RA 2380 – Performance Based Navigation Operations

Rationale

Performance Based Navigation (PBN) is one of several enablers of an airspace concept that offers enhanced use of airspace and reduces reliance on legacy fixed navigation aid installations. It has been widely adopted by international military and civilian operators. Without appropriate oversight the use of PBN concepts, equipment and procedures could drive an increased Risk to Life (RtL) to all airspace users. This Regulatory Article (RA) requires that Aviation Duty Holders (ADH) and Accountable Managers (Military Flying) (AM(MF)) have robust orders and procedures in place to enable PBN operations.

Contents

Regulation 2380(1)

Air System and Pilot Requirements

2380(1) ADH and AM(MF) **shall** ensure PBN operations are only conducted by Air Systems within their Area of Responsibility (AoR) that are certified in accordance with (iaw) the relevant navigation specification and by pilots who are appropriately qualified.

Acceptable Means of Compliance 2380(1)

Air System and Pilot Requirements

1. Where there is a requirement to conduct PBN operations, the navigation specification **should** be detailed in the Air System Release To Service (RTS) or Military Permit to Fly (MPTF) and operations to that specification approved by the ADH / AM(MF) iaw RA 1380[1].

2. Where pilots are required to undertake PBN operations they **should** only do so after they have been granted PBN privileges as an endorsement to their instrument rating iaw RA 2120[2].

3. For multi-crew Aircraft, all flight deck pilots **should** hold the same PBN endorsement, unless pilots are under training and / or are being supervised by an appropriately Qualified Aircrew Instructor.

Guidance Material 2380(1)

Air System and Pilot Requirements

4. Nil.

Regulation 2380(2)

Performance Based Navigation Flight Procedures

2380(2) ADH and AM(MF) **shall** publish orders that enable the safe conduct of PBN operations, where their Air Systems are so equipped.

Acceptable Means of Compliance 2380(2)

Performance Based Navigation Flight Procedures

Required Navigation Performance Authorization Required Approaches

5. UK military registered Air Systems **should not** conduct Required Navigation Performance (RNP) Authorization Required Approaches (AR APCH).

[1] Refer to RA 1380 - Performance Based Navigation.
[2] Refer to RA 2120 - Pilots' Instrument Rating Scheme.

Acceptable Means of Compliance 2380(2)

Required Navigation Performance 0.3 (Helicopters)

6. For RNP 0.3 (H) operations (outside of any final approach)[3], the appropriate approvals **should** be obtained iaw EU Regulation No 965/2012 Annex V (Part-SPA) Subpart B: PBN Operations.

Area Navigation (RNAV) 10

7. Operating procedures and routes **should** take account of the RNAV 10 time limit declared for the inertial system, if applicable, considering also the effect of weather conditions that could affect flight duration in RNAV 10 airspace. Where an extension to the time limit is permitted, the crew **should** ensure adequate en-route radio navigation facilities are available before departure and **should** apply radio updates iaw any RTS or MPTF limitations.

8. If extension of RNAV 10 inertial navigation time by position updating is approved, orders and instructions **should** include the requirement to calculate, using statistically-based typical wind scenarios for each planned route, points at which updates can be made and the points at which further updates will not be possible[4].

Electronic Database Management

9. For RNAV 1, RNAV 2, RNP 1, RNP 2, and RNP APCH, the crew **should not** insert or modify waypoints by manual entry into a procedure (departure, arrival or approach) that has been retrieved from the database.

10. For RNP 4 operations, the crew **should not** modify waypoints that have been retrieved from the database.

11. The lateral and vertical definition of the flight path between the Final Approach Fix (FAF) and the Missed Approach Point (MAPt) retrieved from the database **should not** be modified by the crew.

Preparation for Flight

12. The PBN database validity **should** be checked before flight and **should** be valid for the duration of the flight. An expired database **should** only be used if:

a. The parts of the database which are intended to be used during the flight and any contingencies that are reasonable to expect are not changed in the current version;

b. Maps and charts corresponding to those parts of the flight are current and have not been amended since the last cycle; and,

c. The database has expired by no more than 28 days.

13. The crew **should** ensure that RNAV 1, RNAV 2, RNP 1, RNP 2, and RNP APCH routes or procedures expected to be used for flight, including for any alternate aerodromes, are available from the navigation database and are not prohibited by Notice to Airmen (NOTAM).

14. When PBN relies on Global Navigation Satellite Systems (GNSS) for which Receiver Autonomous Integrity Monitoring (RAIM) is required for integrity, its availability **should** be verified during pre-flight planning. If a continuous loss of fault detection of more than 5 min is predicted, planning **should** be revised to reflect the lack of full PBN capability for that period. Furthermore, the availability of RAIM (or equivalent monitoring system) at the destination **should** be verified as closely as possible before departure and not more than 24 hrs before take-off. It **should** be confirmed as available from 15 min before Estimated Time of Arrival (ETA) until 15 min after ETA.

