



International
Civil Aviation
Organization

Organisation
de l'aviation civile
internationale

Organización
de Aviación Civil
Internacional

Международная
организация
гражданской
авиации

منظمة الطيران
المدني الدولي

国际民用
航空组织

Tel.: +1 (514) 954-8219 ext. 6711

Ref.: AN 13/33.7-04/86

24 September 2004


Subject: Guidance material for the issuance of required navigation performance (RNP) 4 operational approvals

Action required: To note and take action in accordance with paragraph 3 where applicable

Sir/Madam;

1. I have the honour to invite your attention to the attached guidance material on the issuance of operational approvals to aircraft and operators for required navigation performance (RNP) 4 operations. This material has been prepared by the Separation and Airspace Safety Panel (SASP) to support the introduction of 30 NM lateral route spacing and the 30 NM longitudinal separation minimum for use with RNP 4 approved aircraft in oceanic or remote airspace.
2. The material contained in this attachment is to be published as a new appendix to the *Manual on Required Navigation Performance* (Doc 9613); however, the publication and distribution of the material as an amendment to the manual will take some time. Since the introduction of the RNP 4 based 30 NM separation minima in the Pacific Region is planned for 25 November 2004, it was decided that the guidance material should also be distributed at an earlier date in a State letter, so that it would be available to States prior to publication of the amendment to Doc 9613.
3. All States whose operators may require RNP 4 approvals are urged to establish an appropriate approval process in accordance with these guidelines.

Accept, Sir/Madam, the assurances of my highest consideration.


Taïeb Chérif
Secretary General

Enclosure:

Guidance for an RNP 4 operational approval process for initial application in oceanic or remote airspace

GUIDANCE FOR AN RNP 4 OPERATIONAL APPROVAL PROCESS FOR INITIAL APPLICATION IN OCEANIC OR REMOTE AIRSPACE

1. INTRODUCTION

1.1 Purpose

1.1.1 Annex 6 — *Operation of Aircraft* specifies that an operator must obtain required navigation performance (RNP) operational approval from the State of the Operator (for international commercial air transport operations) or the State of Registry (for international general aviation operations) before conducting flights in defined portions of airspace or on routes where RNP types have been prescribed.

1.1.2 The safe, efficient and expeditious implementation of RNP requires a uniform approach by all States to the issuance of these approvals. Guidance material on implementing an RNP 10 operational approval process has already been published. This guidance material has been produced to assist States in developing their approval procedures for RNP 4. To ensure consistency with the approval process for other RNP types, these guidelines generally follow the structure of the guidance material for the RNP 10 operational approval process described in Appendix E of the *Manual on Required Navigation Performance (RNP)* (Doc 9613).

1.2 Background and scope

1.2.1 This guidance material was developed by the Separation and Airspace Safety Panel (SASP), to support the implementation of the 30 NM lateral and the 30 NM longitudinal distance-based separation minima for use in conjunction with RNP 4, which are described in paragraph 3.4.1 e) of Attachment B to Annex 11 — *Air Traffic Services* and Section 5.4 of the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444).

1.2.2 The approval process described in this document does not incorporate all of the equipment functionalities described in the minimum aviation system performance standards (MASPS) for RNP 4, which are contained in RTCA Document DO-236B and EUROCAE Document ED 75B. The existing 30 NM separation minima, which this approval process is designed to support, require RNP 4 as specified in Doc 9613, but do not require compliance with certain additional requirements specified in the MASPS.

1.2.3 The approval process described herein is limited to aircraft which have received airworthiness certification indicating that the installed navigation systems meet the performance requirements for RNP 4. This certification may have been issued at the time of manufacture, or where aircraft have been retrofitted in order to meet the requirements for RNP 4, by the granting of an appropriate supplemental type certificate (STC).

1.2.4 While this guidance material has been developed to support the 30 NM lateral and longitudinal separation minimum based on RNP 4, it should be noted that it addresses only the navigation requirements associated with these standards. It does not address the communications or surveillance

requirements. Aeronautical Information Publications (AIP) and *Regional Supplementary Procedures* (Doc 7030) are the appropriate documents for promulgation of the communications and surveillance requirements for specific airspace or air traffic services (ATS) routes.

