CIVIL AVIATION AUTHORITY
OF VIETNAM

ADVISORY CIRCULAR
AC 10-009

PROCESS & APPLICATION
PERFORMANCE BASED NAVIGATION (PBN)

Purpose— The purpose of this advisory circular (AC) is to provide guidance to aircraft operators regarding the—

1) **International standards for Performance Based Navigation (PBN); and**
2) **Requirement to have CAAV approval for operations involving performance based navigation.**

Emphasis should be on maintaining and ensuring total system performance, accuracy, availability, reliability, and integrity for the intended operations.

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- Advisory Circulars are intended to priovide 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.

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SECTION 1 POLICY & GENERAL INFORMATION

1.1 STATUS OF THIS AC

This is issuance [2]2018 of this AC.

1.2 BACKGROUND

A. Conventional navigation is dependent upon ground-based radio navigation aids. It has been the mainstay of aviation for the last seventy years, and pilots, operators, manufacturers and air navigation service providers are all familiar with the associated technology, avionics, instrumentation, operations, training and performance.

B. Performance-based navigation (PBN) is based upon area navigation principles. While various methods of area navigation have been in existence for many years, the widespread use of area navigation as a primary navigation function is a more recent phenomenon. The PBN concept is intended to better define the use of area navigation systems and is expected to replace many of the existing conventional navigation routes within the next twenty years.

C. The fundamentals of PBN operations are relatively straightforward, and operational approval need not be a complicated process for the applicant. However the transition to new technology, new navigation and new operational concepts and the dependence on data-driven operations require careful management.

D. The PBN operational approval process is intended to ensure that the appropriate level of oversight is provided for all PBN operations in an environment where there are currently many variables in terms of international aviation standards, as well as experience in the related equipment, engineering and operational issues. In this way, the benefits of PBN will be achieved consistently and safely.

1.3 APPLICABILITY

The requirement for CAAV approval before operations in defined PBN airspace applies to operators of Vietnam-registered aircraft involved in general aviation and commercial air transport.

1.4 RELATED REGULATIONS

- VAR Part 6 includes requirements for instruments and equipment for performance based navigation
- VAR Part 10 includes the requirements for performance based navigation.
- VAR Part 10 includes the requirements for CAAV approval of AOC performance based navigation.

1.5 RELATED PUBLICATIONS

These ICAO publications are source documents for this advisory circular—

1) International Civil Aviation Organization (ICAO)

   - ♦ Doc 9613-AN/937 – Performance Based Navigation Manual (PBN)
   - ♦ Doc 9997 – Performance Based Navigation (PBN) Operational Approval Manual
   - ♦ Annex 6, Part 1, International Commercial Air Transport – Aeroplanes
   - ♦ Annex 6, Part 3, International Operations – Helicopters

Copies may be obtained from Document Sales Unit, ICAO, 999 University Street, Montreal, Quebec, Canada H3C 5H7.

1.6 DEFINITIONS & ACRONYMS

1.6.1 DEFINITIONS

The following definitions apply to this advisory circular—

1) **Aircraft-Based Augmentation System (ABAS)**. An augmentation system that augments and/or integrates the information obtained from the other GNSS elements with information available on board the aircraft.
   - ♦ The most common form of ABAS is receiver autonomous integrity monitoring (RAIM).
2) **Airspace Concept.** An Airspace Concept provides the outline and intended framework of operations within an airspace.
   - ♦ Airspace Concepts are developed to satisfy explicit strategic objectives such as improved safety, increased air traffic capacity and mitigation of environmental impact etc.
   - ♦ Airspace Concepts can include details of the practical organisation of the airspace and its users based on particular CNS/ATM assumptions. e.g. ATS route structure, separation minima, route spacing and obstacle clearance.
3) **Approach procedure with vertical guidance (APV)**. An instrument procedure which utilizes lateral and vertical guidance but does not meet the requirements established for precision approach and landing operations.
4) **Area navigation (RNAV).** A method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained navigation aids, or a combination of these.
   - ♦ Area navigation includes Performance Based Navigation as well as other RNAV operations that do not meet the definition of Performance Based Navigation.

