Australian Government
Civil Aviation Safety Authority

DRAFT
Advisory Circular

AC 91U-II-C-5 (0) JULY 2011

NAVIGATION AUTHORISATIONS – RNP APCH

CONTENTS

1. REFERENCES

- ICAO Doc 9613 Performance Based Navigation Manual Volume II Part C Chapter 5 Implementing RNP APCH.
- CAO 20.91 Navigation Authorisations, Appendix 6, Requirements for use of RNP APCH.
- CAAP 179(A)-1(1) Navigation using Global Navigation Satellite Systems (GNSS).
- CASA Form 1307: *Reduced Vertical Separation Minimum and Required Navigation Performance* Application Form.
- FAA AC 20-138A Airworthiness Approval of Global Navigation Satellite System (GNSS) Equipment
- FAA AC 20-138B Airworthiness Approval of Positioning and Navigation Systems

Advisory Circulars are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material.

Where an AC is referred to in a 'Note' below the regulation, the AC remains as guidance material.

ACs should always be read in conjunction with the referenced regulations.

This AC has been approved for release by the Executive Manager Standards Development and Future Technology Division.

2. PURPOSE

2.1 This Advisory Circular (AC) provides information for operators of Australian, or foreign registered aircraft, who wish to gain approval to conduct Performance Based Navigation (PBN) operations in Australian airspace. These operations are consistent with the navigation specifications described in International Civil Aviation Organization (ICAO) Document 9613 Performance-based Navigation Manual (ICAO Doc 9613 PBN Manual) and include area navigation (RNAV) and Required Navigation Performance (RNP) navigation specifications.

3. STATUS OF THIS AC

3.1 This is the first AC relating to Required Navigation Performance Approach (RNP APCH) navigation authorisations and is based on information contained in Volume II, Part C, Chapter 5, of ICAO Doc 9613 PBN Manual and Appendix 4, Requirements for use of RNP APCH *Civil Aviation Order (CAO) 20.91 Navigation Authorisations*. The numbering convention used in the title of this AC is also aligned to the relevant part of the PBN manual.

4. ACRONYMS

AC	Advisory Circular
AFM	Aircraft Flight Manual
ANSP	Air Navigation Service Provider
AOC	Air Operators Certificate
APV	Approach with Vertical Guidance
ATC	Air Traffic Control
Baro-VNAV	Barometric Vertical Navigation
CAAP	Civil Aviation Advisory Publication
CAO	Civil Aviation Order
CAR	Civil Aviation Regulations 1988
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulations 1998
CDI	Course Deviation Indicator
DA	Decision Altitude
EASA	European Aviation Safety Agency
EUROCAE	European Organisation for Civil Aviation Equipment
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FMS	Flight Management System
FTE	Flight Technical Error
GNSS	Global Navigation Satellite System
GPS	Global Positioning System

IAL	Instrument Approach and Landing
ICAO	International Civil Aviation Organization
IF	Intermediate Fix
ILS	Instrument Landing System
LNAV	Lateral Navigation
LOA	Letter of Acceptance
LP	Localiser Performance
LPV	Localiser Performance with Vertical Guidance
MEL	Minimum Equipment List
NOTAM	Notice to Airmen
NPA	Non-Precision Approach
OEM	Original Equipment Manufacturer
Ops Specs	Operations Specifications
PBN	Performance Based Navigation
QRH	Quick Reference Handbook
RNAV	Area Navigation
RNP	Required Navigation Performance
RNP APCH	RNP Approach
RVSM	Reduced Vertical Separation Minimum
SBAS	Space Based Augmentation System
SIS	Signal in Space
TSO	Technical Standard Order
VNAV	Vertical Navigation
2D	2 Dimensional
3D	3 Dimensional

5. BACKGROUND

5.1 RNP APCH is an ICAO PBN Manual navigation specification which supports Global Navigation Satellite System (GNSS) based instrument approach procedures characterised by straight segments and for which the minimum standard of avionics is typically a Technical Standard Order (TSO) C129a (or equivalent) stand-alone receiver.

5.2 One type of RNP APCH procedure has been flown in Australia for some years, initially identified as Global Positioning System Non-Precision Approach (GPS NPA) procedures and more recently as RNAV (GNSS) procedures. ICAO has identified that this type of operation meets the basic requirements of an RNP operation and this type of approach is now known as an RNP APCH - LNAV.