Note 1. — The provisions relating to these separation minima, including the communications and surveillance requirements, can be found in paragraph 3.4.1 e) of Attachment B to Annex 11 and Section 5.4 of the PANS-ATM. Provided that they can support the increased reporting rate required, controller-pilot data link communications (CPDLC) and automatic dependent surveillance (ADS) systems which meet the requirements for application of the 50 NM lateral and longitudinal minima based on RNP 10 will also meet the requirements for the application of the 30 NM lateral and longitudinal minima.

Note 2. — Although this RNP 4 operational approval has been developed to support the application of reduced separation minima in oceanic or remote area airspace, it could also be used to support other future area navigation (RNAV) separation minima smaller than 30 NM (e.g. in non-radar continental airspace) if the navigation performance requirements are the same. However, the communications and surveillance requirements associated with such minima may be quite different. For example, direct voice communications might be required instead of CPDLC and an increase in the ADS reporting rate might be necessary.

1.2.5 While this operational approval document deals only with the navigation element (RNP 4), flight crews must be aware that different airspaces may have other operational requirements that need to be considered when they are flight planning into RNP airspace. The need to verify compliance with any such additional requirements is noted in the guidelines provided for flight crew training, which can be found in Section 5 of this document.

1.3 RNP 4 requirements

1.3.1 The navigation accuracy requirement for issuance of an RNP 4 approval requires that the aircraft navigate with a cross-track total system error (TSE) no greater than ± 7.4 km (± 4 NM) for 95 per cent of the total flight time. The aircraft along-track TSE must also be no greater than ± 7.4 km (± 4 NM) for 95 per cent of the flight time.

Note.— For the definition of TSE and its components, see Appendix A of Doc 9613.

1.3.2 The technical capabilities of the equipment leading to the navigation solution must be presented by the operator to the appropriate State's airworthiness authority and must be certified by the State prior to the grant of a full operational approval. For commercial operators, this equipment approval should be reflected in Operations Specifications forming part of an Air Operator Certificate (AOC), and for non-commercial operators, in the form of a flight manual supplement. This, in combination with operational considerations, forms an RNP 4 operational approval.

1.3.3 The required and recommended equipment functionalities for RNP 4 operations are listed in Section 3.

1.3.4 In addition to the aircraft having the appropriate RNP certification, the issuance of an RNP 4 operational approval requires consideration of issues related to continuing airworthiness, operational procedures, and training for the flight crew and other operational staff.

1.3.5 Sources of additional information on RNP are listed in the Appendix.

1.3.6 Operators and flight crews must also comply with the relevant requirements of Annex 2 — *Rules of the Air*.

2. RNP 4 OPERATIONAL APPROVAL PROCESS

2.1 General

2.1.1 The following steps must be completed before an RNP 4 operational approval can be issued to an operator:

- a) eligibility of aircraft and certification of its navigation equipment for RNP 4 must be determined by the State of Design and State of Registry;
- b) flight crew training and operating procedures for the navigation systems to be used must be identified by the operator; and
- c) the operator database used, flight crew training, and operating procedures must be evaluated by the State of the Operator or State of Registry.

2.1.2 When these steps have been successfully completed an RNP 4 operational approval, letter of authorization, appropriate operations specifications, special authorization, or equivalent, can be issued by the State.

2.1.3 This guidance material addresses only the approval of aircraft for which the certification of RNP 4 navigation capability for operations in oceanic or remote airspace is based upon the use of global navigation satellite system (GNSS) or equivalent systems as either stand-alone navigation systems, or as one of the navigation inputs to a multi-sensor system. GNSS ensures that there is no time limit imposed upon the RNP 4 approval.

2.2 Starting the approval process

2.2.1 Operators should contact their aviation/regulatory authority to discuss the aviation authority's airworthiness and operational requirements. Topics for discussion include the:

- a) contents of the operator's application;
- b) aviation authority's review and evaluation of the application;
- c) limitations (if any) on the approval; and
- d) conditions under which the operational approval may be cancelled.

2.3 Contents of an application for an RNP 4 operational approval

Aircraft eligibility

2.3.1 Operators must provide relevant documentation (e.g. the flight manual) to establish that the aircraft is equipped with navigation equipment that satisfies the requirements of RNP 4. Operational approval is based upon the equipment listed in the appropriate documents having been approved by the aviation authority of the State of Design. Additional details regarding aircraft eligibility are given in Section 3 below.

