

# **General Requirements and Guidance Material for the use of RNAV Substitution**

CAP 1926

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## Chapter 1

# Introduction

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Methods of navigating in UK airspace, like that in Europe and elsewhere, is changing. The means of navigation within the airspace is moving from a network of ground-based radio navigation aids such as Doppler VOR (DVOR), DME and NDB, to one defined by Performance-based Navigation (PBN) whereby reliance is made on use of area navigation techniques requiring a certified airborne navigation capability. In many respects, the global standards and requirements for both airborne equipment and flight crew qualification have evolved to the point of PBN fast becoming the everyday norm, whereas UK airspace still contains routes and procedures predicated on traditional ground-based radio navigation aids. Some airspace has already transitioned to PBN e.g., ATS routes, but a number of UK airports are still heavily dependent on ground-based radio navigation aids, especially for Standard Instrument Departures (SIDs).

As part of the modernisation of the UK airspace design, the UK ground-based radio navigation infrastructure is also in transition, with the optimisation and decommissioning of the conventional nav aids to 'right-size' the navigation infrastructure and create an 'exclusive use of PBN' environment.

Whilst PBN exploits the performance available from Global Navigation Satellite Systems (GNSS) and their augmentations, certain ground-based radio navigation aids will continue to play a significant part in the UK navigation infrastructure. In the event of loss of GNSS, DME/DME/IRU radio navigation positioning provides RNAV 1 performance in terminal airspace, ILS provides Precision Approach and a DVOR Minimum Operational Network (MON) will provide a means of supporting tactical contingency procedures.

As we move towards the 'exclusive use of PBN', during this transition period there will inevitably be a continued dependency on conventionally defined procedures and procedure segments.

Given that the introduction of new airspace procedures lags behind the aircraft capability, the use of Flight Management Systems (FMS) / Area navigation systems, provides a means for applying an alternate means of primary navigation on conventionally defined routes, procedures and path segments, pending the introduction of permanent PBN procedures. These systems rely upon use of either a "fix" or an FMS Coded Overlay to apply a technique referred to as RNAV substitution.

RNAV Substitution can have significant operational benefits, derived from the following:

- Failure of the conventional radio navigation aid does not automatically impose an operational limitation;
- Flight crew workload is reduced in part due to not having to interpret both conventional radio navigation aids and FMS navigational displays;

- Flight crew are able to employ common operating procedures across a range of routes and instrument flight procedures; and
- The ability to use the full functionality of modern navigation displays is maintained thereby improving situational awareness.

In the UK, RNAV Substitution may be envisaged in a number of operational scenarios:

- Short-term ground-based radio navigation aid outage (notionally one NOTAM cycle) due to maintenance or failure. ANSPs have an expectation, and make assumptions in their ATS procedures, that all/most operators fly FMS Coded Overlays;
- DVOR/DME/NDB Rationalisation where there will be a long-term (greater than 90 days) outage due to planned decommissioning of a ground-based navigation aid which supports conventional procedures or segments, pending the introduction of new PBN procedures. For this scenario, CAA has published guidance for aerodrome operators and ANSPs capturing specific safety requirements Ref. CAP1781: DVOR / DME / NDB Rationalisation: Guidance for the use of RNAV Substitution<sup>1</sup>.
- New aircraft delivery without ADF installed or Minimum Equipment List (MEL) dispatch relief. The CAA has issued an exemption from the requirement to carry an ADF for certain aircraft types.
- Instrument Approach Procedures with a Missed Approach segment defined by reference to ground-based navigation aids.

In respect of other regulatory developments, ICAO has published a State Letter<sup>2</sup> with proposed amendments to PANS-OPS, Volumes I and III, related to the use of FMS/Area navigation system in conventional procedures, with an envisaged applicability of 03 November 2022. Furthermore, EASA has consulted on a proposed amendment to AIR-OPS Part NCO<sup>3</sup> with a Comment Response Document (CRD) published on 03 August 2021. This CAP has therefore been developed, cognisant of the above material with the intention of providing both general requirements and supporting guidance for operators/pilots (airspace users) on the use of RNAV Substitution.

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<sup>1</sup> <https://www.caa.co.uk/CAP1781>

<sup>2</sup> ICAO State Letter SL21.50.

<sup>3</sup> EASA NPA 2020-02

## Chapter 2

## Definitions

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**Area navigation system:** A navigation system is either an RNP system or an RNAV System depending on its performance capabilities<sup>4</sup>.

