



# Advisory Circular

**Subject: Required Navigation Performance Authorization Required Approach (RNP AR APCH)**

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## 1.0 INTRODUCTION

- (1) This Advisory Circular (AC) is provided for information and guidance purposes. It describes an example of an acceptable means, but not the only means, of demonstrating compliance with regulations and standards. This AC on its own does not change, create, amend or permit deviations from regulatory requirements, nor does it establish minimum standards.

### 1.1 Purpose

- (1) The purpose of this AC is to provide air operators and private operators with the requirements to obtain a Canadian Operations Specification (Ops Spec) for Required Navigation Performance Authorization Required Approach (RNP AR APCH). This authorization will constitute the operational approval for Canadian air operators or private operators to conduct RNP AR APCH procedures, subject to the requirements of the Operations Specification (Ops Spec) 621 and this AC.
- (2) These requirements are based on the International Civil Aviation Organization (ICAO) Doc. 9613 *Performance Based Navigation Manual Volume II Part C Chapter 6 Implementing RNP AR APCH*. Some regulatory requirements may have been repeated herein for convenience purposes. The PBN manual contains navigation specifications, which are guidance used by States to develop certification and operational approval material. Navigation specifications describe, in detail, the requirements placed on the area navigation system for operation along a particular route, procedure or within airspace where approval against the navigation specification is prescribed.
- (3) The PBN manual also aims to provide practical guidance to States, air navigation service providers and airspace users on how to implement RNAV and RNP applications, and how to ensure that the performance requirements are appropriate for the planned application.
- (4) Paragraph 70#.08(g) of the *Canadian Aviation Regulations (CARs)* and the *Private Operators Interim Order* mandate that where the air operator or private operator complies with the [Commercial Air Service Standards](#), the operating certificate shall contain operations specifications with respect to instrument approach procedures and any other condition pertaining to the operation that the Minister deems necessary for aviation safety, amongst other provisions.
- (5) Until a Standard on RNP AR APCH is published in the *Commercial Air Services Standards (CASS)*, the content of this AC will constitute the conditions to be met to obtain the authorization for RNP AR APCH. Ops Spec 621 will also form the basis upon which a foreign National Aviation Authority (NAA) may authorize, within their jurisdiction, a Canadian air operator or private operator to conduct instrument approaches designated as RNP AR APCH.

### 1.2 Applicability

- (1) This AC applies to Canadian air operators holding an Air Operator Certificate issued under Part VII of the CARs or to private operators holding a Private Operator Certificate issued under Subpart 604 of the CARs, who wish to conduct instrument approaches requiring RNP AR APCH navigation performance. These will be commonly referred to as “operator” in this AC.
- (2) This document is also applicable to all Transport Canada Civil Aviation (TCCA) employees, and to individuals and organizations when they are exercising privileges granted to them under an External Ministerial Delegation of Authority. The content of this document is also available to the aviation industry at large for information purposes.

- (3) Language
- (a) This AC uses mandatory terms such as “must” and “is/are required” so as to convey the intent of the PBN manual, and of other regulatory requirements where applicable. The term “should” is to be understood to mean that the proposed method of compliance must be used, unless another method of compliance has been approved.

### 1.3 Description of Changes

- (1) Not applicable.

## 2.0 REFERENCES AND REQUIREMENTS

### 2.1 Reference Documents

- (1) The following reference material may be consulted for information purposes:
- (a) Part V of the *Canadian Aviation Regulations (CARs)—Airworthiness*;
  - (b) Part VI, subpart IV of the CARs—*Private Operator Passenger Transportation*;
  - (c) Part VII, subpart II of the CARs—*Aerial Work*;
  - (d) Part VII, subpart III of the CARs – *Air Taxi Operations*;
  - (e) Part VII, subpart IV of the CARs—*Commuter Operations*;
  - (f) Part VII, subpart V of the CARs—*Airline Operations*;
  - (g) Standard 722 of the *Commercial Air Services Standards (CASS)—Aerial Work*;
  - (h) Standard 723 of the CASS – *Air Taxi Operations*;
  - (i) Standard 724 of the CASS—*Commuter Operations*;
  - (j) Standard 725 of the CASS—*Airline Operations*;
  - (k) Operations Specification 621 —*Required Navigation Performance Authorization Required Approach (RNP AR APCH)*;
  - (l) Transport Canada Publication (TP) 308, *Criteria for the Development of Instrument Procedures*;
  - (m) International Civil Aviation Organization (ICAO) Doc. 9613, *Performance Based Navigation (PBN) Manual, Volume II Part C Implementing RNP AR APCH*;
  - (n) ICAO Doc. 7030, *Regional Supplementary Procedures*;
  - (o) Federal Aviation Administration (FAA) AC 90-101A, *Approval Guidance for RNP Procedures with AR*;
  - (p) FAA AC 20-129() *Airworthiness Approval of Vertical Navigation (VNAV) Systems for use in the U.S. National Airspace System (NAS) and Alaska*;
  - (q) FAA AC 20-130A *Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors*;
  - (r) FAA AC 20-138C *Airworthiness Approval of Positioning and Navigation Systems*;
  - (s) FAA Order 8400.12A *Required Navigation Performance 10 (RNP 10) Operational Approval*;
  - (t) European Aviation Safety Agency (EASA) AMC 20-26, *Airworthiness Approval and Operational Criteria for RNP Authorisation Required (RNP AR) Operations*;
  - (u) EUROCAE ED-75/RTCA DO-236 *Minimum Aviation System Performance Standards: Required Navigation Performance for Area Navigation*;

- (v) Radio Technical Commission for Aeronautics (RTCA) DO-229 *Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment*.
- (w) U.S. CFR 14 Part 121 Appendix G *Doppler Radar and Inertial Navigation System (INS)*.

## 2.2 Cancelled Documents

- (1) Not applicable.
- (2) By default, it is understood that the publication of a new issue of a document automatically renders any earlier issues of the same document null and void.

## 2.3 Definitions and Abbreviations

- (1) The following **definitions** are used in this document:
  - (a) **Advisory Circular (AC):** A document providing an example of an acceptable means, but not the only means, of demonstrating compliance with regulations and standards.
  - (b) **Air navigation services:** This term includes air traffic management (ATM); communications, navigation and surveillance systems (CNS); meteorological services for air navigation (MET); search and rescue (SAR); and aeronautical information services (AIS). These services are provided to air traffic during all phases of operations (approach, aerodrome and en route).
  - (c) **Air navigation services provider:** An independent entity established for the purpose of operating and managing air navigation services, and empowered to manage and use the revenues it generates to cover its costs. In Canada, this function is normally performed by NAV CANADA.
  - (d) **Aircraft-based Augmentation System (ABAS):** A system which augments and/or integrates the information obtained from other Global Navigation Satellite System (GNSS) elements with information available on board the aircraft. The most common form of ABAS is the receiver autonomous integrity monitoring (RAIM).
  - (e) **Area Navigation:** A method of navigation which permits aircraft operation on any desired flight path within the coverage of ground or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these.  
*Note. Area navigation includes performance-based navigation as well as other operations that are not contemplated in the definition of performance-based navigation.*
  - (f) **Barometric Aiding (Baro-Aiding):** A method of augmenting the Global Positioning System (GPS) integrity solution in receiver autonomous integrity monitoring (RAIM) by using a barometric altitude input source. Baro-aiding requires four satellites and a barometric altimeter to detect an integrity anomaly (the current altimeter setting may need to be entered into the receiver as described in the operating manual). Baro-aiding satisfies the RAIM requirement in lieu of a fifth satellite.
  - (g) **Barometric Vertical Navigation (baro-VNAV):** A function of certain RNAV systems which presents computed vertical guidance to the pilot referenced to a specified vertical path. The computed vertical guidance is based on barometric altitude information and is typically computed as a geometric path between two waypoints or an angle based on a single waypoint.