2.3.2 Operators must provide a detailed list of the equipment and components to be used for long-range navigation and RNP 4 operations. Installed equipment must be identical to that certified in the flight manual and must be operational unless exceptions are listed in the minimum equipment list (MEL) for specific non-standard conditions.

Training documentation

2.3.3 Operators that are required to have an approved training programme under the terms of their operating certificate must submit training syllabi and training material (e.g. computer based training, simulator training) to the aviation authority to show that the operational practices and procedures and training items related to RNP 4 operations have been incorporated in training programmes (e.g. initial, upgrade or recurrent training for flight crew, dispatchers or maintenance personnel). Practices and procedures in the following areas must be standardized:

- a) flight planning;
- b) pre-flight procedures at the aircraft for each flight;
- c) procedures before entry into an RNP 4 route or airspace;
- d) in-flight contingency and
- e) flight crew qualification procedures.

2.3.4 Operators that are not required to have an approved training programme (e.g. non-commercial operators) must accept responsibility for training flight crew in accordance with the practices and procedures described in Section 5 of this Appendix.

Operations manuals and checklists

2.3.5 Commercial operators must revise their operations manuals and checklists to include information/guidance on the standard operating procedures detailed in Section 5. The appropriate manuals should contain navigation system operating instructions and contingency procedures where specified (e.g. weather deviation procedures). Commercial operators must submit manuals and checklists for review as part of the application process.

2.3.6 Non-commercial operators must create appropriate instructions containing navigation operating instructions and contingency procedures. This information must be available to crews in flight and should be entered into the Operations Manual or Pilot Operating Handbook, as appropriate. These manuals and manufacturer's instructions for operation of the aircraft navigation equipment, as appropriate, must be submitted for review as part of the application process.

Past performance

2.3.7 Operators must include a company "operating history" in their application. The "operating history" must address any events or incidents related to navigation errors (e.g. as reported on a State's navigation error investigation form) and the means by which the operator addressed those events or incidents through new or revised training programmes procedures, maintenance, or modifications to the aircraft.

Minimum equipment list (MEL)

2.3.8 For commercial operations, the appropriate State aviation authority must approve any MEL revisions necessary to address the RNP 4 provisions in this manual. For non-commercial operations, installed navigation equipment, listed in the flight manual as required for RNP 4 operations must be operational.

Maintenance and continuing airworthiness

2.3.9 All operators/owners must submit their maintenance programme, including a reliability programme for monitoring the equipment, for approval at the time of application. The holder of the design approval, including either the type certificate (TC) or supplemental type certificate (STC) for each individual navigation system installation, must furnish at least one set of complete instructions for continuing airworthiness.

2.4 Evaluation, investigation and cancellation

Review and evaluation of applications

2.4.1 After an operator submits an application, the aviation authority will begin the process of review and evaluation. If the contents of the application are deficient the approving authority will request additional information from the operator. When all the certification, airworthiness and operational requirements of the application have been met, the RNP 4 approval will be issued.

2.4.2 An RNP 4 operational approval should be issued in an appropriate form (e.g. a certificate indicating an RNP 4 operational approval, operations specifications, special authorization or letter of authorization). It should identify any conditions or limitations on operations in RNP 4 airspace or on an RNP 4 route (e.g. required navigation systems or procedures, routes or areas of operation).

Monitoring and investigation of navigation and system errors

2.4.3 Demonstrated navigation accuracy provides the basis for determining the lateral route spacing and separation minima necessary for traffic operating on a given route. Accordingly, lateral and longitudinal navigation errors are monitored through monitoring programmes. Radar observations of each aircraft's proximity to track and altitude, before coming into coverage of short-range nav aids at the end of

the oceanic route segment, are noted by ATS facilities. If an observation indicates that an aircraft is not within the established limit, a navigation error report is submitted, and an investigation undertaken to determine the reason for the apparent deviation from track or altitude, in order that steps may be taken to prevent a recurrence.

Cancellation of RNP 4 approval

2.4.4 An aviation authority may consider any navigation error reports in determining remedial action. Repeated navigation error occurrences attributed to a specific piece of navigation equipment or operational procedure may result in cancellation of the operational approval pending replacement or modifications on the navigation equipment or changes in the operator's operational procedures.

