# Chapter 5 RNP 4

## 1. General

RNP 4 is a navigation specification applicable to oceanic and remote airspace, and supports 30NM lateral and 30NM longitudinal separation.

## 2. Operational Approval

Operators holding an existing RNP 4 operational approval do not need to be re-examined as the PBN Manual requirements are essentially unchanged.

## 3. ATS communications and surveillance

The PBN Manual does not address communication or air traffic services (ATS) surveillance requirements that may be specified for operation on a particular route or area. These requirements are specified in other documents, such as the aeronautical information publications (AIP) and ICAO Regional Supplementary Procedures (Doc 7030). An operational approval conducted in accordance with the requirements of the PBN Manual assumes that operators and flight crews take into account all the communication and surveillance requirements related to RNP 4 routes.

## 4. Summary

For RNP 4 operational approval:

- Two long range navigation systems are required
- At least one GNSS receiver is required
- A navigation database is required.
- Navigation displays in the pilot's forward view must be sufficient to permit track following and manoeuvring
- The maximum cross-track error deviation permitted is 2NM

## 5. GNSS

GNSS is fundamental to the RNP 4 navigation specification, and carriage avoids any need to impose a time limit on operations. The consequences of a loss of GNSS navigation need to be considered and there are a number of requirements in the navigation specification to address this situation.

Irrespective of the number of GNSS receivers carried, as there is a remote probability that a fault may be detected en-route, a fault detection and exclusion (FDE) function needs be installed. This function is not standard on TSO C129a receivers and for oceanic operations a modification is required.

With FDE fitted, integrity monitoring is available provided there are sufficient satellites of a suitable configuration in view. Some reduction in availability of a positioning service with integrity results, as additional satellites are required, although for RNP 4 as the alerting requirements are large, it is highly improbable that service will not be available.

The RNP 4 navigation specification does not require a dispatch prediction of the availability of integrity monitoring (with FDE) in the case of a multi-sensor system. In this context a system integrating GNSS and IRS is a suitable multi-sensor system. A prediction of GNSS availability is therefore not considered necessary the multi-sensor system will revert to IRS in the remote possibility that GNSS is unavailable.

Other methods of integrity monitoring, discussed under the heading *Aircraft Autonomous Integrity Monitoring (AAIM*) in Part 1, utilise hybrid GNSS/IRS monitoring systems which provide increased availability sufficient to not require a dispatch prediction to be conducted. Examples of these systems are Honeywell HIGH and Litton AIME.

A difficulty is that most availability programs are based on a specific location (normally the destination airport) and are unable to provide predictions over a route or large area. For RNP 4, as the alerting limits are large, provided a minimum number of satellites are available, availability can be assured without the need to carry out a prediction for each flight.

## 6. Functionality

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 lateral deviation is not normally displayed on a CDI or HSI, but is commonly available 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).

Aircraft equipped with stand-alone GNSS navigation systems, should be installed to provide track guidance via a CDI or HSI. The CDI/HSI must be coupled to the RNAV route providing a direct indication of lateral position reference the flight planned track. This type of unit in en-route mode (normal outside 30NM from departure and destination airports) defaults to a CDI/HSI full-scale display of 5NM, which is adequate for RNP 4. A 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.

The navigation specification includes some requirements for fly-by transition criteria. The default method for RNAV systems to manage turns at the intersection of "straight" route segments (TF/TF), is to compute, based on groundspeed and assumed angle of bank, a position at which the turn should commence so that the resulting radius will turn inside the angle created by the two consecutive segments and "fly-by" the intermediate waypoint. For aircraft fitted with a stand-alone GNSS system or an FMS fly-by transitions are a standard function and should not require specific evaluation. However a stand-alone GNSS receiver may require a pilot action to initiate the turn. All turns are limited by the physical capability of the aircraft execute a turn of suitable radius. In normal cases where the angle between track is small there is seldom a problem, but operators need to be aware that large angle turns, particularly at high altitude where TAS is high and bank angle is commonly limited can be outside the aircraft capability. While this condition is rare, flight crews need to be aware of the aircraft and avionics limitations.

## 7. Operating Procedures

The standard operating procedures adopted by operators flying on oceanic and remote routes should normally be generally consistent with RNP 4 operations, except that some additional provisions may need to be included to specifically address NP 4 operations.

A review of the operator's procedure documentation against the requirements of the PBN Manual and the [State] regulatory requirements should be sufficient to ensure compliance. The essential elements to be evaluated are that the operator's procedures ensure that:

- The aircraft is serviceable for RNP 4 ops
- RNP 4 capability is indicated on the flight plan
- En-route loss of capability is identified and reported
- Procedures for alternative navigation are described

GNSS based operations also require the prediction of FDE availability. Most GNSS service prediction programs are based on a prediction at a destination and do not generally provide predictions over a route or large area. However for RNP 4 operations the probability that the constellation cannot support FDE is remote and this requirement can be met by either a general route analysis or a dispatch prediction of satellite availability. For example a specified minimum satellite constellation may be sufficient to support all RNP 4 operations without specific real-time route prediction being required.

## 8. Pilot Knowledge and Training

Unless the operator is inexperienced in the use of RNAV, flight crews should possess the necessary skills to conduct RNAV 4 operations with minimal additional training.

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

Where additional training is required, this can normally be achieved by bulletin, computer based training or classroom briefing. Flight training is not normally required.