- (h) **Fault Detection and Exclusion (FDE):** A receiver autonomous integrity monitoring (RAIM) algorithm that can automatically detect and exclude a faulty satellite from the position solution when measurements from six or more satellites are available. Wide Area Augmentation System (WAAS) equipment uses FDE for integrity whenever a WAAS signal is not available to permit continued operation from en route through approach operations.
- (i) **Galileo:** Galileo is Europe's global navigation satellite system which is inter-operable with GPS and GLONASS.
- (j) **Global Navigation Satellite System (GNSS):** A generic term used by ICAO to define any global position, speed, and time determination system that includes one or more main satellite constellations, such as GPS and the global navigation satellite system (GLONASS), aircraft receivers and several integrity monitoring systems, including aircraft-based augmentation systems (ABAS), satellite-based augmentation systems (SBAS), such as the wide area augmentation systems (WAAS), and ground-based augmentation systems (GBAS), such as the local area augmentation system (LAAS).
- (k) **Global Positioning System (GPS):** The Global Navigation Satellite System (GNSS) of the United States is a satellite-based radio navigation system that uses precise distance measurements to determine the position, speed, and time in any part of the world. The GPS is made up by three elements: the spatial, the control, and the user elements. The GPS spatial segment nominally consists of at least 24 satellites in 6 orbital planes. The control element consists of 5 monitoring stations, 3 ground antennas, and one main control station. The user element consists of antennas and receivers that provide the user with position, speed, and precise time.
- (l) **GLONASS:** GLObal NAVigation Satellite System is a radio-based satellite navigation system operated for the Russian government by the Russian Space Forces.
- (m) **Integrity:** A measure of the trust that can be placed in the correctness of the information supplied by the total system. Integrity includes the ability of a system to provide timely and valid warnings to the user (alerts).
- (n) **Navigation specification:** A set of requirements needed to implement and support performance based navigation within a defined airspace.
  - (i) **RNAV specification:** A navigation specification based on area navigation that does not include the requirement for on-board performance monitoring and alerting, designated by the prefix RNAV (e.g. RNAV 5, RNAV 1).
  - (ii) **RNP specification:** A navigation specification based on area navigation that includes the requirement for on-board performance monitoring and alerting, designated by the prefix RNP (e.g. RNP 4, RNP APCH).
- (o) **Performance Based Navigation (PBN):** Area navigation based on performance requirements for aircraft operating along an Air Traffic Service (ATS) route, on an instrument approach procedure or in a designated airspace.

*Note. Performance requirements are expressed in navigation specification (RNAV specification or RNP specification) in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept.*
- (p) **RNAV System:** A navigation system which permits aircraft operation on any desired flight path within the coverage of station-referenced NAVAIDs or within the limits of the capability of self-contained aids, or a combination of these. An RNAV system may be included as part of a flight management system (FMS).
- (q) **RNP System:** An area navigation system that supports on-board performance monitoring and alerting.

- (r) **Radius to Fix (RF) Path Terminator:** A specific fixed-radius curved path in a terminal and approach procedure intended to be applied where an accurate repeatable and predictable ground path is required. Also known as RF leg.
  - (s) **Receiver Autonomous Integrity Monitoring (RAIM):** A form of ABAS whereby a GNSS receiver processor determines the integrity of the GNSS navigation signals using only GPS signals or GPS signals augmented with altitude (baro-aiding). This determination is achieved by a consistency check among redundant pseudo-range measurements. At least one additional satellite needs to be available with the correct geometry over and above that needed for the position estimation for the receiver to perform the RAIM function.
  - (t) **Satellite-based augmentation system (SBAS):** A wide coverage augmentation system in which the user receives augmentation information from a satellite-based transmitter. The Wide Area Augmentation System (WAAS) is a form of SBAS.
  - (u) **Standard instrument arrival (STAR):** A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an air traffic service (ATS) route, with a point from which a published instrument approach procedure can be commenced.
  - (v) **Standard instrument departure (SID):** A designated instrument flight rule (IFR) departure route linking the aerodrome or a specified runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the en-route phase of a flight commences.
  - (w) **Technical Standard Order (TSO):** A minimum performance standard for specified materials, parts, and appliances used on civil aircraft.
  - (x) **Total System Error (TSE):** The difference between the true position and the desired position. This error is equal to the sum of the vectors of the path definition error (PDE), the flight technical error (FTE), and the navigation system error (NSE).
    - (i) **Flight Technical Error (FTE):** The FTE is the accuracy with which an aircraft is controlled as measured by the indicated aircraft position with respect to the indicated command or desired position. It does not include blunder errors.
    - (ii) **Navigation System Error (NSE):** The difference between the true position and the estimated position.
    - (iii) **Path Definition Error (PDE):** The difference between the defined path and the desired path at a given place and time.
  - (y) **World Geodetic System 1984 (WGS 84):** The most recent geocentric reference system definition developed by the United States Department of Defence (World Geodetic System Committee).
- (2) The following **abbreviations** are used in this document:
- (a) **(j):** Indicates any version of the document (e.g. FAA AC 20-138(j) would indicate FAA AC 20-138(A), FAA AC 20-138(B), FAA AC 20-138(C) etc.)
  - (b) **AAIM:** Aircraft Autonomous Integrity Monitoring;
  - (c) **AC:** Advisory Circular;
  - (d) **ABAS:** Aircraft-based Augmentation System;
  - (e) **AIRAC:** Aeronautical Information Regulation And Control;
  - (f) **ANSP:** Air Navigation Service Provider;
  - (g) **DA:** Decision Altitude;
  - (h) **FAF:** Final Approach Fix;
  - (i) **FTE:** Flight Technical Error;

- (j) **GNSS:** Global Navigation Satellite System;
- (k) **GPS:** Global Positioning System;
- (l) **HIL:** Horizontal Integrity Limit;
- (m) **MAHF:** Missed Approach Holding Fix;
- (n) **NSE:** Navigation System Error;
- (o) **OCS:** Obstacle Clearance Surface;
- (p) **OEM:** Original Equipment Manufacturer;
- (q) **PBN:** Performance Based Navigation;
- (r) **PDE:** Path Definition Error;
- (s) **RNAV:** Area Navigation;
- (t) **RAIM:** Receiver Autonomous Integrity Monitoring;
- (u) **RF:** Radius to Fix;
- (v) **RNP:** Required Navigation Performance;
- (w) **ROC:** Required Obstacle Clearance;
- (x) **SBAS:** Satellite-Based Augmentation System;
- (y) **SID:** Standard Instrument Departure;
- (z) **STAR:** Standard Instrument Arrival;
- (aa) **TAWS:** Terrain Awareness and Warning System;
- (ab) **TERPs:** Terminal Instrument Procedures;
- (ac) **TSE:** Total System Error;
- (ad) **TSO:** Technical Standard Order;
- (ae) **TCCA:** Transport Canada Civil Aviation;
- (af) **VPA:** Vertical Path Angle; and
- (ag) **WAAS:** Wide Area Augmentation System.