2.4.5 Information that indicates the potential for repeated errors may require modification of an operator's training programme, maintenance programme or specific equipment certification. Information that attributes multiple errors to a particular pilot crew may necessitate remedial training or crew licence review.

3. AIRCRAFT ELIGIBILITY GROUPS, TECHNICAL REQUIREMENTS AND EXPLANATION OF TERMS

3.1 Aircraft eligibility groups

Group 1: RNP certification

3.1.1 Group 1 aircraft are those with formal certification and approval of RNP integration in the aircraft. RNP compliance is documented in the aircraft's flight manual.

3.1.2 The certification will not necessarily be limited to a specific RNP type. The flight manual must address the RNP levels that have been demonstrated and any related provisions applicable to their use (e.g. navaid sensor requirements). Operational approval is based upon the performance stated in the flight manual.

3.1.3 This method also applies in the case where certification is received through a STC issued to cover retrofitting of equipment, such as GNSS receivers, to enable the aircraft to meet RNP 4 requirements in oceanic and remote area airspace.

Group 2: Prior navigation system certification

3.1.4 Group 2 aircraft are those that can equate their certified level of performance, given under previous standards, to RNP 4 criteria. Those standards listed below in subparagraphs a) to c) can be used to qualify aircraft under Group 2.

- a) *Global navigation satellite systems (GNSS)*. Aircraft fitted with GNSS as an approved long-range navigation system for oceanic and remote airspace operations must meet the technical requirements specified in Section 3.2. The flight manual must indicate that dual GNSS equipment approved under an appropriate standard is required. Appropriate standards are FAA Technical Standard Orders (TSO) C129a or C146, and JAA Joint

Technical Standard Orders (JTSO) C129a or C146. In addition, an approved dispatch fault detection and exclusion (FDE) availability prediction program must be used. The maximum allowable time for which FDE capability is projected to be unavailable is 25 minutes. This maximum outage time must be included as a condition of the RNP 4 operational approval. If predictions indicate that the maximum allowable FDE outage will be exceeded the operation must be rescheduled to a time when FDE is available.

- b) *Multi-Sensor Systems Integrating GNSS with integrity provided by Receiver Autonomous Integrity Monitoring (RAIM)*. Multi-sensor systems incorporating Global Positioning System (GPS) with RAIM or FDE that are approved under FAA AC20-130A, or other equivalent documents, meet the technical requirements specified in Section 3.2.
- c) *Aircraft Autonomous Integrity Monitoring (AAIM)*. AAIM uses the redundancy of position estimates from multiple sensors, including GNSS, to provide integrity performance that is at least equivalent to RAIM. These airborne augmentations must be certified in accordance with TSO C-115b, JTSO C-115b or other equivalent documents. An example is the use of an inertial navigation system or other navigation sensors as an integrity check on GNSS data when RAIM is unavailable but GNSS positioning information continues to be valid.

Group 3: New technology

3.1.5 This group has been provided to cover new navigation systems that meet the technical requirements for operations in airspace where RNP 4 is specified.

3.2 Technical requirement

Navigation accuracy

3.2.1 Accuracy is defined relative to a geodesic path along a route or defined procedure. RNP 4 operations require that aircraft navigate with a cross-track navigation error no greater than ± 7.4 km (± 4 NM) for 95 per cent of the total flight time. This includes position estimation error (PEE), flight technical error (FTE), path definition error (PDE) and display error. The aircraft along-track positioning error must be no greater than ± 7.4 km (± 4 NM) for 95 per cent of the flight time.

GNSS monitor

3.2.2 The GNSS navigation system must detect satellite failures before they cause the aircraft to exceed the defined airspace limits. This requirement is derived from the overall effect of a GNSS failure, and applies to all navigational uses of GNSS. The probability of missed detection of satellite failures must be less than or equal to 10^{-3} , and the effective monitor limit for these failures on the navigation solution, known as the horizontal alert limit (HAL), must consider the other normal errors that may exist during the satellite fault, the latency of the alert, the crew reaction time to an alert and the aircraft response. An acceptable means of compliance is to use a HAL as follows: Oceanic (RNP 4): 4 NM.