5.3 An RNP APCH procedure may be flown using a stand-alone GNSS system, or a Flight Management System (FMS) with GNSS input.

5.4 An RNP APCH may be flown using either augmented or non-augmented GNSS signals as determined by aircraft receiver capability, augmented GNSS service area availability and aircrew qualifications.

5.5 There are four types of RNP APCH procedures; they are:

- RNP APCH – LNAV (lateral navigation): where lateral guidance is provided by GNSS signal in space (SIS);
- RNP APCH - LNAV/VNAV (vertical navigation) where lateral guidance is provided by GNSS SIS and vertical guidance is provided by barometric vertical navigation (Baro-VNAV);
- RNP APCH - LP (localiser performance): where lateral guidance equivalent to a localiser approach is provided by augmented GNSS SIS; and
- RNP APCH - LPV (localiser performance with vertical guidance): where lateral and vertical guidance is provided by augmented GNSS SIS.

5.6 An RNP APCH may be flown as either a 2-dimensional (2D) or 3-dimensional (3D) procedure. Where RNP APCH procedures involve only 2D guidance they are classified as NPA, where they have 3D guidance they are classified as Approaches with Vertical Guidance (APV). Therefore RNP APCH NPA and APV are:

- NPA:
  - RNP APCH - LNAV; and
  - RNP APCH - LP;
- APV:
  - RNP APCH - LNAV/VNAV; and
  - RNP APCH - LPV.

Note 1: *LP and LPV approaches are designed to similar criteria as Instrument Landing Systems (ILS) and as such have much narrower splays than a LNAV or LNAV/VNAV approach. To achieve the required lateral (LP) and vertical (LPV) navigation accuracy, availability, integrity and continuity requirements some form of GNSS SIS augmentation is required.*

Note 2: *This augmentation does not currently exist in Australia and as such RNP APCH using LP or LPV minima are not available to Australian operators. The requirement for GNSS augmentation to support LP/LPV operations is unlikely to be removed until a dual frequency multi-constellation GNSS becomes available; estimated circa 2025.*

5.7 A 2D RNP APCH (i.e. an NPA) is flown to a minimum descent altitude which is charted as either LNAV or LP minima on the approach plate.

5.8 A 3D RNP APCH (i.e. an APV) is flown to a decision altitude which is charted as either LNAV/VNAV or LPV minima on the approach plate.

Note: *Due to the lack of GNSS augmentation in Australia it is unlikely that LP or LPV minima will be published on Australian approach plates. Australian RNP APCH charts are likely therefore to be limited to non-augmented GNSS design criteria and two lines of minima; namely LNAV and LNAV/VNAV.*

5.9 A basic RNP APCH navigation authorisation (or endorsement) only applies to lateral navigation using non-augmented GNSS SIS i.e. RNP APCH - LNAV. Due to the complexity and limitations of Baro-VNAV systems and the effects of temperature and pressure variations on their operation an additional navigation authorisation/endorsement is required for LNAV/VNAV operations (see AC 91U-II-Attachment (0) APV Baro-VNAV).

Further, due to the differences in equipment functionality, pilot knowledge and training and operating procedures between non-augmented and augmented GNSS approach operations it is likely that a separate navigation authorisation/endorsement will be required for LP and LPV operations. These requirements will be developed only if Australia acquires a GNSS augmentation system. Where the additional requirements of AC 91U-II-Attachment (0) APV Baro-VNAV or those to be determined for LP/LPV operations have been met the RNP APCH navigation authorisation (or endorsement) may be annotated as follows:

- RNP APCH:
  - LNAV;
  - LP/LPV; and
  - LNAV/VNAV.

Note: *RNP APCH – LNAV is simply a name change from RNAV GNSS. There are no changes to extant operational, training or recent experience requirements for these procedures. LP and LPV are fundamentally the GNSS equivalent of localiser and ILS but require an augmentation system to enhance the GNSS SIS performance. Their level of error tolerance and ease of use would suggest minimal additional training requirements over those of the current RNAV GNSS syllabus and an ILS endorsement. Training and recent experience requirements are yet to be fully determined for LP/LPV approach operations. As an interim measure, for operators holding Civil Aviation Regulations 1988 (CAR) 217 training approvals operational requirements will be met through the relevant CAR 217 training programme. For non-CAR 217 operators the requirements of Civil Aviation Order (CAO) 40.2.1 are being developed and interim arrangements (such as an Instrument) may be required.*

5.10 Air Operators Certificate (AOC) holders and operators of other RNP APCH – LNAV/VNAV capable aircraft, typically those equipped with a FMS, are required to operate in accordance with an RNP APCH navigation authorisation as described in this AC.