5) **Area navigation route**. An ATS route established for the use of aircraft capable of employing area navigation.

6) **Cyclic Redundancy Check (CRC)** A mathematical algorithm applied to the digital expression of data that provides a level of assurance against loss or alteration of data.

7) **Navigation Function.** The detailed capability of the navigation system (such as the execution of leg transitions, parallel offset capabilities, holding patterns, navigation data bases) required to meet the Airspace Concept.

8) **Navigation Specification.** A set of aircraft and air crew requirements needed to support Performance based navigation operations within a defined airspace.

9) **Performance Based Navigation.** Performance Based Navigation specifies system performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace.

10) **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).

11) **RNAV Operations.** Aircraft operations using area navigation for RNAV applications.

12) **RNAV System**: A navigation system which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

    ♦ A RNAV system may be included as part of a Flight Management System (FMS).

13) **RNP Route.** An ATS Route established for the use of aircraft adhering to a prescribed RNP Specification.

14) **RNP System**. An area navigation system which supports on-board performance monitoring and alerting.

15) **RNP Operations**. Aircraft operations using a RNP System for RNP applications.

16) **Satellite based augmentation system (SBAS).** A wide coverage augmentation system in which the user receives augmentation from a satellite-based transmitter.

17) **Standard instrument arrival (STAR).** A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.

18) **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

1.6.2 ACRONYMS & ABBREVIATIONS

The following acronyms apply to this advisory circular—

1) **ABAS** = Aircraft-based Augmentation System

2) **AC** = Advisory Circular

3) **AFM** = Aircraft Flight Manual

4) **AOC =** Air Operator Certificate

5) **APV** = Approach Procedure with Vertical Guidance

6) **ATS** =Air Traffic Services

7) **CAAV** = Civil Aviation Authority of Vietnam

8) **CRC** = Cyclic Redundancy Check
9) **DME** = Distance Measuring Equipment
10) **DTED** = Digital Terrain Elevation Data
11) **EASA** = European Aviation Safety Agency
12) **ECAC** = European Civil Aviation Conference
13) **EUROCAE** = European Organization for Civil Aviation Equipment
14) E**UROCONTROL** = European Organisation for the Safety of Air Navigation
15) **FAA** = Federal Aviation Administration
16) **FCOM** = Flight Crew Operating Manual
17) **FTE** = Flight Technical Error
18) **FMS** = Flight Management System
19) **FRT** = Fixed Radius Transition
20) **GBAS** = Ground-based Augmentation System
21) **GNSS** = Global Navigation Satellite System
22) **GPS** = Global Positioning System
23) **INS** = Inertial Navigation System
24) **IRS** = Inertial Reference System
25) **IRU** = Inertial Reference Unit
26) **JAA** = Joint Aviation Authorities
27) **LNAV** = Lateral Navigation
28) **L/DEV** = Lateral deviation
29) **LOA** = Letter of authorization
30) **LP** = Localizer performance
31) **LPV** = Localizer performance with vertical guidance
32) **LRNS** = Long range navigation system
33) **MCM** = Maintenance Control Manual
34) **MDA** = Minimum descent altitude
35) **MDA/H** = Minimum descent altitude/height
36) **MEL** = Minimum Equipment List
37) **MTM** = Maintenance Training Manuals
38) **NAT-HLV** = North Atlantic High Level Airspace
39) **Nav** = Navigation
40) **NSE** = Navigation System Error
41) **OEM** = Original Equipment Manufacturer
42) **PBN** = Performance Based Navigation
43) **RAIM** = Receiver Autonomous Integrity Monitoring

