International Civil Aviation Organization

Thirteenth Meeting of The Performance Based Navigation Implementation Coordination Group (PBNICG/13)

(Bangkok, Thailand, 14-16 October 2026)

Agenda Item 5: Review PBN Implementation and Operational Guidance Document

RNP AR DP DESIGN CRITERIA – A BIG CHALLENGE FOR RNP AR OPERATIONS

(Presented by Pakistan)

SUMMARY

This paper presents the challenge being faced by the States and aviation industry in implementation of RNP AR operations in rich terrain and other challenging environments where the implementation of departure procedures using other navigation specifications are not practicable due to non-availability of ICAO RNP AR departure design criteria.

1. INTRODUCTION

1.1 Performance-Based Navigation (PBN) has enabled the development of increasingly efficient and precise instrument flight procedures. The application of Required Navigation Performance Authorization Required (RNP AR) procedures has demonstrated benefits in operational environments characterized by challenging terrain, significant obstacles, complex airspace structures, environmental constraints and the need for highly precise flight paths. This provides significant operational and safety advantages over other PBN navigation specifications by incorporating additional navigational accuracy, integrity, and functional capabilities to permit operations where other types of approach and departure procedures are not operationally possible or satisfactory.

1.2 ICAO provisions presently provide detailed criteria and guidance for the development and implementation of RNP AR approach procedures. While the RNP AR navigation specification provisions were extended in last update of PBN Manual (5th Edition 2023) to include the scope of departure; however, internationally harmonized ICAO procedure design criteria for RNP AR departure procedures have not yet been established. This represents a gap in the current framework, particularly as States and aircraft operators increasingly identify operational requirements for departures requiring navigation performance and path control beyond those provided by conventional RNAV 1 or RNP 1 departure procedures. This results in a serious challenge for implementing RNP AR Departures in challenging environments.

2. DISCUSSION

RNP AR Operations Evolution

2.1 RNP AR APCH was initially developed and included in PBN Manual (3rd Edition 2008) as a navigation specification in the approach phase for access to aerodromes where other procedure design criteria and solutions will not fit. It was expected that integration of the aircraft and operational criteria in the manual will enable procedure design criteria to be updated so that it will take full account of the aircraft capabilities integrated with the aircraft approval and qualification requirements satisfying the possible needs for challenging environments. The option of including departures was open and not covered in navigation specification in PBN Manual.

2.2 As the concepts behind the RNP AR APCH were relatively new, it was decided not to include the procedure design criteria in PANS-OPS. Accordingly, RNP AR Procedure Design Manual (Doc 9905) was issued by ICAO in 2009 which covered design criteria for RNP AR APCH. However, need for similar departure criteria was fully recognized and it was mentioned in 1st Edition of Doc 9905 that similar criteria for departures will be incorporated when developed.

2.3 PBN evolution continued and PBN Manual 4th Edition 2013 was issued which covers new navigation specifications such as RNP 0.3 and Advanced RNP. However, the requirement to extend the RNP AR concept on all operations remains missing.

2.4 Considering the importance of departures, the RNP AR navigation specification was expanded to cover departures in PBN Manual (5th Edition 2023). The navigation specification now covers RNP AR operations enabling an operator to conduct RNP AR approach (RNP AR APCH) and RNP AR departure procedures (RNP AR DP). These specifications take advantage of the unique capabilities of an operator's aircraft, their flight crews and their operations and demand the aircraft and flight crew eligibility in meeting the specifications for all RNP AR operations including approach and departures.

Emerging Operational Requirement

2.5 Standardized departure procedures are an essential component of safe and predictable IFR access to airports. For airports located in mountainous, constrained, or environmentally sensitive areas, the availability of an appropriately designed departure procedure can determine whether reliable IFR operations are possible at all for access to the airport. In the absence of such departure, operators may not find it viable to use RNP AR APCH which may result in prolonged ground time of their aircraft due to unfavorable conditions. The departure phase is particularly critical because it combines several demanding conditions. A properly designed RNP AR departure can provide a precise, repeatable and monitorable flight path through complex terminal airspace. The use of high navigation accuracy, onboard performance monitoring and alerting, and, where appropriate, radius-to-fix legs can enable aircraft to follow routes that cannot be safely or efficiently achieved using in the absence of departure procedure.

2.6 Based on the benefits foreseen, there is increasing operational interest in RNP AR departure applications, particularly at aerodromes where conventional departure procedures or standard RNP1/RNAV1 procedures cannot fully address operational requirements. Such applications may be particularly beneficial where there are:

- significant terrain or obstacle constraints;
- limited manoeuvring space following take-off;
- a requirement for early or precise turns;
- curved flight paths requiring RF legs;
- complex terminal airspace;

2.7 In all such environments, existing departure design criteria may not provide the necessary level of flexibility or precision to achieve the desired operational outcome. The access to airports therefore remains a challenge if the option of RNP AR operations is not considered.

Harmonized procedure design criteria

2.8 Article 37 of the Convention on international civil aviation demands States to collaborate in securing the highest practicable degree of uniformity in regulations, standards, procedures, and organization in relation to aircraft, personnel, airways and auxiliary services in all matters which such uniformity will facilitate and improve air navigation. To this end, ICAO adopts SARPs and approve **procedures** dealing with the safety, regularity and efficiency of air navigation.

2.9 The design criteria for RNP AR DP is considered to be among the procedures which require standardized criteria which will allow operators to utilize RNP AR capabilities to optimize departure tracks with assurance of safety in challenging and complex environments. While RNP AR Navigation Specification has been extended to cover RNP AR operations, standardized criteria for design of RNP AR departure procedure is yet to be developed. States may develop different assumptions for navigation performance, aircraft capability, bank angle, wind, obstacle assessment, RF-leg design and minimum climb performance. The absence of such criteria is therefore leading to use of diversified methodology based on proprietary or limited regional criteria resulting in inconsistent safety margins, operational difficulties for operators seeking approvals and lack of standardized validation/flight inspection procedures.

2.10 Based on above details, it is considered that the development and implementation of internationally harmonized RNP AR departure criteria should be regarded as an enabler of safe IFR access, rather than solely as an efficiency initiative. A common ICAO framework would ensure that the assumptions used for procedure design are consistently evaluated and subject to an internationally recognized level of safety assurance.

2.11 Common criteria would support consistent procedure development and reduce the need for States to independently develop complex and highly specialized design methodologies. Such criteria would also provide aircraft operators and avionics manufacturers with a clearer and more predictable framework for aircraft capability and operational authorization.as well as facilitate the development of standardized training, competency requirements and quality assurance processes for flight procedure designers.

2.12 Although the requirement for design criteria for RNP AR departures was acknowledged in 2009 while RNP AR APCH was first published in 2009, apparently the task does not have a priority in the ongoing activities of relevant ICAO panel.

Conclusion

2.13 The absence of RNP AR DP design criteria is resulting in use of different assumptions by industry and state resulting in a big challenge for implementation of RNP AR operations under the umbrella of Performance Based Navigation. There is a dire need to prioritize the issue at ICAO level for the availability of harmonized criteria for design of RNP AR Departures to facilitate the implementation of RNP AR operations.

3. ACTION REQUIRED BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) deliberate on the possible options for prioritizing the aspect in IFPP Task List; and

b) discuss any relevant matter as appropriate.

– – – – – – – – – – – – –