PBN Operational Approval

Navigation Database Management

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PBN at Work!
TOPICS

✈ PBN Concept:

➢ General;
➢ Overview per flight phases;
➢ Scope of PBN;
➢ Understanding PBN applications;

✈ Operational Approval for each PBN application (new updates Doc. 9613):

➢ Navigation database requirements;
➢ Publication, samples;
PBN specifies RNAV system performance i.e. accuracy, integrity, continuity, availability + functionality written up in:

**Navigation specification**

- **Designation RNP X**: Require on-board self contained performance monitoring + alerting
- **Designation RNAV X**: Do not require on-board self contained performance monitoring + alerting

This is the fundamentally difference to the RNP concept which stressed navigation accuracy and ‘stopped’ at *required performance*.

Note: For both RNP and RNAV designations, the expression ‘X’ (where stated) refers to the LNAV accuracy in NM expected 95% of the flight time by aircraft operating within the airspace, route or procedure.
Example of Application of RNAV and RNP specifications

For any particular PBN operation, it is possible that a sequence of RNAV and RNP applications is used.
PBN applications

Navigation Specifications

RNP Specifications
(includes a requirement for on-board performance monitoring and alerting)

- Designation
  - RNP 4
  - RNP 2
  - Oceanic & Remote navigation applications

- Designation
  - RNP 2
  - RNP 1
  - A-RNP
  - RNP APCH
  - RNP AR APCH
  - RNP 0.3
  - En-route & Terminal navigation applications

RNAV Specifications
(no requirement for on-board performance monitoring and alerting)

- Designation
  - RNAV 10
  - Oceanic & Remote navigation applications

- Designation
  - RNAV 5
  - RNAV 2
  - RNAV 1
  - En-route & Terminal navigation applications
Some operations with angular performance requirements e.g. ILS/MLS/GLS precision approaches are not yet considered in the concept:

- Linear lateral performance requirements using an RNP system, e.g. RNP and RNAV specs
- Angular lateral performance requirements using an RNP system, e.g. RNP APCH to LPV minima
Scope of PBN (vertical performance)

- RNAV & RNP specification are defined for the lateral and longitudinal dimensions only;

- Vertical RNP (3D) i.e. alerting monitoring on vertical position is under development for future applications;

  Barometric-VNAV is not considered vertical RNP!

- PBN will likely progress from 2D to 3D/4D (time-based capabilities)
Understanding RNAV and RNP designations

- Navigation accuracy is only *one* of the many performance requirements included in a navigation specification;

- Therefore, an aircraft approved for:
  - An RNP specification is **NOT** automatically approved for all RNAV specifications;
  - An RNP or RNAV NavSpex having a stringent accuracy requirement (e.g. RNP 0.3) is not automatically approved for a NavSpex having a *less* stringent accuracy (e.g. RNP 4)
Navigation database should be obtained from a qualified supplier that complies with RTCA DO-200A/EUROCAE ED-76A standard;

LoA type 1 issued by the appropriate regulatory authority:
A Navigation Database does not form part of the required functionality of RNAV 10;

If a Navigation Database is carried and used:

- It must be current for the duration of the flight and,
- Appropriate for the region of intended operation i.e. must include the nav aids and waypoints required for the route;

State AIP shall clearly indicate that the navigation application is RNP 10 where reference is to existing routes;

The route should identify Minimum En-route Altitude (MEA) for each segment;

All routes must be based upon WGS-84 coordinates;
A Navigation Database does not form part of the required functionality of RNAV 5;

Where a Navigation Database is carried and used:

- It must be current for the duration of the flight and,
- If the AIRAC cycle is due to change during flight, operators should establish procedures to ensure correctness of data (verifying electronic against paper products).

RNAV 5

GNSS is the primary navigation sensor to support RNP 4, either as stand-alone or as part of a multi-sensor system (no ground infrastructure necessary);

The Operator's database should be obtained from a supplier that complies with DO-200A/ED-76A “Standards for Processing Aeronautical Data”.

A letter of Acceptance (LoA) Type 1 issued by the appropriate regulatory authority supplier demonstrates compliance with this requirement;

Operators should consider the need to check the Navigation Database periodically;

Operators must advise the data supplier of discrepancies that invalidate a route and prohibit the use of the affected procedure(s) through a notice to its flight crew;

RNP 4

RNP 2

RNP 2 primarily intended for a diverse set of en-route Oceanic/remote and Continental applications (limited ATS surveillance);

RNP 2 specification is based upon GNSS sensor (ABAS RAIM available);

The Operator's database should be obtained from a supplier that complies with DO-200A/ED-76A “Standards for Processing Aeronautical Data”.