44) **RF** = Radius to Fix

45) **RNAV** = Area Navigation

46) **RNP** = Required Navigation Performance

47) **RTCA** = Radio Technical Commission on Aeronautics

48) **SB** = Service Bulletin

49) **SBAS** = Satellite-based Augmentation System

50) **SID** = Standard Instrument Departure

51) **STAR** = Standard Terminal Arrival

52) **STC** = Supplemental Type Certificate

53) **TAWS** = Terrain awareness warning system

54) **TC** = Type certificate

55) **TLS** = Target Level of Safety

56) **TSE** = Total System Error VNAV Vertical Navigation

57) **VAR =** Vietnam Aviation Regulations

58) **VOR** = Very High Frequency Omni-directional Radio Range

1.7 PBN OVERVIEW

A. Area navigation systems evolved in a manner similar to conventional ground-based routes and procedures.

- The early systems used very high frequency omnidirectional radio range (VOR) and distance measuring equipment (DME) for estimating their position in domestic operations, and inertial navigation systems (INS) were employed in oceanic operations.
- In most cases a specific area navigation system was identified, and its performance was evaluated through a combination of analysis and flight testing.
- In some cases, it was necessary to identify the individual models of equipment that could be operated within the airspace concerned.
- Such prescriptive requirements resulted in delays in the introduction of new area navigation system capabilities and higher costs for maintaining appropriate certification.
- The PBN concept was developed with globally applicable performance requirements, detailed in accompanying navigation specifications, in order to avoid these high costs and delays.

B. The PBN concept requires that the aircraft area navigation system performance be defined in terms of the accuracy, integrity, availability, continuity and functionality necessary to operate in the context of a particular airspace concept.

- Appropriate positioning sensors are also identified; these may include VOR/DME, DME/DME, GNSS and/or inertial systems.
- Performance is detailed in a navigation specification in sufficient detail to facilitate global harmonization.
- The navigation specification not only lays out the aircraft system performance requirements but also the aircrew requirements in terms of crew procedures and training, as well as any appropriate maintenance requirements, such as the provision of navigation databases.

1.8 RNAV & RNP

1.8.1 RNAV SPECIFICATIONS

RNAV specifications were developed to support existing capabilities in aircraft equipped with area navigation systems which, in the general case, were not designed to provide on-board performance monitoring and alerting.

> RNAV specifications are similar to RNP specifications but do not require an on-board performance monitoring and alerting capability.

1.8.2 RNP SPECIFICATIONS

RNP specifications developed from a need to support operations that require greater integrity assurance, where the pilot is able to detect when the navigation system is not achieving, or cannot guarantee with appropriate integrity, the navigation performance required for the operation. Such systems are known as RNP systems.

> RNP systems provide greater assurance of integrity and, hence, can offer safety, efficiency, capacity and other operational benefits.

1.9 PBN DESIGNATIONS

A. The designations for both RNP and RNAV are expressed as suffixes—

- *A RNP specification* is designated as RNP X (e.g. RNP 4).
- A *RNAV specification* is designated as RNAV X (e.g. RNAV 1).

> For both RNP and RNAV designations, the expression 'X' (where stated) refers to the lateral navigation accuracy in nautical miles that is expected to be achieved.

- If two navigation specifications share the same value for X, they may be distinguished by use of a prefix. e.g. Advanced-RNP 1 and Basic-RNP 1.
- RNP approach navigation specifications are designated using RNP as a prefix and an abbreviated textual suffix e.g. RNP APCH or RNP AR APCH.

> - Approach navigation specifications cover all segments of the instrument approach.
> - There are no RNAV approach specifications.

1.10 ICAO NAVIGATION SPECIFICATIONS

1.10.1 NAVIGATION SPECIFICATIONS

The following navigation specifications will require approval by the CAAV before entry into airspace defined for the navigation performance requirements—

> A more detailed listing of the nav specifications, their application and user notes is provided in Appendix A to this AC.

1) RNAV 10
2) RNAV 5
3) RNAV 2
4) RNAV 1
5) RNP 4
6) RNP-2
7) Advanced RNP
8) RNP-1
9) RNP-0.3

> - The official ICAO navigation specifications for these designations are located in Doc 9613, Volume II.
> - Operators are expected to ensure that their proposed operation will conform to the applicable nav specification(s) prior to submission of the application to the CAAV.