15. For RNP 4 operations with only GNSS sensors, a Fault Detection and Exclusion (FDE) check **should** be performed. If predictions indicate that the maximum allowable FDE outage of 25 min will be exceeded, the operation **should** be rescheduled to a time when FDE is available.

[3] Operation to a specification of 0.3 within the Final approach segment is implicit within any RNP APCH approval.
[4] Refer to ICAO Doc 9613 - Performance-based Navigation Manual Volume II, Part B, Chapter 1 - Implementing RNAV 10, para 1.3.9.6.

Acceptable Means of Compliance 2380(2)

16. Where an RNP APCH is expected to be flown in IMC, crews **should** ensure that an alternative instrument approach system is available at the destination or a suitable alternate aerodrome, which is not dependent on GNSS data and for which the weather is forecast to be suitable to enable a landing.

Flight Procedures

17. Pre-departure.

a. ADH and AM(MF) **should** detail in orders the system settings required before flight. As a minimum they **should** detail:

(1) Checks on database validity iaw para 12.

(2) Checks on any appropriate Course Deviation Indicator (CDI) scaling, alarms, airspace and altitude buffers, map settings and orientation.

(3) Verification of or changes to heading and track display.

(4) Verification of or changes to map datum. Crews **should** have WGS84 set as the datum.

(5) Verification of or changes to the units of measure of distance, speed, altitude, barometric pressure and position format.

(6) Verification of or changes to the navigation displays.

b. The active flight plan, if applicable, **should** be checked.

c. The crew **should** check that the navigation aids critical to the operation of the intended PBN procedure are available.

18. Departure.

a. Prior to commencing a take-off on a PBN procedure, the crew **should** check that the indicated Aircraft position is consistent with the actual Aircraft position at the start of the take-off roll (fixed wing) or lift-off (helicopters).

b. Where GNSS is used, the signal **should** be acquired before the take-off roll (fixed wing) or lift-off (helicopters) commences.

c. Unless automatic updating of the actual departure point is provided, the crew **should** ensure initialisation on the runway or Final Approach and Take-off (FATO) by means of a manual runway threshold or intersection update, as applicable. This is to preclude any inappropriate or inadvertent position shift after take-off.

19. En route, arrival and approach.

a. When navigating under IFR, user defined waypoints **should** be used only for en route navigation above safety altitude.

b. For RNAV 1, RNP 1 and RN APCH operations, the pilot **should** use a lateral deviation indicator, and where available, flight director and / or autopilot in lateral navigation mode.

c. The appropriate displays **should** be selected so that the following information can be monitored:

(1) The waypoint identifier to which navigation is being given;

(2) The GPS computed desired path (DTK);

(3) Aircraft position relative to the lateral path (cross-track deviation) for FTE monitoring;

(4) Aircraft position relative to the vertical path (for a 3-Dimensional (3D)[5] operation);

(5) Groundspeed;

(6) Distance to next waypoint; and

[5] 3D Approaches have lateral and vertical guidance.

Acceptable Means of Compliance 2380(2)

(7) Absence of RAIM or Loss of Integrity (LOI) alert.

d. The pilot of an Aircraft with a lateral deviation indicator (eg CDI) **should** ensure that lateral deviation indicator scaling (full-scale deflection) is suitable for the navigation accuracy associated with the various segments of the procedure.

e. The pilot **should** maintain procedure centrelines unless authorized to deviate by Air Traffic Control (ATC) or demanded by emergency conditions.

f. Cross-track error / deviation (the difference between the area-navigation-system-computed path and the Aircraft-computed position) **should** normally be limited to half the RNAV / RNP value associated with the procedure. Brief deviations from this standard (eg overshoots or undershoots during and immediately after turns) up to a maximum of the RNAV / RNP value **should** be allowable.

g. The pilot **should** endeavour to maintain Aircraft altitude within +/- 75' of the advisory Continuous Descent Final Approach descent profile published on the chart and not below the level of any step down fix until the Aircraft has passed it. Where a vertical glidepath is displayed on a 3D approach (either lateral navigation / vertical navigation (LNAV / VNAV) or localiser performance with vertical guidance (LPV)) pilots **should** endeavour to maintain a steady and stable descent within a half scale deviation of both the glidepath indication and the final approach track in the same way as for an ILS.

h. For a 3D approach operation, the pilot **should** use a vertical deviation indicator and, where required by Air System Document Set (ADS) limitations, a flight director or autopilot in vertical navigation mode.

i. Any published altitude and speed constraints **should** be observed.

j. Prior to commencing the approach operation (before the Initial Fix (IF)), the crew **should** verify the navigation system is operating within the correct specification and that the appropriate sensor is selected. The correctness of the loaded procedure **should** also be confirmed by comparison of Air System displays with the appropriate approach charts. As a minimum, the crew **should** check the position of the FAF and the track and distance to the MAPt. For approaches with vertical guidance, the crew **should** check the correct altitude at the FAF and descent gradient. The flight path between the IF and MAPt **should not** be modified by the crew.