A letter of Acceptance (LoA) Type 1 issued by the appropriate regulatory authority demonstrates compliance with this requirement;

Operators should consider the need to check the Navigation Database periodically in order to meet existing quality system requirements;

Operators must report any discrepancies invalidating an ATS route to the data supplier and must take actions to prohibit their pilots from flying the affected ATS route.
Publication

RNAV 5

✈ State AIP shall clearly indicate RNAV 5 application i.e. carriage of RNAV 5 equipment in specific airspace or on identified routes;
✈ Identification of MEA for each route;
✈ All routes must be based upon WGS-84 coordinates;
✈ The available navaid infrastructure i.e. sensor(s) as well as any radio facilities critical to RNAV 5 operations shall be identified in the relevant AIP pages;
✈ In absence of such database, there is potential for waypoint errors: en-route charts should support gross error checking by the crew;

RNP 4

✈ State AIP shall clearly indicate that the navigation application is RNP 4 where reference is to existing routes;
✈ The route should identify Minimum En-route Altitude (MEA) for each segment;
✈ All routes must be based upon WGS-84 coordinates;

RNP 2

✈ State AIP shall clearly indicate that the navigation application is RNP 2 where reference is to existing routes;
✈ The route should identify Minimum En-route Altitude (MEA) for each segment;
✈ All routes must be based upon WGS-84 coordinates;
Publication (AIP samples)

RNAV 5

RNP 4

3. Area route of operation

3.1 CFDLC and ADS services will initially be provided to voice-data link capable aircraft within designated airspace in Kunming, Chengdu, Lanzhou and Urumqi Flight Information Regions (FIRs). See En-route Chart.

3.2 The widths of the data link route Y1, Y2, L888 is 56km, width of Y3 is 33.4km. Air Traffic services with data link will be available on route Y1, Y2 and the segment of BIDRU to KCA VOR of L888. The route points are (See En-route Chart):

L888: BIDRU MAKUL DONEN NIVUX LEVBA PUKUN SANLI LUVAR MUMAN TEMOL LEBAK TONAX NOLPE SADAN KCA (VOR)
Y1: OMBON MEPEP LUSMA DUMIN SADAN
Y2: LUVAR MEPEP
Y3: DUMIN-TUSLI RUSDI IMUUN FEK (VOR)

3.3 The data-link aircraft of which planning to operate the data-link route shall be satisfied the navigation requirements of RNP or higher.

3.4 For data-link aircraft operating within this airspace, CFDLC will be used as the primary means of voice communications with ATC on normal conditions instead of VHF and HF voice communications.

3.5 When CFDLC is being used, a backup HF or VHF voice communications will be notified to the pilot by relevant ATC facility. See RNP 2 for back-up voice communications.

4. Separations and flight level

4.1 The minimum longitudinal separation between two data-link aircraft flying on same flight level in data-link service space in 10 minutes.
RNAV 1: Used to support RNAV operations in the en-route phase of flight, on SIDs, on STARs and on approaches up to the FAF/FAP (RNAV-1/P-RNAV).

DME/DME RNAV systems are allowed for RNAV 1 operations.

RNP 1: Used to support RNAV operations on SIDs, on STARs and on approaches up to the FAF/FAP with no, or limited, ATS surveillance and with low to medium density traffic.

GNSS is the primary navigation sensor to support RNP 1, either as stand-alone or as part of a multi-sensor system; RNP 1 shall not be used in areas of known navigation signal GNSS interference;

Use of RF leg is an optional function for RNP 1;
The Operator must validate every RNAV 1/RNP 1 SID and/or STAR route before flying in IMC in order to ensure compatibility with aircraft and to ensure consistency with the published routes;

As a minimum, the Operator must:
- Compare RNAV 1/RNP 1 SID/STAR to be loaded into FMS with respective valid charts;
- Validate the data loaded for RNAV 1/RNP 1 SID/STAR routes, either on the flight simulator or on aircraft under VMC. Chart display must be compared to the published routes;
- Complete set of routes must be flown to ensure fly-ability and eliminating any discrepancies/chart inconsistencies;

Once RNAV 1/RNP 1 routes are validated, a copy of the validated data shall be kept/maintained in order to compare them with subsequent updates;