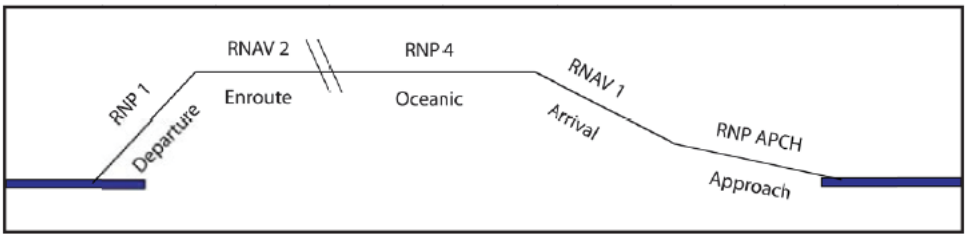
> When preparing for RNP approach operations, the operators should also consult AC 10-018 for guidance for Baro-VNAV approvals.

10) RNP APCH

11) RNP AR APCH

1.10.2 APPLICATION OF NAV SPECIFICATIONS TO FLIGHT PHASE

A. The following graphic demonstrates how an operator may apply more than one navigation specification during a single flight—



B. An operator should make similar evaluations of all proposed operations to determine the minimum navigations specifications that should be requested from the CAAV during certification.

1.10.3 RNAV 10 = RNP 10

A. The designation RNP 10 has been used for years to define long range oceanic navigation requirements.

Under the PBN concepts, RNP 10 actually conforms to the RNAV 10 navigation specification.

B. Because the designator RNP 10 appears in numerous published documents and charts, RNP 10 will be retained in its current designation form.

C. Under PBN, RNP 10 and RNAV 10 will be used synonymously to define these types of RNAV operations.

1.10.4 OCEANIC & REMOTE CONTINENTAL

A. Oceanic and Remote continental Airspace Concepts are currently served by two navigation applications, RNAV 10 and RNP 4.

B. Both these navigation applications rely primarily on GNSS to support the navigation element of the Airspace Concept.

- In the case of the RNAV 10 application, no form of ATS Surveillance service is required.
- In the case of the RNP 4 application, ADS contract (ADS-C) is used.

1.10.5 APPROACH

A. Approach concepts cover all segments of the instrument approach, including—

1) Initial;

2) Intermediate;

3) Final; and

4) Missed approach.

B. Under the PBN concept, these segments call for RNP specifications requiring a navigation accuracy of 0.3 NM to 0.1 NM or lower.

Refer to Doc 9613 for the navigation specifications for RNP APCH and RNP AR APCH.

C. Three general applications of RNP are characteristic of this phase of flight—

1) New procedures to runways never served by an instrument procedure;
2) Procedures either replacing or serving as backup to existing instrument procedures based on different technologies: and
3) Those developed to enhance airport access in demanding environments.

SECTION 2 OVERVIEW OF CERTIFICATION CONCEPTS

2.1 OVERVIEW

2.1.1 GENERAL

The PBN concept requires that the aircraft meets certain airworthiness certification standards, including the necessary navigation system performance and functionality, to be eligible for a particular application and that the operator has operational approval from an appropriate regulatory body before the system can be used.

- A PBN navigation specification operational approval is an approval that authorizes an operator to carry out defined PBN operations with specific aircraft in designated airspace.
- The operational approval for an operator may be issued when the operator has demonstrated to the regulatory authority of the State of Registry/State of the Operator that the specific aircraft are in compliance with the relevant airworthiness standard and that the continued airworthiness and flight operations requirements are satisfied.

2.1.2 MULTIPLE STATES & REGULATORY AGENCIES

There may be up to three different States and regulatory agencies involved in PBN operational approvals—

2.1.2.1 State of Design/Manufacture

A. The organization which has designed the aircraft applies for a type certificate (TC) from the State of Design.

B. The State of Design also approves the master minimum equipment list (MMEL), the mandatory maintenance tasks and intervals, and the aircraft flight manual (AFM) and its amendments, which determine the PBN capabilities and limitations of the aircraft.

C. A State of Design, which may be different from the State which issued the original TC, may issue a design change approval for an aircraft as a supplemental type certificate (STC).

2.1.2.2 State of Registry

A. The CAAV is the State of Registry for all Vietnam-registered aircraft. The State of Registry is responsible for the airworthiness of the aircraft.

B. It approves the aircraft maintenance program, in accordance with VARs, and issues the certificate of airworthiness. It also approves aircraft repairs and modifications (as stand-alone modifications or as STCs).