### 3.0 BACKGROUND

- (1) The material described in this Advisory Circular (AC) is based on International Civil Aviation Organization (ICAO) Doc 9613 *Performance Based Navigation (PBN) Manual*, Volume II Part C Implementing RNP AR APCH.
- (2) This AC does not establish all the requirements that may be specified for a given Required Navigation Performance Authorization Approach (RNP AR APCH) instrument procedure. Some of these requirements are established in other documents, such as the Transport Canada Publication (TP) TP 308 *Criteria for the Development of Instrument Procedures* and ICAO Doc 7030 – *Regional Supplementary Procedures*. Although operational approval is normally related to equipment, procedures and training requirements, operators must consider other regulatory requirements before conducting RNP AR APCH operations.
- (3) The ICAO standard for waypoint definition is the use of World Geodetic System 1984 (WGS 84) as the reference datum. Canada uses WGS 84 in the definition of approach waypoints and has deemed North American Datum 1983 (NAD 83) coordinates to be equivalent to WGS 84 for aeronautical purposes.

- (4) RNP AR APCH operational authorization is required for the conduct of RNP AR APCH procedures. An RNP AR APCH authorization is based on Global Navigation Satellite System (GNSS) as the primary Navigation Aid (NAVAID) infrastructure. RNP AR APCH shall not be used in areas of known navigation signal (GNSS) interference. Canada does not permit the use, including as a reversionary form of navigation, of radio updating (i.e. DME/DME, VOR/DME) or INS as the primary source of positioning for the purpose of continuing an RNP AR APCH procedure.

**Note.** *Most modern RNP systems will prioritize inputs from GNSS over Distance Measuring Equipment (DME/DME) positioning. Although VHF Omni-directional radio (VOR) /DME positioning is usually performed within a flight management computer when DME/DME positioning criteria cannot be met, avionics and infrastructure variability pose serious challenges to standardization.*

- (5) When the aircraft's vertical path is dependent on barometric vertical navigation (Baro-VNAV), current local barometric pressure settings must be provided to support RNP AR procedures. Failure to set the altimeter sub-scale with the local QNH may compromise vertical obstacle protection provided by the procedure.
- (6) These procedures require additional levels of scrutiny, control and authorization. The increased risks and complexities associated with these procedures are mitigated through more stringent RNP criteria, advanced aircraft capabilities and increased flight crew member training.
- (7) Due to the unique requirements for RNP AR APCH operations and the need for flight crew procedures that are specific to each particular aircraft and navigation system, RNP AR APCH operational support documentation should be obtained from the design approval holder. The documentation should describe the navigation capabilities of the applicant's aircraft in the context of RNP AR APCH operations, and provide all the assumptions, limitations and supporting information necessary for the safe conduct of RNP AR APCH operations. Such documentation is intended to support the operational approval requirements.
- (8) Operators should use the design approval holder recommendations when developing their procedures and applying for approval. Operator contingency procedures must, as a minimum, incorporate the design approval holder contingency procedures. Installation of equipment is not sufficient by itself to obtain approval for use on RNP AR APCH instrument procedures.
- (9) The RNP AR instrument approach procedures:
- (a) are based on the GNSS;
  - (b) use the WGS 84 coordinates in the creation of procedures;
  - (c) meet the requirements of Annex 15 to the Convention on International Civil Aviation in the navigation data published for the routes and procedures;
  - (d) indicate the required navigation standard (e.g. RNP AR APCH) on all the appropriate charts.
- (10) The issuance of Ops Spec 621 to the operator constitutes the final step in the approval process.

#### 4.0 AIRCRAFT ELIGIBILITY REQUIREMENTS

- (1) The aircraft eligibility is determined through demonstration of compliance against the relevant airworthiness criteria and the criteria contained in this AC. The design approval holder will demonstrate compliance, and the approval will be documented in manufacturer documentation. If the operator's aircraft documentation does not contain such a statement, the application for RNP AR APCH authorization cannot proceed. The design approval holder must contact TCCA Aircraft Certification to coordinate a demonstration of compliance.
- (2) In addition to the specific criteria below, the aircraft must comply with:
  - (a) Federal Aviation Administration (FAA) AC 20-129 and FAA AC 20-130A;
  - (b) FAA AC 20-129 and FAA AC 20-138(A);
  - (c) FAA AC 20-129 and FAA AC 20-138(B); or
  - (d) FAA AC 20-138C (or later versions of this document).
- (3) An aircraft may meet the aircraft eligibility and equipment requirements for Ops Spec 621 by indicating in its Aircraft Flight Manual compliance with FAA AC 90-101(), EASA AMC 20-26 or TCCA AC 700-024 for the purpose of demonstrating its ability to conduct RNP AR APCH operations.
- (4) The aircraft must be equipped with a Class A TAWS which:
  - (a) should be updated to have the most current version of its functional software;
  - (b) should be updated to the most current version of the terrain and obstacle database ;
  - (c) must meet the altitude accuracy alerting criteria of TSO-C151b (or later version):
    - (i) without any pilot action or input;
    - (ii) independent of altimeter setting on the altimeter(s); and
    - (iii) independent of temperature and pressure deviations from the International Standard Atmosphere (ISA);
  - (d) should use a navigation source that is independent of the navigator/FMS position (usually the GNSS position can be considered independent of the navigation source if used directly by TAWS, and is not the same position as that used by the flight crew an auto flight systems).
- (5) Additional information regarding aircraft certification requirements is available from TCCA Aircraft Certification.

#### 4.1 Continued Airworthiness

- (1) The operator of aircraft approved to perform RNP AR APCH operations must ensure that the navigation system is maintained according to the design approval holder's instructions for continuing airworthiness (ICAs), including any software updates.
- (2) Each operator who applies for RNP AR APCH operational approval is required to incorporate the RNP AR APCH equipment inspection requirements, specified by the design approval holder, and amend the aircraft maintenance schedule as required. This requirement is designed to ensure that navigation systems continue to meet the RNP AR APCH approval criteria.

**Note.** *If the aircraft was delivered by the aircraft manufacturer with RNP AR APCH capability, the maintenance requirements may already exist in the maintenance schedule.*

- (3) Maintenance for the affected aircraft is required to include the maintenance practices listed in the maintenance manuals of the aircraft manufacturer and its components, and must consider:
  - (a) that the equipment involved in the RNP AR APCH operation is required to be maintained according to the ICA from the component design approval holder;
  - (b) that any amendment or change of navigation system affecting in any way RNP AR APCH initial approval, must be submitted to the Principle Maintenance Inspector (PMI) and reviewed for acceptance or approval of such changes prior to its implementation; and
  - (c) that any repair that is not included in the approved/accepted maintenance documentation, and that could affect the integrity of navigation performance, is required to be forwarded to the PMI or regional airworthiness office for acceptance for approval thereof prior to conducting any further RNP AR APCH procedures.