**Fix:** A geographical position determined by visual reference to the surface, by reference to one or more radio navigation aids, by celestial plotting, or by another navigational device.

*Note: Fix is the generic name for a geographical position and may alternatively be referenced as a fix, waypoint, intersection, reporting point, etc.*

**Fix Substitution:** Use of an area navigation system or equipment to substitute a Fix defined by a ground-based navigation aid.

**FMS Coded Overlay:** A generic term used to describe an airborne navigation system data base coding in accordance with ARINC Specification 424<sup>5</sup> (or equivalent) provided by a Navigation Data Provider, representing a conventionally defined instrument flight procedure, that may be stored in a Flight Management System (FMS) or Area navigation system.

The FMS Coded Overlay provides lateral and vertical navigation guidance which has the appearance of an RNAV/RNP procedure.

*Note: The FMS Coded Overlay is neither State approved or assessed for obstacle protection nor is it standardised across the different navigation data providers.*

**RNAV Substitution:** The act of using an FMS Coded Overlay procedure, selected from a navigation data base, and then executed.

*Note: RNAV Substitution depends on a coding of the conventional procedure into the navigation data base whereas it has not been originally designed with that intention. As a consequence, there are limitations associated with RNAV Substitution and required operating procedures, in order to maintain the same level of safety.*

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<sup>4</sup> ICAO Doc 9613 Edition 5, Performance-based Navigation (PBN) Manual

<sup>5</sup> Industry standard – ARINC Specification 424 – Navigation System Database [424-22 Navigation System Database | SAE ITC \(aviation-ia.com\)](#)

## Chapter 3

## General Requirements

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An operator/pilot may fly conventional procedures using the FMS/Area navigation system for primary navigation without monitoring the raw data of the radio navigation aids designated by the conventional procedure, provided that the operational criteria defined in Chapter 5 and 6 of this CAP for the use of RNAV Substitution, are complied with.

*Note: Current provisions require the monitoring of conventional radio navigation aids in all cases where navigation is predicated on use of an FMS/Area navigation system. CAP 1926 allows for the use of an FMS/Area navigation system without monitoring the primary navigation aid, subject to the criteria outlined in Chapter 5 and 6 of this CAP. Where the provisions of Chapter 5 and 6 cannot be complied with, monitoring the conventional radio navigation aids will still be required.*

*Note: It is not intended to require a specific operational approval or authorisation.*

*Commercial Air Transport (CAT) operators are expected to have made the appropriate amendments to relevant parts of the Operations Manual detailing procedures and flight crew training pertinent to the use of RNAV Substitution. Utilising their Management System, operators should manage associated risks in implementing RNAV Substitution operations.*

*For other commercial and non-Commercial operators/pilots, this guidance should be read in conjunction with other applicable regulatory material.*

## Chapter 4

## Scope and Limitations

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RNAV Substitution may be used in all phases of flight in UK airspace, except to provide lateral guidance in the final approach segment of an Instrument Approach Procedure (IAP).

Applications of RNAV substitution include:

- determination of aircraft position relative to or distance from:
  - a Very High Frequency Omnidirectional Radio range (VOR);
  - a Marker;
  - a DME fix; or
  - a named fix defined by a VOR radial or Non-Directional Beacon (NDB) bearing and DME distance.
- navigation to or from a VOR, or NDB, except as lateral guidance in the final approach segment of an Instrument Approach Procedure (IAP);
- holding over a VOR, NDB, or DME fix;
- flying an arc based upon DME;
- where a route or procedure is defined by reference to conventional radio navigation aids and coded as an overlay which may be selected from the navigation data base and executed:
  - flying a departure or arrival route (SID or STAR); or
  - flying the Initial, Intermediate or Missed Approach segments of an Instrument Approach Procedure (IAP).

*Note: Operators/pilots may apply RNAV Substitution as an Alternative Means of Compliance where Charts indicate that a published route or instrument approach procedure segment is not available without a particular conventional radio navigation aid e.g., NDB(L).*

RNAV substitution for ADF, VOR or DME may be used where the aircraft equipment is not installed or is inoperative and/or the ground-based radio navigation aid is either inoperative or unreliable.

