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USE OF DME/DME POSITIONING IN TÜRKİYE TO SUPPORT RNP OPERATIONS AS A PRECAUTION AGAINST GNSS INTERRUPTIONS

(Presented by Türkiye)

EXECUTIVE SUMMARY

Efforts are underway to expand performance-based navigation (PBN) operations in Türkiye. However, due to crises in the region, global navigation satellite system (GNSS) signal interruptions occurring in Turkish airspace significantly affects PBN operations.

In order to mitigate the negative effects of GNSS signal interruptions, a study has been carried out on the use of distance measuring equipment (DME)/DME positioning to support RNP operations in cases of GNSS interruptions.

This information paper presents details about the study.

<i>Strategic Goals:</i>	This information paper relates to Strategic Goals <i>Every Flight is Safe and Secure; Aviation Delivers Seamless, Accessible, and Reliable Mobility for All; and Aviation is Environmentally Sustainable.</i>
<i>Financial implications:</i>	Not applicable.
<i>References:</i>	Annex 10 — <i>Aeronautical Telecommunications</i> Doc 8168, <i>Procedures for Air Navigation Services, Aircraft Operations (PANS-OPS), Volume II — Construction of Visual and Instrument Flight Procedures</i> Doc 9906, <i>Quality Assurance Manual for Flight Procedure Design, Volume 5 — Validation of Instrument Flight Procedures</i> Doc 8071, <i>Manual on Testing of Radio Navigation Aids</i> Doc 9613, <i>Performance-based Navigation (PBN) Manual</i> FAA Order 8200.1D, <i>United States Standard Flight Inspection Manual</i>

1. INTRODUCTION

1.1 GNSS signal interruptions significantly affect performance-based navigation (PBN) operations in Turkish airspace, as well as in various parts of the world.

1.2 In order to expand PBN operations in Türkiye and mitigate the negative effects of global navigation satellite system (GNSS) signal interruptions, a study was initiated by General Directorate of State Airports Administration (DHMI - Turkish ANSP and Airport Management) on the use of distance measuring equipment (DME)/DME positioning method to support required navigation performance (RNP) operations in cases of GNSS interruptions and the study was completed in coordination with Turkish Civil Aviation Authority (Turkish CAA) and airline operators.

2. DISCUSSION

2.1 Upon reviewing the relevant sections of the reference documents;

2.1.1 In regard to procedure design requirements:

- DME/DME RNAV design criteria are available, and using these criteria, a DME/DME RNAV 1 STAR procedure can be designed up to the Final Approach Fix of an instrument approach procedure,
- RNP 1 design criteria are available and can be used to design an RNP 1 STAR procedure up to the Final Approach Fix of an instrument approach procedure,
- Regarding the design of STAR procedures, while design criteria have been established separately for each of the GNSS and DME/DME positioning methods for the RNAV concept, there is only one design criterion for the RNP concept, and GNSS is specified as the sole positioning method for the RNP Concept.
- DME/DME RNAV systems are sufficient to meet RNP 1 accuracy requirements; however, RNP 1 criteria are specifically designed for use in areas where DME infrastructure is inadequate (i.e., DME infrastructure is insufficient to meet DME/DME RNAV navigation requirements). It is particularly emphasized that RNP 1 criteria should not be used in areas where GNSS signals are known to be subject to interference.
- It is explicitly stated in the ICAO PANS-OPS Document that DME/DME RNAV design criteria cannot be used for RNP procedure design. However, the DME/DME positioning method can be used to SUPPORT RNP procedures, and in this case, RNP 1 design criteria must be used.

2.1.2 In regard to communication and ATS surveillance requirements;

- It is stated that RNAV 1 and RNAV 2 criteria are primarily determined for use in areas with radar capabilities (for the provision of air traffic control services), while RNP 1 criteria are intended for similar operations in areas outside radar coverage.

- On the other hand, it is stated that, provided that the State guarantees appropriate system safety and takes into account the absence of performance monitoring and alerting systems (on-board monitoring and alerting systems) in aircraft, RNAV 1 and RNAV 2 criteria may also be used in areas where radar capabilities are not available or below minimum radar vector altitudes.

2.2 From the explanations provided above, the use of radar in air traffic control services is a requirement for RNAV 1 SID/STAR procedures which enables use of DME/DME positioning method criteria. Therefore, in order to design a RNAV STAR procedure based on the DME/DME positioning criteria to be used at airports where only the Procedural Approach Control Service is provided, a regulatory framework must be established that includes the criteria for meeting the requirements specified in ICAO *Performance-based Navigation (PBN) Manual* (Doc 9613) (Chapter 3, 3.1.2.3).

2.3 If regulatory authorities establish legislation in this regard, within the framework of the conditions specified in this regulation, after following an assessment conducted within the framework of DME infrastructure and air traffic control service requirements, STAR procedures based on RNAV 1 (DME/DME) criteria could be designed for airports providing Procedural Air Traffic Control Services for those deemed suitable.

2.4 As stated in Doc 9613 (Chapter 3, 3.3.2.1) for RNP procedures, the procedure may only be used with the DME positioning method when authorized by the State. However, this use is subject to operators approved according to aircraft production criteria (such as E-TSO-C129-E-TSO C145, AC20-130A) and national operating rules.

2.5 On the other hand; in the section “DME/DME RNAV” of Doc 8168, *Procedures for Air Navigation Services — Aircraft Operations (PANS-OPS)*, Volume II — *Construction of Visual and Instrument Flight Procedures* which contains the DME/DME RNAV procedure design criteria, it is stated that the criteria described under this section can be used for STARs, Initial Approaches, and Intermediate Approach Segments for RNAV 1 and RNAV 2, provided that they are applicable up to the Final Approach Fix. Also, it is explicitly stated that these design criteria are not suitable for RNP applications, and it is recommended that, when the DME/DME positioning used to SUPPORT RNP applications, the existing RNP 1 and RNP APCH criteria should be used, as appropriate (Part III, Section 1, Chapter 3).

3. CONCLUSION

3.1 The use of the GNSS positioning method is mandatory for the implementation of STAR procedures that are published in the AIP of the relevant State and require RNP 1 certification approval at airports where the Procedural Approach Control Service is provided. However, the ICAO PANS-OPS Document also states that the DME/DME positioning method can be used to SUPPORT RNP applications and that RNP 1 design criteria must be used in such cases.

3.2 It is understood that DME/DME positioning method can be used to SUPPORT RNP applications (provided that it is limited to situations where GNSS signals cannot be used due to interference) and when the DME/DME positioning method is used to SUPPORT RNP applications, there is no other specified procedure design criterion. Therefore, no additional procedure design work is required for the implementation of published STAR procedures using the DME/DME positioning method.

3.3 On the other hand, in order for the aforementioned procedures to be implemented using the DME/DME positioning method (in situations where GNSS signals cannot be used due to interference), a

study must be conducted to assess whether the DME infrastructure is adequate. By using the DEMETER software developed by EUROCONTROL the competence of the required DME coverage should be assessed and additional DME equipment shall be installed where necessary.

3.4 The results of the theoretical study conducted using DEMETER software to determine whether the required DME coverage is available or not must be verified via flight control validation to confirm that the DME coverage is in place.

3.5 All these processes have been completed, and work is underway to launch a pilot program at Van Ferit Melen and Gaziantep Airports in Türkiye, where GNSS signal interruptions are particularly frequent and as a result flight cancellations occur. The goal is to implement the program at both airports before the 2026 summer season.

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