5.11 Pilots with an RNAV (GNSS) endorsement on an instrument rating conducting an RNP APCH - LNAV in an aircraft equipped with an approved stand-alone GNSS navigation system meet the standards contained in this AC and are not required to operate under an RNP APCH navigation authorisation.

6. APPLICABILITY

6.1 This AC is applicable to operators of Australian and foreign registered aircraft and their flight crews. An RNP APCH navigation authorisation (or equivalent approval from another State) is not mandatory in order to gain access to Australian 'PBN airspace'. However, an RNP APCH navigation authorisation/endorsement (or equivalent approval from another State) must be obtained from the Civil Aviation Safety Authority (CASA) in order to conduct an RNP APCH - LNAV procedure in Australia. An RNP APCH *and* an APV Baro-VNAV navigation authorisation/endorsement (or equivalent approval from another State) must be obtained from CASA in order to conduct an RNP APCH (LNAV/VNAV) procedure in Australia.

7. RELATED PUBLICATIONS

7.1 For further information on this topic, operators are advised to view the following regulations/publications:

- ICAO Doc 8168 Procedures for Air Navigation Services – Aircraft Operations Volume I.
- CASA AC 21-37(0) Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors.
- CASA AC 21-36(0) Global Navigation Satellite System (GNSS) Equipment: Airworthiness Guidelines.
- CAO 40.2.1 Instrument Ratings.

8. NAVIGATION AUTHORISATION

8.1 An operator should carry out the following steps so that CASA has sufficient information to issue a RNP APCH navigation authorisation:

- Demonstrate Aircraft Eligibility:
  - Aircraft equipment eligibility requirements for RNP APCH are described in the PBN Manual and may be demonstrated through an Aircraft Flight Manual (AFM) compliance statement, AFM supplement or Original Equipment Manufacturer (OEM) service letter; however where aircraft equipment varies from these requirements, subsequent eligibility will be determined by CASA;
- Describe Training and Operating Procedures:
  - Flight crew training and operating procedures for the navigation systems to be used must be described by the operator in a syllabus of training and an aid memoir e.g. Quick Reference Handbook (QRH), checklist etc.; and
- Document Training and Operating Procedures:
  - Methods of control for flight crew training, operational procedures and database management must be identified in the operations manual.

9. NAVIGATION AUTHORISATION PROCESS

9.1 Navigation authorisations for all PBN navigation specifications and Reduced Vertical Separation Minimum operations are as follows:

- An aircraft operator applies for a navigation authorisation through the CASA Permission Application Centre using Form 1307 *Reduced Vertical Separation Minimum and Required Navigation Performance Application Form*;
- The CASA Permission Application Centre registers the Form 1307 and forwards it to the relevant Certificate Management Team for assessment;
- The Certificate Management Team conducts the navigation authorisation assessment:
  - Where the application meets the criteria listed in the PBN Manual and this AC, the Certificate Management Team approves the application and returns it to the Permission Application Centre;
  - Where the application does not meet the criteria listed in the PBN Manual and this AC (e.g. a non-standard application due to specific aircraft equipment functionality or training requirements) the Certificate Management Team seeks further information from the applicant. Once sufficient information has been received such that CASA may assess the application as 'equivalent' to the requirements of the PBN Manual and this AC the Certificate Management Team approves the application and returns it to the Permission Application Centre; and
- The CASA Permission Application Centre registers the approved navigation authorisation application in the operator's Operations Specifications (Ops Spec) and issues an updated Ops Spec to the operator.