#### 5.0 RNP AR APCH OPERATING PROCEDURES

##### 5.1 Pre-flight considerations

- (1) *Minimum equipment list (MEL).* If a MEL in respect to an operator has been approved by the Minister, the operator must establish guidance, restrictions and procedures (as required) in the MEL for use in the event of RNP AR APCH equipment unavailability, and amend its Maintenance Program accordingly. The MEL should be developed/ revised to address the equipment requirements for RNP AR APCH instrument approaches. Guidance for these equipment requirements is available from the aircraft manufacturer. The required equipment may depend on the intended navigation accuracy and whether the missed approach requires an RNP less than 1.0 Nautical Mile (nm). For example, GNSS and autopilot are typically required for high navigation accuracy. Dual equipment is typically required when conducting an approach requiring an RNP value less than RNP 0.3 nm and/or where the missed approach has an RNP less than 1.0 nm.
- (2) *TAWS.* An operable Class A terrain awareness warning system (TAWS) is required for all RNP AR APCH procedures.
- (3) *Autopilot and flight director.* RNP AR APCH procedures with lateral navigation accuracy less than RNP 0.3 nm or with RF legs require the use of an autopilot or flight director driven by the RNP system in all cases. Thus, the autopilot/flight director must be serviceable and able to track the lateral and vertical paths defined by the procedure. When the dispatch of a flight is predicated on flying an RNP AR APCH procedure requiring the autopilot at the destination and/or alternate, the operator must determine that the autopilot is operational.
- (4) *Dispatch RNP availability prediction.* The operator must have a predictive performance capability which can forecast whether or not the specified RNP will be available at the time and location of a desired RNP AR APCH operation. This capability can be a ground service and need not be resident in the aircraft's avionics equipment. The operator must establish procedures requiring use of this capability as both a pre-flight dispatch tool and as a flight-following tool, where

required, in the event of reported failures. The RNP assessment must consider the specific combination of the aircraft capability (sensors and integration).

- (a) *RNP assessment when GNSS updating.* This predictive capability must account for known and predicted outages of GNSS satellites or other impacts on the navigation system's sensors. The prediction programme should not use a mask angle below 5 degrees, as operational experience indicates that satellite signals at low elevations are not reliable. The prediction must use the actual GNSS constellation with the integrity monitoring algorithm (Receiver Autonomous Integrity Monitoring (RAIM), Aircraft Autonomous Integrity Monitoring (AAIM) etc.) identical to that used in the actual equipment. For RNP AR APCHs with high terrain, use a mask angle appropriate to the terrain.
- (b) RNP AR APCH operations must have GNSS updating available prior to commencement of the procedure.
- (5) *NAVAID exclusion.* The operator must establish procedures to exclude NAVAID facilities in accordance with NOTAMs (e.g. DMEs, VORs, localizers).
- (6) *Navigation database currency.* During system initialization, flight crew members of aircraft equipped with an RNP capable system must confirm that the navigation database is current. Navigation databases are expected to be current for the duration of the flight. If the AIRAC cycle will change during flight, operators and flight crew members must establish procedures to ensure the accuracy of the navigation data, including the suitability of the navigation facilities used to define the routes and procedures for the flight. An outdated database must not be used to conduct the RNP AR APCH operation unless it has been established that any amendments to the database has no material impact on the procedure. If an amended chart is published for the procedure, the database must not be used to conduct the operation.

## 5.2 In-flight considerations

- (1) *Modification of the flight plan.* Flight crew members are not authorized to fly a published RNP AR APCH procedure unless it is retrievable by the procedure name from the aircraft navigation database and conforms to the charted procedure. The lateral path must not be modified, with the exception of:
  - (a) Accepting a clearance to go direct to a fix in the approach procedure, that is before the FAF and that does not immediately precede an RF leg.
  - (b) Changing the altitude and/or airspeed waypoint constraints on the initial, intermediate, or missed approach segments (e.g. to apply cold temperature corrections or comply with an Air Traffic Control (ATC) clearance/instruction).
- (2) *Required list of equipment.* The flight crew members must have a required list of equipment for conducting RNP AR APCH operations or alternate methods to address in-flight equipment failures prohibiting RNP AR APCHs (e.g. a quick reference handbook).
- (3) *RNP management.* The flight crew member's operating procedures must ensure the navigation system uses the appropriate navigation accuracy throughout the approach. If multiple lines of minima associated with different navigation accuracies are shown on the approach chart, the flight crew members must confirm that the desired navigation accuracy is entered in the RNP system. If the navigation system does not extract and set the navigation accuracy from the on-board navigation database for each leg of the procedure, then the flight crew member's operating procedures must ensure that the smallest navigation accuracy value (i.e. highest degree of accuracy) required to complete the approach or the missed approach is selected before initiating the procedure (e.g. before the initial approach fix (IAF)). Different segments may have different navigation accuracy requirements, which are annotated on the approach chart.

- (4) *GNSS updating.* All RNP AR APCH instrument approach procedures require GNSS updating of the navigation position solution. The flight crew members must verify that GNSS updating is available prior to commencing the RNP AR APCH procedure. If GNSS updating is lost at any time during an RNP AR APCH procedure, the flight crew members must abandon the RNP AR APCH procedure unless the flight crew members have the visual references in sight required to continue the approach. See section 5.3 *Contingency Procedures* of this AC for more information.
- (5) *Radio Updating.* Initiation of all RNP AR APCH procedures is based on the availability of GNSS updating. DME/DME and VOR updating are not authorized for use as the primary form of positioning during RNP AR APCH procedures. The flight crew members must comply with the operator's procedures for inhibiting specific facilities.
- (6) *Procedure confirmation.* The flight crew members must confirm that the correct procedure has been selected. This process includes confirmation of the waypoint sequence, reasonableness of track angles and distances, and any parameters that can be altered by the flight crew members, such as altitude or speed constraints. A procedure must not be used if the validity of the navigation database is in doubt. A navigation system textual display or navigation map display must be used.
- (7) *System cross-check.* For approaches with navigation accuracy less than RNP 0.3 nm, the flight crew members must monitor the lateral and vertical guidance provided by the navigation system by ensuring it is consistent with other available data and displays that are provided by an independent means.

**Note.** *This cross-check may not be necessary if the lateral and vertical guidance systems have been developed consistent with a hazardous (severe-major) failure condition for misleading information and if the normal system performance supports airspace containment.*

(8) *Approach Procedures.*

(a) Procedures with RF Legs

An RNP AR APCH procedure may require the ability to execute an RF leg to avoid terrain or obstacles. This requirement will be noted on the approach chart. As not all aircraft have this capability, flight crew members must be aware of whether they can conduct these procedures.

(b) Indicated Airspeed Limitations

When flying an RNP AR approach, flight crew members must not exceed the maximum airspeeds shown in Table 1 throughout the approach segment being flown. For example, a Category C A320 must slow to 140 KIAS at the final approach fix (FAF) or may fly as fast as 165 KIAS if using Category D minima. A missed approach prior to the DA may require the segment speed for that segment be maintained.

