Chapter 7 Basic RNP 1

1. General

Basic RNP 1 is based on GNSS positioning. The navigation specification is intended to support arrival and departure procedures without the dependence on a DME/DME infrastructure.

Other than the requirement for GNSS there is no significant difference between the RNAV 1 and 2 navigation specification and basic RNP 1.

2. Operational Approval

Operators of GNSS equipped aircraft holding an RNAV 1 and 2 operational approvals qualify for Basic RNP 1 subject to the following conditions:

- Manual entry of SID/STAR waypoints is not permitted
- Pilots of aircraft with RNP input selection capability (typically equipped FMS aircraft) should select RNP 1 or lower for Basic RNP 1 SIDs and STARs
- If a Basic RNP 1 SID or STAR extends beyond 30NM from the ARP in some cases the CDI scale may need to be set manually to maintain FTE within limits (see below)
- If a MAP display is used, scaling must be suitable for Basic RNP 1 and a FD or AP used.

Operators of GNSS equipped aircraft holding both P-RNAV and US RNAV approvals also meet the requirements for RNAV 1 and 2 and therefore also qualify for Basic RNP 1 subject to the additional conditions listed in the previous paragraph.

Applicants without previous relevant approvals will need to be assessed against the requirements of the Basic RNP 1 navigation specification.

3. Summary

- A single RNAV system only is required.
- GNSS is required
- A navigation database is required.
- Navigation displays in the pilot's forward view must be sufficient to permit track following and manoeuvring
- MAP display (without CDI) is acceptable provided FD or AP is used
- The maximum cross-track error deviation permitted is 0.5NM

4. Stand-alone GNSS systems

The most basic qualifying system is a stand-alone GNSS receiver (TSO C129 (a)) which should coupled to a CDI or HSI display providing course guidance and cross-track deviation indications. This type of system may also be integrated with a map display, however primary guidance is provided by the CDI/HSI. The receiver normally incorporates a self-contained control and display unit but the interface may also be provided by a separate CDU.

In this arrangement Basic RNP 1 capability is provided when in *terminal* mode. In terminal mode:

- CDI scaling is automatically set at +/- 1NM full scale deflection
- HAL is automatically set to 1 NM (RAIM alert limit)

In the default mode (en-route) CDI scaling increases to +/- 5NM and HAL increases to 2NM. Terminal mode cannot be manually selected but will be system selected provided certain conditions exist.

For departure, provided the current flight plan includes the departure airport (usually the ARP) terminal mode will be active and annunciated. (An annunciator panel should be installed in accordance with the manufacturer's recommendations and State airworthiness regulations). In the general case terminal mode will automatically switch to en-route mode at 30NM from the departure ARP. If the Basic RNP 1 SID extends past 30NM, the CDI scaling will no longer be adequate to support the required FTE limit (+/- 0.5NM), and flight crew action is necessary to manually select +/-1NM CDI scaling.

On arrival, provided the current flight plan route includes the destination airport (ARP) the receiver will automatically switch from en-route to terminal mode at 30NM from the ARP. If the STAR commences at a distance greater than 30NM radius from the destination, then en-route CDI scaling of +/-5NM is inadequate for Basic RNP 1 and must be manually selected to +/-1NM.

Note: Manual selection of +/- 1NM CDI scale (terminal scaling) does not change the mode, and en-route RAIM alert limits apply.

5. RNP Systems

Aircraft equipped with a flight management system, normally integrate positioning from a number of sources (radio navaids, GNSS) often using a multi-mode receiver (MMR) with IRS.

In such systems the navigation capability, alerting and other functions are based upon an RNP capability, and the RNP for a particular operation may be a default value, a pilot selected value or a value extracted from the navigation database.

There is normally no automatic mode switching (as in the case of a stand-alone receiver), although the default RNP may vary with the phase of flight.

For this type of operation it is necessary for the flight crew to select either RNP 1 or accept a lesser default value before commencement of a Basic RNP 1 SID or STAR.