Note: *Ops Specs are yet to be provided with a legislative head of power through Subpart 91U of the Civil Aviation Safety Regulations 1998 (CASR 1998). This will occur in the future through the Subpart 91U of CASR 1998 update and rewrite process which will align all navigation authorisations with the ICAO PBN Manual. Until such time, RNP APCH navigation authorisations will be issued under CAO 20.91.*

10. APPLICATION

10.1 Content of an application for an RNP APCH navigation authorisation:

- Aircraft airworthiness documents (e.g. the AFM, AFM Supplement, OEM service letters) that establish that the aircraft is equipped to meet the requirements for RNP APCH operations (LNAV, LNAV/VNAV or LP/LPV);
- A description of aircraft equipment and components, including a configuration list that details the components and equipment that the operator will use for RNP APCH operations;
- A description of the proposed flight crew training, including:
  - training syllabus; and
  - arrangements to manage RNP APCH recurrent training.

Note: *Course material, lesson plans and other training products are subject to CASA approval.*

- A description of training programmes for maintenance personnel, dispatchers and any other relevant training details of the operating procedures to be used, including:
  - relevant sections of the company operations manual;
  - checklists; and
  - contingency procedures, QRH etc.
- Sections of the Minimum Equipment List (MEL) applicable RNP APCH operations;
- A description of the maintenance programme including any provisions necessary to ensure the continuing airworthiness of relevant navigation equipment;
- Details of the method to be used to ensure the continuing integrity of the airborne navigation database; and
- An implementation programme, including the proposed method to monitor RNP APCH operations, to identify, report and investigate any failure or potential failure in the aircraft systems or operating procedures.

11. AIRCRAFT ELIGIBILITY

11.1 An aircraft is eligible for an RNP APCH navigation authorisation if:

- The AFM, an AFM supplement, or OEM service letter states that the aircraft navigation system is approved for RNP 0.3 approach operations with GNSS updating;
- The aircraft is equipped with a navigation system which meets the requirements of AC 91U-II-C-6 (0) RNP AR navigation authorisation;
- The aircraft is equipped with GNSS stand-alone system approved for NPA operations in accordance with AC 21-36(0) (TSO-129a/ ETSO-C129a Class A1 or E/TSO-146 Class Gamma and operational Class 1,2 or 3);
- The aircraft is equipped with a multi-sensor system (e.g. FMS) with GNSS equipment in accordance with TSO C129()/ETSO-C129() Class B1, C1, B3, C3 or E/TSO C145() class 1,2 or 3, approved for approach operations in accordance with AC 21-36(0) and AC 21-37(0); or
- The aircraft is demonstrated to comply with the requirements for RNP APCH operations (LNAV, LP/LPV or LNAV/VNAV) contained in ICAO Doc 9613 PBN Manual Volume II, Part C, Chapter 5, Implementing RNP APCH.

Note: *LP/LPV and LNAV/VNAV operations are yet to be published in Volume II, Part C, Chapter 5 of the PBN Manual however they have been released by ICAO under State Letter SP 65/4-10/53 of 23 July 2010.*

12. SYSTEM PERFORMANCE, MONITORING AND ALERTING

12.1 System performance, monitoring and alerting requirements for RNP APCH operations are as stated in ICAO Doc 9613 Volume II, Part C, Chapter 5, Implementing RNP APCH.

13. SYSTEM FUNCTIONALITY

13.1 System functionality requirements for RNP APCH operations are as stated in ICAO Doc 9613 Volume II, Part C, Chapter 5, Implementing RNP APCH.

13.2 Guidance provided in AC 21-36(0) Global Navigation Satellite System (GNSS) Equipment: Airworthiness Guidelines is also relevant.

13.3 An alternative means for the display of cross-track information is:

- Display in the pilot's primary field of view of aircraft position relative to the path;
- Display of numeric cross-track deviation in 1/10th nm or less outside the pilot's primary field of view;
- The flight crew consists of two pilots;
- The pilot not flying is able to monitor the numeric cross-track deviation;
- Crew procedures (including callouts) are implemented to ensure that both operating crew can perform all normal duties in addition to monitoring cross-track deviation; and
- CASA has conducted an operational evaluation of the displays and crew procedures.

Note: *In some cases aircraft position is displayed graphically on a map display and it is possible for the pilot flying to detect off-track deviation and estimate the approximate cross-track error by reference to the characteristics of the symbol used to indicate the aircraft position. A display of this type may provide an adequate standard of deviation indication where supplemented by a numeric indication of deviation, (which may be outside the pilot's normal field of view), such as a control and display unit. Commonly this information will be monitored by the pilot not flying and relayed to the pilot flying in accordance with suitable crew procedures.*

13.4 The requirement for the display of lateral position relative to the desired path is;

- A digital indication in 1/10th nm or less; or
- A relative indication which allows the pilot to determine deviation in proportion to a known indicator scale.