C. For general aviation operators, the CAAV approves the minimum equipment list (MEL) and the conduct of specified PBN operations.

2.1.2.3 State of the Operator

The CAAV is the State of the Operator for all Vietnam AOC holders. The CAAV accepts the aircraft maintenance program and approves the MEL, the flight crew training programs and the conduct of specified PBN operations, in accordance with the VARs.

2.1.3 TECHNICAL DATA FROM ANOTHER STATE

A. CAAV will not re-approve technical data approved by another State; re-approving already approved technical data would effectively transfers the regulatory responsibility for that data to the State re-approving the data with respect to aircraft registered under its jurisdiction.

B. The CAAV will use technical data approved by another State. The CAAV will review the data, determine that the data are acceptable for use in Vietnam and formally accept the data. In this way, *the regulatory responsibility remains with the State that originally approved the data*.

2.2 CERTIFICATION ELEMENTS

2.2.1 AIRWORTHINESS ELEMENT

A. The airworthiness element ensures that the aircraft meets the aircraft eligibility and safety requirements for the functions and performance defined in the navigation specifications (or other referenced certification standards) and the installation meets the relevant airworthiness standards.

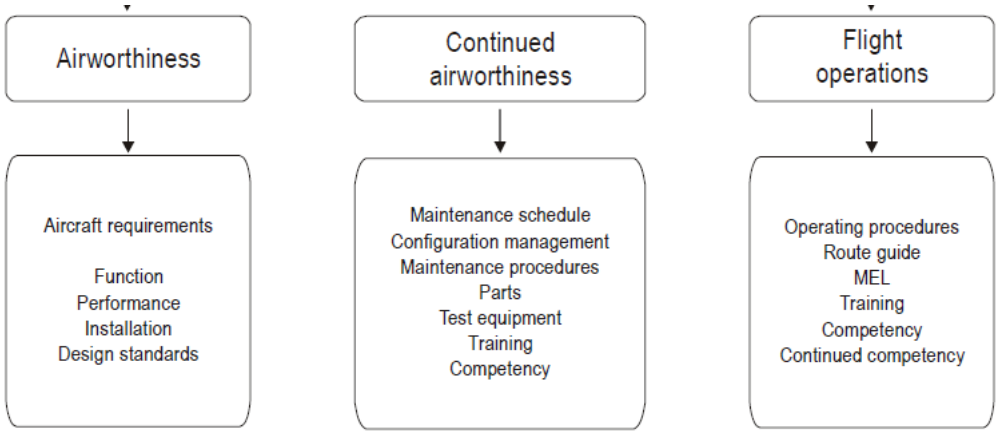
B. The continued airworthiness element of the operational approval is inherent in the aircraft airworthiness approval through the airworthiness requirements, but the operator is expected to be able to demonstrate that the navigation system will be maintained compliant with the type design.

- For navigation system installations there are few specific continued airworthiness requirements other than database and configuration management, systems modifications and software revisions.
- But the element is included for completeness and consistency with other CNS/ATM operational approvals, e.g. RVSM.

2.2.2 FLIGHT OPERATIONS ELEMENT

A. The flight operations element considers the operator's infrastructure for conducting PBN operations and flight crew operating procedures, training and competency demonstrations.

B. This element also considers the operator's MEL, operations manual, checklists, instrument flight procedure approval processes, navigation database validation procedures, dispatch procedures, etc.



SECTION 3 CERTIFICATION APPROVAL CONSIDERATIONS

A. The CAAV is responsible for the operational approval of the operator's navigation specifications for

- Vietnam AOC holders
- General aviation operators of Vietnam-registered aircraft.

B. The following general factors will be considered in a CAAV decision to require a formal operational approval process and specific documentation of approval—

- General aviation operators are required to may the same application outlined in this AC.
- The CAAV will then determine the required events for processing the approval and notify the operator.