6. Integrity availability

GNSS based operations require prediction that a service (with integrity) will be available for the route. Most GNSS availability prediction programs are computed for a specific location (normally the destination airport) and are unable to provide predictions over a route or large area. However for Basic RNP 1 the probability of a loss of GNSS integrity is remote and the prediction requirement can normally be met by determining that sufficient satellites are available to provide adequate continuity of service.

7. Deselection of radio updating

The PBN Manual makes reference to the possibility of position errors cased by the integration of GNSS data and other positioning data and the potential need for deselection of other navigation sensors. This method of updating is commonly associated with IRS/GNSS systems and the weighting given to radio updating is such that it is unlikely that any potential reduction in positioning accuracy will be significant in proportion to Basic RNP 1 navigation accuracy.

8. Functionality

The PBN MANUAL lists the functional requirements for Basic RNP 1 which are identical to RNAV 1 and 2.

For the majority of air transport aircraft equipped with FMS, the required functionalities, with the exception of the provision of a non-numeric lateral deviation display are normally available. For this category of aircraft lateral deviation is displayed on a map display, usually with a numeric indication of cross-track error in $1/10^{th}$ NM. In some cases a numeric indication of cross-track error may be provided outside the primary field of view (e.g. CDU). Acceptable lateral tracking accuracy for Basic RNP 1 routes is adequate provided the autopilot is engaged or flight director is used.

Aircraft equipped with stand-alone GNSS navigation systems, should be installed to provide track guidance via a CDI or HSI. An lateral deviation display is often incorporated in the unit, and may be suitable if of sufficient size and position to allow either pilot to manoeuvre and monitor cross-track deviation.

Caution should be exercised in regard to the limitations of stand-alone GNSS systems with respect to ARINC 424 path terminators. Path terminators involving an altitude termination are not normally supported due to a lack of integration of the lateral navigation system and the altimetry system. For example, a departure procedure commonly specifies a course after takeoff until reaching an specified altitude (CA path terminator). Using a basic GNSS navigation system it is necessary for the flight crew to manually terminate the leg on reaching the specified altitude and then navigate to the next waypoint, ensuring that the flight path is consistent wit the departure procedure. This type of limitation does not preclude operational approval (as stated in the PBN MANUAL functional requirements) provided the operator's procedures and crew training are adequate to ensure that the intended flight path and other requirements can be met for all SID and STAR procedures.

9. Operating procedures

Operators with en-route RNAV experience will generally meet the basic requirements of Basic RNP 1 and the operational approval should focus on procedures associated with SIDs and STARs.

Particular attention should be placed on selection of the correct procedure from the database, review of the procedures, connection with the en-route phase of flight and the management of discontinuities. Similarly an evaluation should be made of procedures manage selection of a

new procedures, including change of runway, and any crew amendments such as insertion or deletion of waypoints.

10. Pilot Knowledge and Training

During the operational approval, particular attention should be placed on the application of the pilot knowledge and training to the conduct of Basic RNP 1 SIDs and STARs. Most crews will already have some experience RNAV operations, and many of the knowledge and training items will have previously been covered in past training.

Execution of SIDs and STARs, connection with the enroute structure and transition to approach procedures require a thorough understanding of the airborne equipment, and its functionality and management.

Particular attention should be placed on:

- The ability of the airborne equipment to fly the designed flight path. This may involve pilot intervention where the equipment functionality is limited
- Management of changes (procedure, runway, track)
- Turn management (turn indications, airspeed & bank angle, lack of guidance in turns)
- Route modification (insertion/deletion of waypoints, direct to waypoint)
- Intercepting route, radar vectors

Where GNSS is used, flight crews must be trained in GNSS principles related to en-route navigation.

Flight training for Basic RNP 1 is not normally required, and the required level of competence can normally be achieved by classroom briefing, computer based training, desktop simular training, or a combination of these methods. Computer based simulator programs are available from a number of GPS manufacturers which provide a convenient method for familiarity with programming and operation of stand-alone systems.

Although not specifically mentioned in the PBN MANUAL Basic RNP 1 navigation specification, where VNAV is used for SIDs and STARs attention should be given to the management of VNAV and specifically the potential for altitude constraints to be compromised in cases where the lateral flight path is changed or intercepted.