*Note: For the Initial, Intermediate and Missed Approach segments of an Instrument Approach Procedure (IAP), the entire procedure must be coded as an overlay procedure, from which it may be selected from the navigation data base and executed.*

*Note: For VOR and DME, RNAV Substitution should not encourage operators/pilots to remove VOR or DME, which remain as standard equipment.*

RNAV substitution shall not be applied to any route or procedure where RNAV substitution has been indicated as “not authorised” in the UK Aeronautical Information Publication (AIP) entry or by NOTAM.



*Note: Additional information regarding the validation of procedures and the use of radio navigation aids is provided in the Quality Assurance Manual for Flight Procedure Design (Doc 9906), Volume 5 - Validation of Instrument Flight Procedures; and the Performance-based Navigation (PBN) Manual (Doc 9613).*

## Chapter 5

## Operational Criteria

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The FMS/Area navigation system installation in the aircraft shall be certified for either RNAV 1 or RNP 1 or Advanced RNP.

RNAV substitution shall be restricted to operators/pilots authorised for either RNAV 1, RNP 1 or Advanced RNP.

*Note: An FMS/Area navigation system typically supports multiple PBN capabilities. The link to established navigation specifications makes a clear definition of required aircraft capability and operator/pilot authorisation and the need for consistency. It also indicates that this is not a means to avoid proper authorisation for the conduct of PBN operations.*

*Note: Consistent with PBN operations, the same established operating procedures specified for management of the electronic navigation database, apply to RNAV Substitution operations. This includes database suitability and currency.*

*Note: Whereas it is recommended that aircraft conducting RNAV Substitution are GNSS equipped, if operations are predicated on RNAV 1, consideration should be given to the supporting infrastructure e.g., ATS surveillance and DME/DME coverage for radio position updating.*

*Note: Each of the specified navigation specifications includes requirements for information to be displayed in the primary field of view, and for functionality such as:*

- *capability for the “direct to”;*
- *display of distance and bearing to the active waypoint;*
- *display of ground speed or time to the active waypoint;*
- *display of the identification of the active (TO) waypoint; and*
- *support for path/terminator types consistent with the phase of flight.*

The operator/pilot shall establish and document:

- a policy for the use of RNAV Substitution. Depending on its operational constraint(s), the operator/pilot may decide to limit the use of RNAV Substitution to particular cases, mainly to cope with inoperative or unreliable conventional radio navigation aids;
- standard operating procedures to be used by the flight crew when utilising the FMS/Area navigation system for substitution, complying with any procedures and/or limitations developed by the aircraft manufacturer in its documentation (Aircraft Flight Manual (AFM), Quick Reference Handbook (QRH), etc.); and
- training for the use of RNAV substitution. The training programme shall, as a minimum, include the limitations, operational criteria and operating procedures as

detailed in this chapter and Chapter 6. See also Chapter 7. Such training shall be extended to support staff, as applicable.

The operator/pilot shall ensure that the Minimum Equipment List (MEL), as applicable, is updated to include operating limitations associated with the FMS/Area navigation system and any other related system e.g., the GNSS system, that supports that equipment.

The operator/pilot shall verify that conventional radio navigation aids intended to be substituted are coded in the FMS/Area navigation system database, so that they can be used as a waypoint.

The operator/pilot shall verify that the conventional procedure intended to be flown is coded in the FMS/Area navigation system database. Depending on the complexity of the conventional procedure e.g., several conventional radio navigation aids involved in the path definition with several turning points, a flyability check may be considered necessary.

## Chapter 6

# Operating Procedures

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The pilot-in-command is responsible for:

- applying pre-flight procedures associated with GNSS use e.g., Receiver Autonomous Integrity Monitoring (RAIM) check, if applicable;
- checking that the navigation database is current;
- ensuring that any procedures and waypoints used are retrieved from the navigation database;
- verifying waypoint sequence, reasonableness of track angles, and distances of any coded overlay procedure used and in particular, where the use of RNAV Substitution is used to replace offset DME with a zero-range indication, associated with an ILS;
- ensuring that FMS/Area navigation system and the GNSS systems are operational; and
- complying with any limitation on RNAV Substitution in the AFM and manufacturer's documentation.

## Chapter 7

# Pilot Knowledge and Training

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The pilot shall be aware of the limitations of RNAV Substitution and familiar with the operator's policy (if applicable), and operating procedures.

*Note: Requirements for the pilot to ensure that the route or procedure is selected in full, from a current navigation database in conjunction with the checks outlined in Chapter 5, provides assurance that the operation will proceed as intended.*

*Note: Pilot knowledge and training is essential to ensure that any limitations and operator policy and procedure are adhered to.*