Note: *Display of cross-track deviation is commonly provided by either a course deviation indicator (CDI) or as a numeric value displayed on a map display. Where the deviation information is displayed on a CDI or similar instrument, the scaling of the display may vary depending upon the receiver mode or is fixed. Whichever method of display or display scaling is used the standard is met if the information available to the pilot is sufficient to determine that the aircraft is within the permitted cross-track tolerance for each segment of the approach.*

13.5 Where the minimum flight crew is two pilots, a means for the pilot not flying to verify the desired path and the aircraft position relative to the path is required.

13.6 Display in the pilot's primary field of view of a navigation system failure or alert is required for:

- loss of GNSS integrity or integrity monitoring capability; and
- failure of a GNSS sensor.

13.7 Capability is required for determination that:

- GNSS positioning is active; or
- for RNP systems where an alert is not immediately enunciated when GNSS updating is not available, the current navigation performance is adequate.

Note: *Some RNP navigation systems do not provide an alert when GNSS updating is temporarily not available and the navigation accuracy remains with the requirements for the selected RNP. In such cases valid guidance remains available until the position solution is degraded to a level which initiates an alert indicating that the navigation performance limits are exceeded.*

14. OPERATING STANDARDS

14.1 Flight Planning

14.1.1 The availability of a GNSS service (constellation) sufficient to support the intended use of an RNP APCH procedure is to be determined prior to commencement of the procedure and crews must:

- Verify that the aircraft and operating crew are approved for the type of RNP APCH being planned;
- Confirm that the destination and alternate aerodrome requirements for the type of RNP APCH being planned are met (refer to AIP and Civil Aviation Advisory Publication (CAAP) 179(A)-1(1));
- Confirm that the navigational database is current and appropriate for the region of intended operation and includes the navigation aids and waypoints required for the operation; and
- Insert the appropriate identifier in the flight plan to indicate the RNP APCH type (currently only 'NAV/GPSRNAV' is recognised/available and is used to collectively indicate RNP APCH – LNAV, Night Visual Flight Rules (VFR) RNAV and Instrument Flight Rules (IFR) RNAV).

14.2 GNSS Integrity Availability

14.2.1 GNSS navigation systems are equipped with a means of monitoring the integrity of the position solution. Integrity may be assured by a number of methods including Receiver Autonomous Integrity Monitor and proprietary hybrid Inertial Reference System (IRS)GPS systems (e.g. Honeywell HIGH, Litton AIME). Approved GNSS navigation systems provide a means to ensure the integrity of GNSS positioning and provide an alert to the crew when integrity is not available or the system is not able to provide an integrity monitoring function.

14.2.2 The availability of the integrity monitoring function is dependent upon a number of factors including the satellite constellation geometry and serviceability, terrain masking and the integrity algorithm used by the on-board navigation system.

14.2.3 The availability of a GNSS service with integrity to support an RNP APCH operation can be predicted and is available from a variety of sources including Air Navigation Service Provider (ANSP)s, commercial services, and avionics manufacturers. Availability prediction should take into account the latest satellite constellation Notice to Airmen and the integrity algorithms used by the aircraft avionics. An on-board prediction function may also be available but operators should be aware that a prediction may not take account of known or planned constellation unserviceability, and may not be reliable.

14.2.4 Operators, pilots and ANSPs need to be aware, that a prediction of integrity availability, an unplanned failure of GNSS elements can result in a loss of integrity monitoring capability, and in some cases a complete loss of the navigation function whilst airborne, which may require reversion to an alternative means of navigation. Pilots should, therefore, assess their capability to navigate (potentially to an alternate destination) in the case of failure of GNSS navigation.

14.2.5 For aircraft navigating with Space Based Augmentation System (SBAS) receivers (all TSO-C145/C146), check GPS INTEGRITY availability in areas where SBAS is unavailable.

14.3 Flight Procedures

14.3.1 For non AOC holders flight procedures as described in CAAP 179(A)-1(1) apply. For AOC holders the procedures detailed in the following paragraphs apply.