Table 1 - Maximum approach segment airspeed by category

Indicated airspeed (knots)					
Approach Segment	Indicated airspeed by aircraft category				
	CAT A	CAT B	CAT C	CAT D	CAT E
Initial and Intermediate (IAF to FAF)	150	250	250	250	310
Final (FAF to DA)	90	120	140	165	250
Missed approach (DA to MAHF)	110	150	240	265	310
Airspeed restriction*	As Specified				
<p>*RNP AR APCH procedure design may use airspeed restrictions unique to the procedure, and published on the approach plate, to reduce the design turn radius regardless of aircraft category. Operators, therefore, need to ensure they comply with the limiting speed for planned RNP AR APCH operations under all operating configurations and conditions.</p> <p><b>NOTE.</b> The above speeds apply only to procedures designed according to TP308/GPH209. The speed limits applicable to procedures designed according to PANS-Ops are not necessarily the same, and operators intending to conduct RNP AR approach activities using such procedures must train flight crew members accordingly.</p>					

- (9) *Navigation System with Temperature Compensation.* For aircraft with temperature compensation capabilities, approved operating procedures may allow flight crew members to disregard the temperature limits on RNP AR APCH procedures if the operator provides flight crew member training on the use of the temperature compensation function. Temperature compensation by the system is applicable to the baro-VNAV guidance and is not a substitute for the flight crew members correcting, as required, for the cold temperature effects on minimum altitudes such as DA and MSA. Flight crew members should be familiar with the effects of the temperature compensation on intercepting the compensated path.
- (10) *Navigation System without Temperature Compensation.* For aircraft without temperature compensation capabilities, the operation must occur within the temperature limits ( $T_{Lim}$ ) published on the approach chart. Despite being uncompensated, the baro-VNAV path in the final segment will provide the required obstacle clearance. The flight crew members must correct, as required, for the cold temperature effects on minimum altitudes such as IAF, IF, FAF, DA, MA and MSA. In below ISA temperatures the baro-VNAV path will cross the FAF at an altitude below the temperature-corrected FAF crossing altitude. It is permissible to follow the baro-VNAV path from the temperature-corrected intermediate segment altitude.
- (11) *GNSS Vertical Navigation.* When using augmented GNSS vertical guidance on RNP AR APCH operations (e.g. SBAS or GBAS), the temperature limits for the procedure do not apply. However, the flight crew members must still correct, as required, for the cold temperature effects on minimum altitudes such as DA and MSA.
- (12) *Altimeter setting.* RNP AR APCH instrument approach procedures use barometric data to drive vertical guidance. The flight crew members must ensure that the current local QNH is set prior to the FAF. The use of remote altimeter settings is not permitted.
- (13) *Altimeter cross-check.* The intent of this check is to detect a gross error or a bias error in an altimeter system. The flight crew members must complete an altimetry cross-check prior to commencing the procedure ensuring both pilots' altimeters agree within 100 ft ( $\pm 30$  m). If the altimetry cross-check fails, then the procedure must not be conducted. This operational cross-check is not necessary if the aircraft automatically compares the altitudes to within 100 ft (30 m).

- (14) Lateral and Vertical Path deviation monitoring.
- (a) Flight crew members must use a lateral deviation indicator and/or flight director in lateral navigation mode on RNP AR APCH procedures. Flight crew members of aircraft with a lateral deviation indicator must ensure that lateral deviation indicator scaling (full-scale deflection) is suitable for the navigation accuracy associated with the various segments of the RNP AR APCH procedure. All flight crew members are expected to maintain procedure centrelines, as depicted by on-board lateral deviation indicators and/or flight guidance during all RNP operations described in this AC, unless authorized to deviate by ATC or under emergency conditions. For normal operations, cross-track error/deviation (the difference between the RNP system computed path and the aircraft position relative to the path) should be limited to  $\pm\frac{1}{2}$  the navigation accuracy associated with the procedure segment. Brief lateral deviations from this standard (e.g. overshoots or undershoots) during and immediately after turns, up to a maximum of one-times the navigation accuracy of the procedure segment are tolerable.
  - (b) The vertical deviation must be within 75 ft (22 m) during the final approach segment, noting that transients in excess of 75 ft (22 m) above the vertical path are acceptable (e.g. configuration changes or energy management actions). Vertical deviation should be monitored above and below the glide path. While being above the glide path provides margin against obstacles on the final approach, continued intentional flight above the vertical path can result in a go-around decision closer to the runway and reduce the margin against obstacles in the missed approach.
  - (c) Pilots must execute a missed approach if the lateral deviation exceeds  $1 \times$  RNP or the vertical deviation exceeds 75 ft (22 m) below the vertical path, unless the flight crew members have the visual references in sight required to continue the approach.
    - (i) Some aircraft navigation displays do not incorporate lateral and vertical deviations scaled for each RNP AR APCH operation in the primary field of view. Where a moving map, low-resolution vertical deviation indicator (VDI), or numeric display of deviations are to be used, flight crew member training and procedures must ensure the effectiveness of these displays. Typically, this involves the demonstration of the procedure with a number of trained flight crews and inclusion of this monitoring procedure in the recurrent RNP AR APCH training programme.
    - (ii) For installations that use a CDI for lateral path tracking, the AFM or aircraft qualification guidance should state which navigation accuracy and operations the aircraft supports and the operational effects on the CDI scale. The flight crew members must know the CDI full-scale deflection value. The avionics may automatically set the CDI scale (dependent on the phase of flight) or the flight crew members may manually set the scale. If the flight crew members manually select the CDI scale, the operator must have procedures and training in place to assure the selected CDI scale is appropriate for the intended RNP operation. The deviation limit must be readily apparent, given the scale (e.g. full-scale deflection).

**Note.** For dual RNP systems that independently display lateral and vertical paths, the approach must be discontinued when either system indicates a deviation that exceeds the above thresholds.

- (15) *VNAV altitude transitions.* The aircraft barometric VNAV system provides fly-by vertical guidance, and may result in a path that starts to intercept the vertical path prior to the FAF. The small vertical displacement which may occur at a vertical constraint (e.g. the FAF) is considered operationally acceptable, and may provide a smoother transition to the next flight path vertical segment. This momentary deviation below the published minimum procedure altitude is acceptable provided the deviation is limited to no more than 100 ft (30 m) and is a result of a normal VNAV capture. This applies to “level off” and “altitude acquire” segments following a climb or descent; or vertical climb or descent segment initiation; or joining of climb or descent paths with different gradients.
- (16) *Non-standard climb gradient.* When an approach procedure specifies a non-standard climb gradient, the operator and flight crew members must ensure the aircraft is capable of complying with the published climb gradient at the aircraft landing weight under ambient atmospheric conditions.
- (17) Go-around or missed approach
- (a) Where possible, the missed approach will require a navigation accuracy value of RNP 1.0 nm. The missed approach portion of these procedures is similar to a missed approach of an RNP APCH approach. Where necessary, a navigation accuracy value less than RNP 1.0 nm (i.e. a higher degree of accuracy) will be used in the missed approach. Operators must receive approval to conduct an RNP AR APCH missed approach procedure with a RNP value less than 1.0 nm, as indicated on their Ops Spec 621.
  - (b) In some aircraft, activating take-off/go-around (TOGA) during the initiation of a go-around or missed approach, may cause a change in lateral navigation mode or functionality (i.e. TOGA disengages the autopilot and flight director from LNAV guidance) and track guidance may revert to track-hold function. In such cases, LNAV guidance to the autopilot and flight director should be re-engaged as quickly as possible.
  - (c) The flight crew member procedures and training must address the impact on navigation capability and flight guidance if the flight crew member initiates a go-around while the aircraft is in a turn. When initiating an early go-around, the flight crew members must ensure adherence to the published track unless ATC has issued a different clearance. The flight crew members should also be aware that RF legs are designed for a maximum ground speed. Initiating an early go-around at speeds higher than those considered in the design may cause the aircraft to diverge throughout the turn and require flight crew member intervention to maintain the path.