Required functionalities

3.2.3 The following functionalities are mandatory:

- a) CDI in pilot's "Field of Vision" (FOV);
- b) track to fix (TF);
- c) direct to fix (DF);
- d) direct—to function;
- e) course to fix (CF);
- f) parallel offset;
- g) fly-by transition criteria;
- h) user interface displays;
- i) flight planning path selection;
- j) flight planning fix sequencing;
- k) user defined course to fix;
- l) path steering;
- m) alerting requirements;
- n) navigation data base access; and
- o) WGS 84 geodetic reference system.

Recommended functionalities

3.2.4 The following additional functionalities are recommended:

- a) display cross-track error on the control and display unit (CDU);
- b) display present position in distance/bearing to selected waypoints;
- c) provide time to waypoints on the CDU;
- d) along track distance to the next waypoint;
- e) display ground speed;

- f) indicated track angle;
- g) provide automatic navigation aids selection;
- h) purge radio updates;
- i) manually inhibit a navaid facility;
- j) automatic selection and tuning of distance measuring equipment (DME) and/or VHF omnidirectional radio range (VOR);
- k) estimate of position uncertainty;
- l) current RNP type;
- m) flight plan discontinuity; and
- n) navigation sensor in use and display of degraded navigation.

Automatic radio position updating

3.2.5 Automatic updating is the only method acceptable for the update of an aircraft's position.

3.3 Explanation of terms

Note.— This section addresses only those terms not already included in the Explanation of Terms in Appendix A of Doc 9613.

CDI in pilot's field of view (FOV)

3.3.1 A course deviation indicator (CDI) located in the pilot's primary field of view along the forward flight path, enabling the pilot to perform a natural crosscheck, is required. These displays must be visible to the pilot in the primary field of view. A scalable electronic map cannot substitute for a CDI. A fixed scale CDI is acceptable as long as the CDI demonstrates appropriate scaling and sensitivity for the intended RNP type. Differences in CDI scales from one RNP type to another may require operational procedures to check and affirm the CDI scale against the RNP type. With a scalable CDI, the scale must derive from the selection of RNP, not from a separate selection of CDI scale. Alerting and annunciation limits must match scaling values. If the equipment uses default RNP types to describe the operational mode (e.g. en route, terminal area and approach), then displaying the operational mode is an acceptable means from which the flight crew may derive the CDI scale sensitivity. The course selector of the deviation display must have the full-scale deflection required for the flight procedure and track keeping accuracy.

Track to fix (TF)

3.3.2 The TF leg is a geodesic path between two fixes. The first fix is either the previous leg termination or an IF leg. The termination fix is normally provided by the navigation database, but may also be a user-defined fix.

Direct to fix (DF)

3.3.3 The DF leg is a geodesic path starting near the area of initiation and terminating at a fix.

Direct—to function

3.3.4 The direct—to function must be able to be activated at any time by the flight crew, when required. The direct—to function must be available to any fix. The system must be capable of generating a geodesic path to the designated “To” fix. The aircraft must capture this path without “S-turning” and without undue delay.

Course to fix (CF)

3.3.5 The CF leg is a geodesic path terminating at a fix with a specified course at that fix. The inbound course at the termination fix and the fix are provided by the navigation database. If the inbound course is defined as a magnetic course, the source of the magnetic variation needed to convert magnetic courses to true courses is required.

Parallel offset

3.3.6 The system must have the capability to fly parallel tracks at a selected offset distance. When executing a parallel offset, the RNP type and all performance requirements of the original route in the active flight plan must be applicable to the offset route. The system must provide for entry of offset distances in increments of 1 NM, left or right of course. The system must be capable of offsets of at least 20 NM. When in use, system offset mode operation must be clearly indicated to the flight crew. When in offset mode, the system must provide reference parameters (for example, cross-track deviation, distance-to-go, time-to-go) relative to the offset path and offset reference points. An offset must not be propagated through route discontinuities, unreasonable path geometries, or beyond the initial approach fix. Annunciation must be given to the flight crew prior to the end of the offset path, with sufficient time to return to the original path. Once a parallel offset is activated, the offset must remain active for all flight plan route segments until removed automatically, until the flight crew enters a Direct-To routing, or until flight crew (manual) cancellation. The parallel offset function must be available for en route TF and geodesic portion of DF leg types.