14.3.2 Flight crew procedure review including:

- verification of the waypoint sequence;
- reasonableness of the tracks and distances;
- that the GNSS sensor is used for position computation; and
- if barometric aiding is used that the current airport barometric altimeter setting is entered.

14.3.3 Display selection:

- approach procedure path is displayed; and
- cross-track deviation monitoring is available.

Note: *Air Traffic Control (ATC) tactical interventions in the terminal area may include radar headings, or 'direct to' clearances which bypass the initial legs of an approach, intercept an initial or intermediate segment of an approach, or require insertion of waypoints loaded from the database. In accepting ATC instructions, the flight crew should be aware of the implications for the navigation system, which may include:*

- *adequacy of turn guidance;*
- *establishment on next segment prior to descent; and*
- *where VNAV is used, flight planned limiting altitudes not observed.*

Note: *As a general rule 'direct to' tracking to the intermediate fix (IF) is acceptable provided groundspeed is limited and the track change at the IF does not exceed 45 degrees.*

14.3.4 Aircraft is established on the final approach course no later than the final approach fix.

14.3.5 Descent in the final segment is not commenced unless:

- the correct approach mode is enunciated; or
- RNP 0.3 is selected and available.

14.3.6 The procedure is discontinued:

- if the navigation system display is flagged invalid;
- in the case of loss of integrity alert;
- if the integrity alerting function is not available; or
- if Flight Technical Error (FTE) is excessive.

Note: *An alert may not be provided and a missed approach may not be required for some multi-sensor systems where continuity of RNP capability is available when GNSS updating is temporarily lost. Manufacturer documentation should be examined to determine the extent the system may use in such a configuration.*

14.3.7 The standard for limitation of cross-track error/deviation (the difference between the computed path and the displayed aircraft position) is ½ the navigation accuracy for the segment, which is:

- 0.5 nm for the initial, intermediate segment and missed approach; and
- 0.15 nm for the final approach segment.

Note 1: *Brief deviations from this standard during and immediately after turns, are normally considered acceptable. As accurate cross-track information is not provided during turns, crew procedures and training needs to emphasise observance of turn anticipation commands, and management of rate of turn.*

Note 2: *In some aircraft, display of track deviation less than the standard for limitation of cross-track error/deviation in the final approach segment may be limited and the initial numeric display of deviation may exceed the 0.15 nm standard. The control, by crew intervention, of maximum cross-track deviation is intended to provide curtailment of the FTE probability distribution, and there is no absolute value which defines the maximum acceptable deviation. Consideration of all factors which limit the FTE distribution such as the use of autopilot and/or flight director may permit a variation to the standard for the cross-track deviation limit without compromising the safety of operations.*

14.3.8 The use of a flight director and/or autopilot is recommended.

14.3.9 Contingency procedures for a loss of RNP APCH capability during the approach.

Note: *A loss of some functions which warrant a missed approach may not result in a loss of navigational guidance. For example, the loss of integrity monitoring does not imply a loss of integrity, and continued reliable tracking information will normally be available for use and contingency procedures developed accordingly.*

15. FLIGHT CREW KNOWLEDGE AND TRAINING

15.1 Ground and flight (actual or simulated) training in normal and abnormal operations sufficient to achieve operational competency.

Note 1: *The extent of training will vary depending upon many factors including the crew's previous experience in the use of RNAV/RNP systems, the navigation system complexity, aircraft type and the method of training delivery. As a guide, crews typically require 4-8 hours ground training in knowledge elements.*

Flight training programmes vary considerably due to the differences in equipment function and complexity. Stand-alone systems commonly used in general aviation and flown in single-pilot operations, typically require a number of actual and/or simulated flight training exercises to achieve proficiency. FMS equipped aircraft flown by crews familiar with FMS use, commonly require one or more (2-4 hr) simulator exercises per crew.

Normal operations are generally relatively simple and proficiency can be achieved with minimum training. However operations involving multiple approaches, changes to procedure selection, contingency procedures and non-normal operations can be challenging and adequate training in these elements needs to be provided.