### 5.3 Contingency Procedures

- (1) Operator contingency procedures must, as a minimum, incorporate the manufacturer contingency procedures.
- (2) *Contingency procedures — failure while en route.* The aircraft RNP capability is dependent on operational aircraft equipment and GNSS. The flight crew members must be able to assess the impact of equipment failure or inadequate GNSS constellation configuration on the ability to conduct RNP AR APCH procedures, and take appropriate action.
- (3) *Contingency procedures — failure on approach.* The operator’s contingency procedures need to address at least the following conditions:
  - (a) Failure of the RNP system components, including those affecting lateral and vertical deviation performance (e.g. failures of a GPS sensor, the flight director or automatic pilot);
  - (b) Loss of navigation signal in-space (loss or degradation of external signal); and
  - (c) Identification of hazards and special procedures unique to a particular approach.

## **6.0 KNOWLEDGE AND TRAINING REQUIREMENTS**

### **6.1 Operator responsibilities**

- (1) The operator must provide training for flight crew members, dispatchers and maintenance personnel in RNP AR APCH procedures and concepts as they apply to the responsibilities of these personnel. A thorough understanding of the operational procedures and best practices is critical to the safe operation of aircraft during RNP AR APCH operations. The flight crew member training must provide sufficient detail on the aircraft's navigation and flight control systems to enable the flight crew members to identify failures affecting the aircraft's RNP capability and the appropriate abnormal/emergency procedures. Training must include both knowledge and skill assessments of the flight crew members' and dispatchers' duties.
- (2) Each operator is responsible for the training of each flight crew member for the specific RNP AR APCH operations exercised by the operator. The operator must include training on the different types of RNP AR APCH procedures and required equipment. The operator must include these requirements and procedures in their company operations manual and training manuals (as applicable). This material must cover all aspects of the operator's RNP AR APCH operations including the content of the operations specification. An individual must have completed the appropriate ground and flight training programs, as applicable, and, in the case of flight crew members, the evaluation program before engaging in RNP AR APCH operations.
- (3) The flight training syllabus must include training and qualification content representative of the type of RNP AR APCH operations the operator conducts during line-oriented flying activities. RNP AR APCH procedures are eligible for inclusion in an operator's Advance Qualification Programs (AQP). The operator may conduct required flight training and qualification in flight training devices, aircraft simulators, and other enhanced training devices as long as these training devices accurately replicate the operator's equipment and RNP AR APCH operations, and are approved by TCCA.
- (4) An operator may use restricted RNP approach procedures for the purpose of satisfying the RNP AR APCH training and evaluation requirements. Approval to use restricted RNP approach procedures for this purpose must be received prior to their use. The operator must submit the proposed approach procedure with supporting rationale for equivalency to the POI, or private operator equivalent. A determination will be made by TCCA AARTF as to the eligibility of the proposed approach.
- (5) Operators must address initial flight crew member RNP AR APCH training and checking during initial, transition, upgrade, recurrent, differences, or stand-alone training and checking programs. The qualification standards assess each flight crew member's ability to properly understand and use RNP AR procedures (RNP AR APCH initial evaluation). The operator must also conduct a recurrent qualification program to ensure their flight crew members maintain appropriate RNP AR APCH knowledge and skills.
- (6) Operators may address RNP AR APCH operation topics separately on initial training, when it is not practical to combine it with the aircraft training curriculum, or integrate them with other curriculum elements where practicable. For example, an RNP AR APCH flight crew member qualification may focus on a specific aircraft during transition, upgrade, or differences courses. General training may also address RNP AR APCH qualification (e.g. during recurrent training or checking events such as recurrent proficiency check/proficiency training, line oriented evaluation or special purpose operational training). A separate, independent RNP AR APCH qualification programme may also address RNP AR APCH training.
- (7) Operators may receive credit towards the requirements of this Ops Spec 621 for elements of RNP training already conducted as part of an existing training program (e.g. RNAV 1 and 2, RNP APCH). Such operators must receive approval from their principal operations inspector or equivalent. In such a case, the operator must include flight crew member training on the differences between RNP AR APCH procedures and the operation(s) associated with the common training elements.

**6.2 Ground training syllabus**

- (1) The following personnel require RNP AR APCH ground training:
- (a) *Flight Crew Members*: all pilots who will conduct RNP AR APCH procedures;
  - (b) *Operational Control Personnel*: all dispatchers involved in the planning and operational control of flights intended to conduct RNP AR APCH procedures; and
  - (c) *Maintenance Personnel*: maintenance personnel involved in the routine or detailed checks of RNP AR APCH avionics.

Table 2 - Ground Training of Personnel

GROUND TRAINING MODULES (Described Below)	FLIGHT CREW MEMBERS	OPERATIONAL CONTROL PERSONNEL	MAINTENANCE PERSONNEL
General Knowledge	X	X	X
ATC and Flight Planning	X	X	
Equipment and Procedures	X		
MEL Operating Provisions	X	X	X

- (2) The ground training syllabus must address the following subjects in an approved RNP AR APCH training programme during the initial introduction of an operator’s personnel to RNP AR APCH operations:
- (a) General Knowledge
    - (i) The definition of RNP AR APCH;
    - (ii) The differences between RNAV and RNP;
    - (iii) The types of RNP AR APCH procedures and familiarity with the chart depiction of these procedures;
    - (iv) The importance of specific equipment during RNP AR APCH operations;
    - (v) The requirement for GNSS for all RNP AR APCH procedures;
    - (vi) The RNP AR APCH regulatory requirements (Section 1.0 of this AC) and procedures including any restrictions associated with Ops Spec 621 (e.g. RF legs not authorized);
    - (vii) The RNP AR APCH availability (considering aircraft equipment capabilities);
  - (b) ATC and Flight Planning
    - (i) The prefixes and suffixes to be used on flight plans;
    - (ii) Any ATC procedures applicable to RNP AR APCH operations;
    - (iii) The use of GPS RAIM (or equivalent) forecasts and the effects of RAIM availability on RNP AR APCH procedures;
    - (iv) The use of WAAS NOTAMS if the aircraft avionics are WAAS capable;
    - (v) The impact of a failure of any avionics or a known loss of ground- or space-based systems on the remainder of the flight plan.