Fly-by transition criteria

3.3.7 The navigation system must be capable of accomplishing fly-by transitions. No predictable and repeatable path is specified, because the optimum path varies with airspeed and bank angle. However, predictable and repeatable boundaries of the transition area are defined. Path definition error is defined as the difference between the defined path and the theoretical transition area. If the path lies within the transition area, there is no path definition error. Fly-by transitions must be the default transition when the transition type is not specified. The theoretical transition area requirements are applicable for the following assumptions:

- a) course changes do not exceed 120 degrees for low altitude transitions (referred as when the aircraft barometric altitude is less than FL 195); and

- b) course changes do not exceed 70 degrees for high altitude transitions (referred as when the aircraft barometric altitude is equal to or greater than FL 195).

User interface displays

3.3.8 General user interface display features must provide for presentation of information, provide situational awareness and be designed and implemented to accommodate human factors considerations. Essential design considerations include:

- a) minimizing reliance on flight crew memory for any system operating procedure or task;
- b) developing a clear and unambiguous display of system modes/sub modes and navigational data with emphasis on enhanced situational awareness requirements for any automatic mode changes if provided;
- c) use of context sensitive help capability and error messages (for example, invalid inputs or invalid data entry messages should provide a simple means to determine how to enter "valid" data);
- d) fault tolerant data entry methods rather than rigid rule based concepts;
- e) placing particular emphasis on the number of steps and minimizing the time required to accomplish flight plan modifications to accommodate ATS clearances, holding procedures, runway and instrument approach changes, missed approaches and diversions to alternate destinations; and
- f) minimizing the number of nuisance alerts so the flight crew will recognize and react appropriately when required.

Displays and controls

3.3.9 Each display element used as a primary flight instrument in the guidance and control of the aircraft, for manoeuvre anticipation, or for failure/status/integrity annunciation, must be located where it is clearly visible to the pilot (in the pilot's primary field of view) with the least practicable deviation from the pilot's normal position and line of vision when looking forward along the flight path. For those aircraft meeting the requirements of FAR/JAR 25, it is intended that provisions of certification documents such as AC 25-11, AMJ 25-11 and other applicable documents should be satisfied.

3.3.10 All system displays, controls and annunciations must be readable under normal cockpit conditions and expected ambient light conditions. Night lighting provisions must be compatible with other cockpit lighting. All displays and controls must be arranged to facilitate flight crew accessibility and usage. Controls that are normally adjusted in flight must be readily accessible with standardized labelling as to their function. System controls and displays must be designed to maximize operational suitability and minimize pilot workload. Controls intended for use during flight must be designed to minimize errors, and when operated in all possible combinations and sequences, must not result in a condition whose presence or

continuation would be detrimental to the continued performance of the system. System controls must be arranged to provide adequate protection against inadvertent system shutdown.

Flight planning path selection

3.3.11 The system must provide the capability for the crew to create, review and activate a flight plan. The system must provide the capability for modification (for example, deletion and addition of fixes and creation of along-track fixes), review and user acceptance of changes to the flight plans. When this capability is exercised, guidance outputs must not be affected until modification(s) is/are activated. Activation of any flight plan modification must require positive action by the flight crew after input and verification by the flight crew.

Flight planning fix sequencing

3.3.12 The system must provide the capability for automatic sequencing of fixes.

User-defined course to fix

3.3.13 The system must provide the capability to define a user-defined course to a fix. The pilot must be able to intercept the user-defined course.

Path steering

3.3.14 The system must provide data to enable the generation of command signals for autopilot/flight director/CDI, as applicable. In all cases a path steering error (PSE) must be defined at the time of certification, which will meet the requirements of the desired RNP operation in combination with the other system errors. During the certification process, the ability of the crew to operate the aircraft within the specified PSE must be demonstrated. Aircraft type, operating envelope, displays, autopilot performance, and leg transitioning guidance (specifically between arc legs) should be accounted for in the demonstration of PSE compliance. A measured value of PSE may be used to monitor system compliance to RNP requirements. For operation on all leg types, this value must be the distance to the defined path. For cross-track containment compliance, any inaccuracies in the cross-track error computation (for example, resolution) must be accounted for in the total system error.

Alerting requirements

3.3.15 The system must also provide an annunciation when the manually entered RNP type is larger than the RNP type associated with the current airspace as defined in the navigation database. Any subsequent reduction of the RNP type must reinstate this annunciation. When approaching RNP airspace from non-RNP airspace, alerting must be enabled when the cross-track to the desired path is equal to or less than one-half the RNP value and the aircraft has passed the first fix in the RNP airspace.