k. The appropriate chart **should** be immediately to hand throughout the procedure.

l. Crew of aircraft with RNP input selection capability **should** confirm that the indicated RNP value is appropriate for the PBN operation.

m. Crews **should not** activate approach flight plans until clearance has been obtained from ATC.

n. ATC may provide tactical interventions in the terminal area; the crew **should** be aware of the implications for the navigation system. 'Direct to' clearances **should not** be accepted to the IF if the Aircraft will be unable to establish on the final approach track at least 2 NM before the FAF. 'Direct to' clearance to the FAF **should not** be acceptable. Modifying the procedure to intercept the final approach track prior to the FAF **should** be acceptable for radar-vectored arrivals or otherwise only with ATC approval.

o. The final approach trajectory **should** be intercepted no later than the FAF in order for the Aircraft to be correctly established on the final approach track before starting the descent (to ensure terrain and obstacle clearance).

p. 'Direct to' clearances to a fix that immediately precede a Radius-to-Fix (RF) leg **should not** be accepted.

q. For parallel offset operations en route in RNP 4, transitions to and from the offset track **should** maintain an intercept angle of no more than 45° unless specified otherwise by ATC.

Acceptable Means of Compliance 2380(2)

r. Unless the pilot has sufficient visual references to continue the approach operation to a safe landing, an RNP APCH operation **should** be discontinued if:

(1) Navigation system failure is annunciated (eg warning flag);

(2) Lateral or vertical deviations exceed the tolerances; or

(3) Loss of the on-board monitoring and alerting system.

s. The crew **should** make the necessary preparation to revert to a conventional arrival procedure where appropriate. The following conditions **should** be considered:

(1) Failure of the navigation system components including navigation sensors, and a failure affecting flight or technical error (eg failures of the flight director or autopilot);

(2) Multiple system failures affecting Aircraft performance;

(3) Coasting on inertial sensors beyond a specified time limit; and

(4) RAIM (or equivalent) alert or loss of integrity function.

t. In the event of loss of PBN capability, the crew **should** invoke contingency procedures and navigate using an alternative means of navigation and notify ATC of any reduction in PBN or navigational accuracy. In the event of communication failure, the crew **should** continue with the operation iaw published lost communication procedures.

u. When Air Systems that are fitted with GNSS are using Satellite Based Augmentation Systems (SBAS) for vertical navigation, the pilot **should not** fly approaches to LNAV / VNAV minima.

v. On an RNP APCH, other than a notified LPV approach using SBAS, the primary vertical reference **should** be the Aircraft pressure altimeter and not the GPS derived vertical guidance.

w. Altimetry settings for RNP APCH operations using Baro VNAV.

(1) Barometric settings. The crew **should** set and confirm the correct altimeter setting and check that two independent altimeters provide altitude values that do not differ more than 100 ft at the most at or before the FAF. The procedure **should** be flown with the QNH set on the Aircraft's altimeters.

(2) Temperature compensation for RNP APCH operations to LNAV / VNAV minima using Baro VNAV:

(a) The crew **should not** commence the approach when the aerodrome temperature is outside the promulgated aerodrome temperature limits for the procedure unless the area navigation system is equipped with approved temperature compensation for the final approach;

(b) When the temperature is within promulgated limits, the crew **should not** make compensation to the altitude at the FAF and DA/H;

(c) Since only the final approach segment is protected by the promulgated aerodrome temperature limits, the crew **should** consider the effect of temperature on terrain and obstacle clearance in other phases of flight.

(3) For temperature compensation for RNP APCH operations to LNAV minima the crew **should** consider the effect of temperature on terrain and obstacle clearance in all phases of flight, in particular on any step-down fix.

Guidance Material 2380(2)

Performance Based Navigation Flight Procedures

20. For purposes of consistency with the PBN concept, regulation may refer to ‘RNAV 10’ because this specification does not include on-board performance monitoring and alerting, however many routes still use the designation ‘RNP 10’ instead of ‘RNAV 10’. ‘RNP 10’ was used as designation before the publication of the fourth edition of ICAO Doc 9613 in 2013. The terms ‘RNP 10’ and ‘RNAV 10’ will be considered equivalent.

21. RAIM availability may be established either by an internal function of the receiver or an air navigation service provider.

22. Discontinuing an approach operation may not be necessary for a multi-sensor navigation system that includes demonstrated RNP capability without GNSS iaw the ADS.

23. Where vertical guidance is lost while the Aircraft is still above 1000 ft AGL, the crew may decide to continue the approach to LNAV minima, when supported by the navigation system.

24. More detailed guidance material for the operational use of PBN applications can be found in ICAO Doc 9613 Performance-Based Navigation (PBN) Manual.