- (c) Equipment and Procedures
  - (i) The RNP terminology, symbology, operation, optional controls, and display features including any items unique to an operator's implementation or systems;
  - (ii) The description of failure alerts;
  - (iii) The equipment used in RNP operations and any limitations on the use of the equipment during those operations;
  - (iv) The programming and displaying of RNP and aircraft specific displays (e.g. actual navigation performance (ANP display));
  - (v) How to enable and disable the navigation updating modes related to RNP;
  - (vi) The navigation accuracy appropriate for different phases of flight, including RNP AR APCH procedures, and how to select the navigation accuracy, if required;
  - (vii) When and how to terminate RNP navigation and transfer to traditional navigation due to the loss of RNP and/or required equipment;
  - (viii) How to determine database currency and whether it contains the navigational data required for use of GNSS waypoints;
  - (ix) An explanation of the different components that contribute to the total system error and their characteristics;
  - (x) *Temperature compensation* — flight crew members operating avionics systems with compensation for altimetry errors introduced by deviations from ISA may disregard the temperature limits on RNP AR APCH procedures if they have received approved training from the operator on the use of the temperature compensation function and the compensation function is utilized by the flight crew members. However, the training must also recognize that the temperature compensation by the system is applicable to the VNAV guidance and is not a substitute for the flight crew correcting, as required, for the cold temperature effects on minimum altitudes such as DA and MSA;
  - (xi) The normal and abnormal flight crew operating procedures, responses to failure alerts, and any equipment limitations, including related information on RNP modes of operation;
  - (xii) The contingency procedures for loss or degradation of RNP capability. The flight operations manuals approved for use by the flight crews (e.g. flight operations manual (FOM) or pilot operating handbook (POH)) should contain this information.
- (d) MEL Operating Provisions
  - (i) The MEL requirements supporting RNP AR APCH operations.

### 6.3 Flight training syllabus

- (1) Flight training programmes must cover the proper execution of RNP AR APCH procedures in concert with the OEM's documentation. The operational training must include:
  - (a) RNP AR APCH procedures and limitations;
  - (b) standardization of the set-up of the cockpit's electronic displays during an RNP AR APCH procedure;
  - (c) recognition of the aural advisories, alerts and other annunciations that can impact compliance with an RNP AR APCH procedure; and
  - (d) the timely and correct responses to loss of RNP AR APCH capability in a variety of scenarios, within the group of the RNP AR APCH procedures which the operator plans to use.
- (2) This training must address the following specific elements:
  - (a) briefing all RNP AR APCH procedures and the important role cockpit resource management (CRM) plays in successfully completing an RNP AR APCH procedure;
  - (b) verifying that each pilot's altimeter has the current setting before beginning the final approach of an RNP AR APCH procedure, including any operational limitations associated with the source(s) for the altimeter setting, and the cross-checking of the altimeters approaching the FAF;
  - (c) using aircraft radar, TAWS, GPWS, or other avionics systems to support the flight crew member's track monitoring, and weather and obstacle avoidance;
  - (d) determining the source of positioning information, and confirming that GNSS has been given priority over all others (i.e. DME/DME, VOR/DME);
  - (e) confirming and correcting, as applicable, the required RNP accuracy value;
  - (f) recognizing alerts associated with the loading and use of improper navigation accuracy data for a desired segment of an RNP AR APCH procedure;
  - (g) coupling the autopilot/flight director to the navigation system's lateral guidance on RNP AR APCH procedures requiring an RNP of less than RNP 0.3 nm;
  - (h) recognizing the effect of wind on aircraft performance during RNP AR APCH procedures and the need to remain within RNP containment area, including any operational wind limitation and aircraft configuration essential to safely complete an RNP AR procedure;
  - (i) identifying any bank angle restrictions or operational limitations on RNP AR APCH procedures (e.g. temperature limitations);
  - (j) recognizing the potentially detrimental effect on the ability to comply with an RNP AR APCH procedure when reducing the flap setting, reducing the bank angle or increasing airspeed;
  - (k) understanding that aircraft are expected to maintain the standard speeds associated with the applicable category and that RNP AR APCH aircraft category airspeeds associated with RF legs, as published in Table 1 of this AC, are different from aircraft category airspeeds published in the Canada Air Pilot (CAP GEN). The speed limits found in Table 1 are applicable to procedures designed according to TERPs. Operators intending to conduct RNP AR APCH procedures not designed to TERPS criteria, such as PANS OPS, must train flight crew members on the speed limits applicable to RF legs included in those procedures;
  - (l) understanding the relationship between RNP and the appropriate approach minima line on an approved published RNP AR APCH;

- (m) *Missed Approach*
  - (i) responding to the loss of GNSS during a procedure;
  - (ii) identifying the events triggering a missed approach when using the aircraft's RNP capability;
  - (iii) recognizing the effect of activating TOGA while in a turn;
  - (iv) monitoring of and the impact on go-around decision and operation;
  - (v) following flight crew contingency procedures for a loss of RNP capability during a missed approach. Due to the lack of navigation guidance, the training should emphasize the flight crew contingency actions that achieve separation from terrain and obstacles.

#### **6.4 Recurrent training**

- (1) Recurrent training for RNP AR APCH must occur at least every second training event. The operator should incorporate recurrent RNP training that employs the unique RNP AR approach characteristics of the operator's approved procedures (i.e. RF legs, RNP missed approach) as part of the overall programme.
- (2) A minimum of two RNP AR APCHs must be flown by each pilot (pilot flying and pilot monitoring), with one culminating in a landing and one culminating in a missed approach.

#### **6.5 Evaluation module (Checking requirements)**

- (1) *Initial evaluation of RNP AR APCH knowledge and procedures.* The operator must evaluate the knowledge of each individual flight crew member involved in RNP AR APCH procedures, prior to commencing RNP AR APCH procedures. As a minimum, the flight crew members must demonstrate a satisfactory level of competency in flight crew member procedures and specific aircraft performance requirements for RNP AR APCH operations. The flight crew member assessment may be conducted as:
  - (a) An evaluation during a proficiency check or practical test event by an AQP evaluator, an Approved Check Pilot (ACP) or Transport Canada Inspector using an approved simulator or training device which accurately replicates the operator's equipment; or
  - (b) An evaluation, using an approved simulator which accurately replicates the operator's equipment, by an AQP evaluator, an ACP or Transport Canada Inspector during line-oriented flight training (LOFT)/line-oriented evaluation (LOE) programs which incorporate RNP operations that employ the unique RNP AR APCH characteristics of the operator's approved procedures.

**Note.** *The AQP evaluator or ACP mentioned above must have completed the RNP AR APCH training and evaluation.*

- (2) *Initial Evaluation content.* Specific elements that must be addressed in this evaluation module are:
- (a) Demonstrate the use of any RNP limits that may impact various RNP AR APCH procedures;
  - (b) Demonstrate the application of radio-updating procedures, such as enabling and disabling ground-based radio updating of the FMC (i.e. DME/DME and VOR/DME updating) and knowledge of when to use this feature. If the aircraft's avionics do not include the capability to disable radio updating, then the training must ensure the flight crew is able to accomplish the operational actions that mitigate the lack of this feature;
  - (c) Knowledge of the operational limit for deviation below the desired flight path on an RNP AR APCH procedure and how to accurately monitor the aircraft's position relative to the vertical flight path
  - (d) Demonstrate the ability to monitor the actual lateral and vertical flight paths relative to the programmed flight path and complete the appropriate flight crew procedures when exceeding a lateral or vertical FTE limit;
  - (e) Demonstrate the ability to read and adapt to a RAIM (or equivalent) forecast, including forecasts predicting a lack of RAIM availability;
  - (f) Demonstrate the proper set-up of the FMC, the weather radar, TAWS, and moving map for the various RNP AR APCH operations and scenarios the operator plans to implement;
  - (g) Demonstrate the use of flight crew briefings and checklists for RNP AR APCH operations with emphasis on CRM;
  - (h) Demonstrate knowledge of and ability to perform an RNP AR APCH missed approach procedure in an operational scenario (i.e. loss of navigation or failure to acquire visual conditions);
  - (i) Demonstrate speed control during segments requiring speed restrictions to ensure compliance with an RNP AR APCH procedures;
  - (j) Demonstrate competent use of RNP AR APCH plates, briefing cards, and checklists; and
  - (k) Demonstrate the ability to complete a stable RNP AR APCH operation including bank angle, speed, and track control.
- (3) *Recurrent Evaluation/check.* Recurrent evaluation or check for RNP AR APCH should occur during or following each training event where training for RNP AR APCH was conducted, and may be conducted by an AQP evaluator, an ACP, or a Transport Canada Inspector.