Navigation database access

3.3.16 The navigation database must provide access to navigation information in support of the navigation systems reference and flight planning features. Manual modification of the navigation database data must not be possible. This requirement does not preclude the storage of "user defined data" within the

equipment. When data are recalled from storage they must also be retained in storage. The system must provide a means to identify the navigation database version and valid operating period.

WGS-84 geodetic reference system

3.3.17 WGS-84 or an equivalent earth reference model must be the reference earth model for error determination. If WGS-84 is not employed, any differences between the selected earth model and the WGS-84 earth model must be included as part of the path definition error. Errors induced by data resolution must also be considered.

4. OPERATIONAL REQUIREMENTS

4.1 Navigation accuracy

4.1.1 For RNP 4 operations, an aircraft must meet a cross-track keeping accuracy and along-track positioning accuracy of no greater than $\pm 7.4\text{km}$ (4 NM) for 95 per cent of the flight time.

4.2 Navigation equipage

4.2.1 For RNP 4 operations in oceanic or remote airspace, at least two fully serviceable independent long-range navigation systems (LRNSs), with integrity such that the navigation system does not provide misleading information, must be fitted to the aircraft and form part of the basis upon which RNP 4 operational approval is granted.

4.2.2 For aircraft incorporating GPS, United States FAA Advisory Circular AC 20-138 and Australian CAAP 35-1, or equivalent documents, provide an acceptable means of complying with installation requirements for aircraft that use but do not integrate the GNSS output with that of other sensors. FAA AC 20-130A describes an acceptable means of compliance for multi-sensor navigation systems that incorporate GPS.

4.2.3 The equipment configuration used to demonstrate the required accuracy must be identical to the configuration specified in the MEL or flight manual.

4.2.4 The design of the installation must comply with the design standards that are applicable to the aircraft being modified and changes must be reflected in the flight manual prior to commencing operations requiring an RNP 4 navigation approval.

4.3 Flight plan designation

4.3.1 Operators must indicate the ability to meet RNP 4 for the route or airspace in accordance with the PANS-ATM, Appendix 2, which requires the insertion of "R" in Item 10: (Equipment), of the ICAO flight plan. Operators must also comply with any additional flight planning requirements specified in Doc 7030 and State AIP.

4.3.2 Insertion of the letter "R" indicates that the pilot has:

- a) reviewed the planned route of flight, including the routes to any alternate aerodromes, to identify the types of RNP involved;
- b) confirmed that the aircraft and the operator have been approved (i.e. airworthiness and operational approval obtained) by the aviation authority for RNP 4 operations; and
- c) confirmed that the aircraft can comply with all conditions of the approval for the planned route of flight, within airspace or on routes requiring RNP 4.

4.4 Availability of GNSS

4.4.1.1 Before the commencement of flight, the operator must ensure that the GNSS availability requirements on which the operator's approval is based, will be met for the full length of the flight.

4.5 Navigation database

4.5.1 The standards for navigation databases are contained in RTCA document DO-200A and EUROCAE document DO-76. Given that not all current suppliers of navigation databases meet these standards, the operator, as a minimum, must implement navigation database integrity checks using appropriate software tools or approved manual procedures to verify data relating to all waypoints in the subject RNP-4 airspace or routes. These checks are in addition to any checks previously performed by the Aeronautical Information Services, unapproved navigation database suppliers, or navigation equipment manufacturers. The integrity checks need to identify any discrepancies between the navigation database and the published charts/procedures. An approved third party may perform integrity checks. Discrepancies that invalidate a procedure must be reported to the navigation database supplier and affected procedures must be prohibited by an operator's notice to its flight crew. Aircraft operators should consider the need to continue their own database checks even for products obtained from approved suppliers.

5. TRAINING PROGRAMMES AND OPERATING PRACTICES AND PROCEDURES

5.1 Introduction

5.1.1 The following items (5.2 through 5.5) should be standardized and incorporated into training programmes, operating practices and procedures. Certain items may already be adequately standardized in existing operator programmes and procedures. New technologies may also eliminate the need for certain crew actions. If this is found to be the case, then the intent of this material can be regarded as having been met.

Note.— This guidance material has been written for a wide variety of operator types and therefore certain items may not apply to all operators.

