation process based on the Collaborative Decision-Making (CDM) approach, which involves the various stakeholders, specially civil aviation authority, airlines and Air Navigation Service Providers (ANSP);
- c) Development of national criteria in terms of the procedure structure (bank angle, turns, segment length, IAS, etc), protection areas, obstacle assessment and flight inspection;
Note: The criteria was based on the requirements described in the item 1.6, in the RNP AR missed approach criteria and the RNAV departure criteria, which are more conservative;
- d) Development of a prototype procedure and performing evaluations using airline simulators;
- e) Discussions with civil aviation authority to develop the requirements to be adressed during the operational approval process.

2.5 This procedure will be consider as “special” according Brazilian regulation, because criteria used in the design are not yet developed and published by ICAO and also because the aircraft performance considered are very specific to overcome Santos Dumont airport situation (very challenging obstacle environment).

2.6 Some of the most important criteria considered on the development of the prototype RNP AR departure were the following:

- a) Bank angle: 25 degrees;
- b) RNP 0.3;
- c) First turning point altitude: 500ft;
- d) First turn after DER;
- e) First waypoint at the departure threshold;
- f) Use of RF legs.

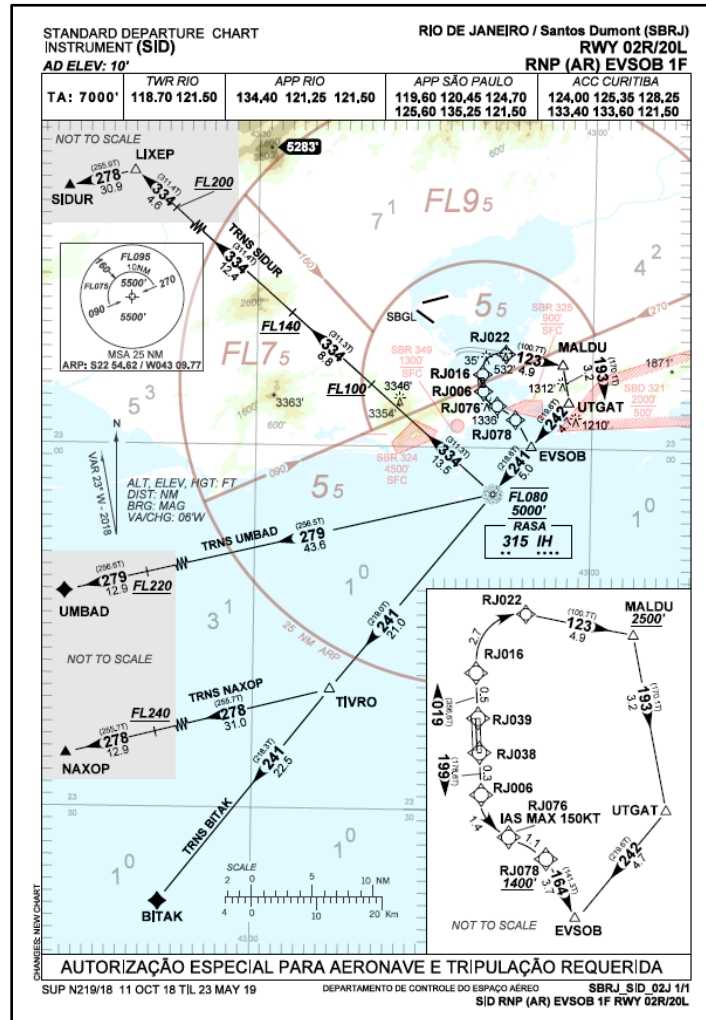


Figure 2 – RNP AR Departure – Prototype Chart

2.7 Evaluations on airlines simulations were already being made and the results were very satisfactory (just some suggestions for improvements). So, the next steps will be to implement those suggestions for improvements and to continue with the simulator evaluations. Studies will also be continued for the development of operational approval requirements.

3. **Proposed Implementation on SAM Region**

3.1 Several States around the world are already publishing RNP AR departure to reach benefits on airport operations, especially in terms of accessibility. Brazil's experience in this regard could help SAM States to implement their own procedures and be aligned with ICAO intention to improve global PBN implementation.

3.2 In this sense, this Working Paper also proposes the creation of the RNP AR Departure Working Group (GT SID RNP AR), subordinated to Subgroup 2 of GESEA (GESEA/SG2), to initiate discussion about criteria for RNP AR departure, based on the Brazilian experience.

3.3 This work would begin in 2020 with a RNP AR Departure Workshop, followed by two meetings of GT SID RNP AR on the dates proposed below and videoconferences before and after them, with the aim of presenting in SAM/IG/27 the result of the work and implementation guidance for SAM Region:

- a) RNP AR Departure Workshop: from April 27 to May the first;
- b) First Meeting (GESEA/SG2/GT SID RNP AR/1): from June 22 to 26, 2020; and
- c) Second Meeting (GESEA/SG2/GT SID RNP AR/2): from November 9 to 13, 2020.

4. **Suggested Action**

4.1 The Meeting is invited to:

- a) take note and review the information provided in this working paper;
- b) approve RNP AR Departure Workshop to address the implementation of this concept in SAM Region;
- c) approve the creation of a working group of the Study and Airspace Implementation Group of the SAM (GESEA) to study and propose criteria for RNP AR departures (GESEA/SG2/GT SID RNP AR);
- d) to appoint advisors and the rapporteur of the GESEA/SG2/GT SID RNP AR, under GESEA/SG2; and
- e) Discuss and approve a schedule of meetings to develop the implementation plan.