## 7.0 NAVIGATION DATABASE

- (1) The procedure stored in the navigation database defines the lateral and vertical path. Navigation database updates occur every 28 days, and the navigation data in each update is critical to the integrity of RNP AR APCH procedures. Given the reduced obstacle clearance associated with these approaches, validation of navigation data warrants special consideration. This section provides guidance for the operator's procedures for validating the navigation data associated with RNP AR APCH procedures:
  - (a) The operator must identify a responsible manager for the data updating process within their procedures;
  - (b) The operator must document a process for accepting, verifying and loading navigation data into the aircraft;
  - (c) The operator must place their documented data process and database management under a Quality Assurance program;
  - (d) The operator must have a procedure in place to prevent flight crew members from using an RNP AR APCH procedure which is accessible to flight crew members in the on-board database, but which has not been validated.
- (2) *Initial data validation.* In order to validate the integrity of the database and the ability of the RNP system to operationally execute the procedure as intended, the operator must do an initial data validation of every RNP AR APCH procedure before flying the procedure in instrument meteorological conditions (IMC). As a minimum, the operator must:
  - (a) Compare the navigation data for the procedure(s) to be loaded into the flight management system with the published procedure;
  - (b) Validate the loaded navigation data for the procedure, either in a simulator or in the actual aircraft in visual meteorological conditions (VMC). The depicted procedure on the map display must be compared to the published procedure. The entire procedure must be flown to ensure the path does not have any apparent lateral or vertical path disconnects, and is consistent with the published procedure; and
  - (c) Once the procedure is validated, retain and maintain a copy of the validated navigation data for comparison to subsequent data updates.
- (3) *Data updates.* Upon receipt of each navigation data update, and before using the navigation data in the aircraft, the operator must compare the update to the validated procedure. This comparison must identify and resolve any discrepancies in the navigation data. If there are significant changes (any change affecting the approach path or performance) to any portion of a procedure and source data verifies the changes, the operator must revalidate the amended procedure, prior to its use, in accordance with initial data validation.
- (4) *Data suppliers.* Data suppliers must have a Letter of Acceptance (LOA), or equivalent regulatory acceptance, for processing navigation data (e.g. FAA AC 20-153, EASA Conditions for the issuance of LOA for navigation data Suppliers by the Agency). An LOA recognizes the data supplier as one whose data quality, integrity and quality management practices are consistent with the criteria of DO-200A/ED-76. If an operator switches data providers, all RNP AR APCH procedures must undergo initial data validation before use.
- (5) *Aircraft modifications.* If an aircraft system required for RNP AR APCH is modified (e.g. software change), the operator is responsible for the validation of RNP AR APCH procedures using the navigation database and the modified system. This may be accomplished without any direct evaluation if the manufacturer verifies that the modification has no effect on the navigation database or path computation. If no such assurance from the manufacturer is available, the operator must conduct an initial data validation using the modified system noting that flight control computers, FMS operations and display software changes are particularly critical.

## **8.0 RNP AR APCH MONITORING PROGRAM**

- (1) TCCA may consider any anomaly reports in determining remedial action. Repeated navigation error occurrences attributed to a specific piece of navigation equipment may result in the cancellation of the approval for use of that equipment.
- (2) Information that indicates the potential for repeated errors may require modification of an operator's training program. Information that attributes multiple errors to a particular flight crew member may necessitate remedial training or license review.
- (3) Operators must have an RNP monitoring programme to ensure continued compliance with the guidance of this AC and to identify any negative trends in performance. Operators must collect and periodically review these data items to identify potential safety concerns:
  - (a) total number of RNP AR APCH procedures conducted;
  - (b) number of satisfactory approaches by aircraft/system (satisfactory if completed as planned without any navigation or guidance system anomalies);
  - (c) reasons for unsatisfactory approaches, such as:
    - (i) UNABLE REQ NAV PERF, NAV ACCUR DOWNGRAD, or other RNP messages during approaches;
    - (ii) excessive lateral or vertical deviation;
    - (iii) TAWS warning;
    - (iv) autopilot system disconnect;
    - (v) navigation data errors; and
    - (vi) pilot report of any anomaly.
  - (d) Crew comments.

## **9.0 OPERATIONAL APPROVAL**

- (1) The requirements for authorization to conduct RNP AR APCH procedures are as follows:
  - (a) The equipment must meet the certification and installation requirements of Part V of the CARs, and the criteria of this AC;
  - (b) The operator must ensure the quality of the navigation database as per this AC;
  - (c) The operator must establish procedures in its Company Operations Manual (COM), or private operator equivalent, for the guidance of its personnel related to the conduct of RNP AR APCH operations;
  - (d) If a MEL in respect to an operator has been approved by the Minister, the operator must establish guidance, restrictions and procedures (as required) in the MEL for use in the event of RNP AR APCH equipment unavailability;
  - (e) The operator must amend its Maintenance Program accordingly;
  - (f) The operator must amend its training program to provide training to operational control personnel, each flight crew member and maintenance personnel involved with RNP AR APCH operations. Updates to the operator's Training Program should be done in accordance with the requirements of this AC, as well as Subpart 604 of the CARs or the guidance in Sections 722.76, 723.98, 724.115, 725.124 of the *Commercial Air Services Standards* (CASS), as applicable;
  - (g) The operator must establish an RNP AR APCH Monitoring Program, as described in this AC; and

- (h) The operator must receive Ops Spec 621 *Required Navigation Performance Authorization Required Approach (RNP AR APCH)* prior to performing the RNP AR APCH procedures.

## 10.0 CONCLUSION

- (1) An operator intending to apply for Ops Spec 621 should review this advisory circular and:
  - (a) determine the accuracy to which the operator would like to conduct RNP AR APCH procedures (final and missed approach) and the operator's intent to conduct RF legs;
  - (b) determine the capabilities of the operator's aircraft to support the desired RNP AR APCH procedures; and then
  - (c) contact their Principal Operations Inspector (POI) or private operator equivalent.
- (2) The POI or private operator equivalent, with the assistance of the PMI or Regional Airworthiness office, will confirm that all of the above requirements are satisfied. Once all of the applicable conditions of this AC have been met, the operator may be issued Ops Spec 621 indicating the lowest RNP value (highest degree of accuracy) to which an operator may conduct RNP AR APCH operations (final and missed approach), and whether or not RF legs are permitted.

## 11.0 INFORMATION MANAGEMENT

- (1) Not applicable.

## 12.0 DOCUMENT HISTORY

- (1) Not applicable.

## 13.0 CONTACT OFFICE

For more information, please contact:

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Suggestions for amendment to this document are invited, and should be submitted via:

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*Original signed by Aaron McCrorie on **January 22, 2015***

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*Transport Canada documents or intranet pages mentioned in this document are available upon request through the Contact Office.*