5.2 Flight planning

5.2.1 During flight planning, the flight crew should pay particular attention to conditions that may affect operations in RNP 4 airspace or on RNP 4 routes. These include, but may not be limited to:

- a) verification that the aircraft has been approved for RNP 4 operations;
- b) verification that the letter “R” has been inserted in “Item 10: Equipment” of the ICAO flight plan;
- c) verification that any additional flight planning requirements specified in Doc 7030 or State AIP have been met;
- d) verification of the requirements for GNSS, such as FDE, if appropriate for the operation; and
- e) account for any operating restriction related to the RNP 4 approval, if required.

5.3 Pre-flight procedures

5.3.1 The flight crew must:

- a) review maintenance logs and forms to ascertain the condition of the equipment required for flight in RNP 4 airspace or on routes requiring RNP 4 navigation capability;
- b) ensure that maintenance action has been taken to correct defects in the required equipment; and
- c) review the contingency procedures for operations in RNP 4 airspace or on routes requiring an RNP 4 navigation capability. These are no different than normal oceanic contingency procedures with one exception; crews must be able to recognize and ATC must be advised when the aircraft is no longer able to navigate to its RNP 4 navigational capability.

5.4 En route

5.4.1 At least two LRNSs, capable of navigating to RNP 4, and listed in the flight manual, must be operational at the entry point of the RNP airspace. If an item of equipment required for RNP 4 operations is unserviceable, then the pilot should consider an alternate routing, or diversion for repairs.

5.4.2 In-flight operating procedures must include mandatory cross-checking procedures to identify navigation errors in sufficient time to prevent inadvertent deviation from ATC-cleared routes.

5.4.3 Crews must advise ATC of any deterioration or failure of the navigation equipment that causes navigation performance to fall below the required level, and/or any deviations required for a contingency procedure.

5.5 Flight crew knowledge

5.5.1 Operators/owners must ensure that flight crews have been trained and that they have appropriate knowledge of the topics contained in this guidance material, the limits of their RNP 4 navigation capabilities, the effects of updating, and RNP 4 contingency procedures.

- 5.5.2 In determining whether training is adequate, an approving authority might:
- a) evaluate a training course before accepting a training centre certificate from a specific centre;
 - b) accept a statement in the operator's/owner's application for an RNP 4 approval that the operator has ensured and will continue to ensure that flight crews are familiar with the RNP 4 operating practices and procedures contained in documents similar to FAA Order 8700.1 and the contents of this manual; or
 - c) accept a statement by the operator that it has conducted or will conduct an RNP 4 training programme utilizing the guidance contained in this document.
-

Appendix

SOURCES OF ADDITIONAL INFORMATION

1. WEBSITES

- Federal Aviation Administration (FAA), United States
<http://www.faa.gov/ats/ato/rnp.htm>
- Civil Aviation Safety Authority (CASA), Australia
<http://www.casa.gov.au/avreg/rules/caap.htm>

2. RELATED PUBLICATIONS

- Federal Aviation Administration (FAA), United States
 - FAA Order 8400.12A (as amended)
 - Code of Federal Regulations (CFR), Part 121, Appendix G
 - Advisory Circular (AC) 20-130. Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors
 - AC20-138. Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for use as a VFR and IFR Supplemental Navigation System
 - FAA Order 7110.82. Monitoring of Navigation/Altitude Performance in Oceanic Airspace
- Civil Aviation Safety Authority (CASA), Australia
 - Civil Aviation Advisory Publication (CAAP) 35-1
(Copies may be obtained from Airservices Australia Publications Centre, Locked Bag 8500, Canberra 2601 ACT, Australia.)
- International Civil Aviation Organization (ICAO)
 - *Manual on Required Navigation Performance (RNP)* (Doc 9613-AN/937)
(Copies may be obtained from the Document Sales Unit, ICAO, 999 University Street, Montreal, Quebec, Canada H3C 5H7)
- RTCA
 - Minimum Aviation System Performance Standards (MASPS): Required Navigation Performance for Area Navigation (DO 236B), RTCA
 - Minimum Operational Performance Standards (MOPS) for Required Navigation Performance for Area Navigation (DO 283), RTCA
(Copies may be obtained from RTCA, Inc., 1828 L Street NW, Suite 805, Washington, DC 20036, United States.)

— END —