Note 2: *Depending upon the aircraft and navigation system, training for an RNP APCH – LNAV (RNAV (GNSS)) endorsement provided by an approved flying training organisation may provide a suitable standard of training. Where the operator has assessed that such training is insufficient, the application should detail any supplementary training and/or checking arrangements.*

15.2 Knowledge elements:

- requirements for an RNP APCH navigation authorisation;
- GNSS and RNP principles;
- navigation system operation;
- Instrument Approach to Land (IAL) procedure characteristics as determined from chart depiction and textural description;
- flight path construction, including waypoint types (flyover and fly-by), path terminators and other elements;
- for FMS/Multi Mode Radio (MMR) systems, the method used to derive displayed position including input from navigation sensors (e.g. Inertial Reference Unit (IRU), GNSS, Distance Measuring Equipment (DME) and system prioritisation/weighting/logic;
- functional integration with other aircraft systems;
- display symbology and interpretation;
- navigation equipment necessary to conduct RNP APCH operations;

Note: *Pilots need to be aware that the type of navigation equipment capable of RNP APCH procedures includes stand-alone and FMS installations and that the conduct of an RNP APCH varies accordingly.*

- levels of automation, mode annunciations, changes, alerts, reversions and degradation;
- speed constraints;
- altitude limitations;
- operator policy on use of automation, including methods to minimise cross-track error; and
- radio telephony phraseology for RNP APCH applications.

15.3 Training elements:

- Navigation equipment operating procedures, including:
  - navigation database currency verification**;**
  - system self-tests;
  - position initialisation; and
  - retrieval, loading and execution of an RNP APCH;
- approach review, verification of waypoint sequence and flight plan;
- display/equipment set-up;
- management of route discontinuities;
- normal approach and landing;
- missed approach and holding;
- fly direct to a waypoint;
- intercept an initial or intermediate segment of an approach;
- turn anticipation including ground speed and altitude effects;
- determine cross-track error/deviation;
- monitoring procedures for each phase of flight;
- change approach, destination or alternate; and
- conduct contingency procedures following RNP system failure.

16. MINIMUM EQUIPMENT LIST

16.1 The operator's MEL must identify any unserviceability that affects the conduct of an RNP APCH operation.

17. CONTINUING AIRWORTHINESS

17.1 The operator is required to implement procedures to ensure the continuing airworthiness of the aircraft for RNP APCH operations.

17.2 Aircraft equipment and configuration control consistent with the RNP APCH capability and minimum equipment requirements is required.

17.3 Engineering personnel are to be provided with training where required to ensure that they are familiar with RNP APCH airworthiness requirements.

18. NAVIGATION DATA BASE

18.1 A navigation database should be obtained from a supplier that complies with Radio technical Commission for Aeronautics (RTCA) DO 200A/ European Organisation for Civil Aircraft Equipment (EUROCAE) document ED-76, Standards for Processing Aeronautical Data and should be compatible with the intended function of the equipment (see ICAO Annex 6, Part 1, Chapter 7). A Letter of Acceptance (LOA), issued by an appropriate regulatory authority to each of the participants in the data chain, demonstrates compliance with this requirement (e.g. Federal Aviation Administration (FAA) LOA issued in accordance with FAA AC 20-153 or European Aviation Safety Agency (EASA) LOA issued in accordance with EASA Implementing Rule (IR) 21 subpart G)

18.2 An operator who uses a navigation database supplier that does not meet these standards must implement navigation database integrity checks using appropriate software tools or approved manual procedures to verify data relating to all waypoints in airspace or routes where RNP 1 operations are conducted. These checks are in addition to any checks performed by the Aeronautical Information Services, unapproved navigation database suppliers or navigation equipment manufacturers.

Note: *While a LOA provides assurance of minimum standards for the supply of a navigation data, errors may still occur and all operators should consider the need to conduct periodic checks to ensure database integrity.*

18.3 Any discrepancy in data is to be reported to the navigation data base supplier and resolved prior to operational use by:

- re-issue of the navigation database;
- prohibition of the route; or
- instructions to flight crew.

Note: *Typically, airline operators will contract with a navigation database supplier to provide a customised database and will establish procedures to validate the navigation data at each 28 day cycle. Other operators may rely on a generic database and may not have the capability to independently validate the data.*

In such cases procedures may need to be implemented to validate navigation data using a simulator or desk-top device, or additional cockpit procedures applied to validate each procedure before commencement of an approach.

Executive Manager
Standards Development and Future Technology

July 2011

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