If there are significant changes i.e. any change affecting the route path or performance or if an FMS system software is modified by the vendor, the Operator must validate the amended route thru the initial validation data steps;
RNAV 1/RNP 1

Publication

✈ State AIP shall clearly indicate the navigation application;

✈ Identification of MEA for each route;

✈ All routes must be based upon WGS-84 coordinates;

✈ The available navaid infrastructure should be clearly designated on all appropriate charts (e.g. GNSS, DME/DME or DME/DME/IRU);

✈ Procedures with critical DMEs have no redundancy. Any DME facilities that are critical to RNAV 1 operations should be identified in the relevant AIP pages/charts;

✈ RF leg noted in PBN box;
RNAV 1/RNP 1
Publication
(AIP sample)
States complete a PBN implementation plan as a matter of urgency to achieve:

1) Implementation of RNAV and RNP operations (where required) for en route and terminal areas according to established timelines and intermediate milestones;

2) Implementation of approach procedures with vertical guidance (APV) (Baro-VNAV and/or augmented GNSS), including LNAV only minima, for all instrument runway ends, either as the primary approach or as a back-up for precision approaches by 2016 with intermediate milestones as follows: 30 per cent by 2010, 70 per cent by 2014; and

3) Implementation of straight-in LNAV only procedures, as an exception to 2) above, for instrument runways at aerodromes where there is no local altimeter setting available and where there are no aircraft suitably equipped for APV operations with a maximum certificated take-off mass of 5 700 kg or more;
The Operator must identify the responsible manager for data uploading, establish process for accepting, verifying and loading into the aircraft;

The Operator must validate each approach procedure before flying in IMC;

As a minimum, the Operator must:

- Compare the navigation data of the procedure to be loaded into FMS with the respective published procedure chart;
- Validate the navdata of the loaded procedure, either on the flight simulator or in the actual aircraft under VMC. The depicted procedure on map display must be compared to the published procedure;
- The entire procedure must be flown to ensure fly-ability and eliminating any discrepancies/chart inconsistencies;

Once the procedure is validated, a copy of the validated data shall be kept and maintained in order to be compared with subsequent data updates;

Data Updating

If there are significant changes i.e. any change affecting the route path or performance or if an FMS system software is modified by the vendor, the Operator must validate the amended route thru the initial validation data steps;
State AIP shall clearly indicate navigation application is RNP APCH*

* Note: Presently in procedure Tabular description, in the future PBN information box;

It shall always include LNAV OCA/H;

If the missed approach is based on conventional means, navaid facilities that are necessary to conduct the approach must be identified in the respective procedure chart;

RF leg is an optional function;

RNP values associated with procedure segment(s)**

** Note: Initial/intermediate/missed 1NM, final 0.3NM;

Current charting convention for procedure title is RNAV RNP – until 30 Nov 2022; after 1 Dec 2022, chart title shall be e.g. RNP rwy 23 (LPV only).

State AIP shall clearly indicate navigation application is RNP AR APCH and that special authorization is required*

* Note: Presently as charted note and/or tabular description;

Through State AIP will be specified permitted sensors, RF leg usage and/or required RNP value(s);

RF leg functionality is required;

Procedure involving an MAS with RNP<1.0, DA/H is published instead and the appropriate notation is made on the chart;

Current charting convention for procedure title is RNAV RNP – until 30 Nov 2022; after 1 Dec 2022, chart title shall be RNP rwy 23 (AR).

ICAO Circular 336 (4th quarter 2013) provides guidance to assist States and other stakeholders with the transition from RNAV to RNP approach chart identification.
RNP APCH/RNP AR APCH
ADVANCED RNP: The Super NAVSPEC

ARNP NavSpec provides for a single assessment of aircraft eligibility the qualification to operate more than one navigation accuracy requirement and multiple applications across all phases of flight (RNAV 1, RNAV 2, RNAV 5, RNP 2, RNP 1, RNP APCH).
The Area Navigation capability required for ARNP will support a number of following applications including closely spaced tracks, RNP Dep/Arr and App;

ARNP is based upon GNSS. Multi-DME may be authorized. No recourse to conventional means (VOR or NDB);

Requires an RNAV system with a holding functionality;

Requires RF leg functionality;

State AIP should clearly indicate ARNP and navigation accuracy;
Captain Jepp

Captain Elrey B. Jeppesen
1907 - 1996