1) The degree of linkage to the basis for aircraft/avionics certification, i.e. whether the aircraft, including its RNAV or RNP navigation system, has an airworthiness approval covering the type of envisaged PBN operations;

2) The complexity of the PBN operation and the level of associated challenges to operators and regulators;

3) The maturity of the related operational concept and systems and, specifically, whether the issues are well understood and relatively stable;

4) The risk associated with improper conduct of operations and operator-specific safety expectations, as well as those of third parties in the air and on the ground;

5) The availability of appropriate training, and checking standards and procedures for the respective type of PBN operations (mainly for pilots but also for maintenance and dispatcher personnel, as appropriate); and

6) The promulgation of information from holders of TCs to air operators (e.g. MMEL and training requirements) throughout the life cycle of the aircraft.

C. In order to facilitate expedited approvals for normal operations, provided all airworthiness and operational requirements are satisfied, the CAAV may allow the operator to “bundle” certain operations, particularly by flight phase, thereby allowing for leveraging of an operator's higher-level capabilities.

- The following table outlines in the green shaded area such a “bundle” of navigation specifications approvals—

<table>
<tr><th>Oceanic/Remote</th><th>Enroute</th><th>Terminal</th><th colspan="2">Approach</th></tr>
<tr><td>Advanced RNP</td><td>Advanced RNP</td><td>Advanced RNP</td><td>Advanced RNP</td><td>RNP AR ARCH</td></tr>
<tr><td>RNP 2</td><td>RNP 2</td><td>RNP 1</td><td colspan="2" rowspan="3">RNP APCH
Parts A and B</td></tr>
<tr><td>RNP 4</td><td>RNAV 1 and RNAV 2</td><td>RNAV 1 and RNAV 2</td></tr>
<tr><td>RNAV 10
designated RNP 10</td><td>RNAV 5</td><td></td></tr>
</table>

D. The preferred alternative, provided that the operator is capable of meeting all necessary requirements, is to initially approve the operator for a core set of navigation specifications (RNAV 5, RNAV 2, RNAV 1, RNP 2, RNP APCH) because—

These navigation specification have less operational risk because they are already in common use in the aviation community.

- Pilot knowledge and training is covered by instrument and type ratings;
- Operating and maintenance procedures are covered by the VARs, and
- Aircraft eligibility is documented in the AFM, TC or STC

The operator may complete all of these approvals under a single certification process provided all requirements are met.

E. Note that the CAAV does require a separate certification process for Oceanic/Remote RNP 10, RNP 4 and RNP AR ARCH approvals.

Where other nav specification approvals (such as RNP 2) can be accomplished during this certification process, the CAAV will consider including them as a "bundle."

3.1 MINIMUM OVERALL OPERATIONAL CONSIDERATIONS

The minimum operational approval assessment must take account of the following—

1) Aircraft eligibility and airworthiness compliance (any limitations, assumptions or specific procedures considered in the framework of the airworthiness approval must be addressed);
2) Operating procedures for the navigation systems used;
3) Control of operating procedures (documented in the operations manual);
4) Flight crew initial training and competency requirements and continuing competency requirements;
5) Dispatch training requirements; and
6) Control of navigation database procedures. Where a navigation database is required, operators need to have documented procedures for the management of such databases.
   - These procedures will define the sourcing of navigation data from approved suppliers, data validation procedures for navigation databases and the installation of updates to databases into aircraft so that the databases remain current with the AIRAC cycle.
   - For RNP AR applications, the control of the terrain database used by TAWS must also be addressed.)

3.2 MINIMUM AIRWORTHINESS CONSIDERATIONS

A. An aircraft is eligible for a particular PBN application provided there is clear statement in—
   1) The TC; or
   2) The STC; or
   3) The associated documentation - AFM or equivalent document; or
   4) A compliance statement from the manufacturer, which has been approved by the State of Design and accepted by the State of Registry or the State of the Operator, if different.

B. The operator must have a configuration list detailing the pertinent hardware and software components and equipment used for the PBN operation.

C. Possible aircraft eligibility approval scenarios—

Scenario	*Aircraft certification status*	*Actions by the operator/owner*
1	Aircraft designed and type-certificated for PBN application. Documented in the AFM, TC or STC.	No action required; aircraft eligible for PBN application.
2	Aircraft equipped for PBN application but not certified. No statement in the AFM. SB available from the aircraft manufacturer.	Obtain the SB (and associated amendment pages to the AFM) from the aircraft manufacturer.
3	Aircraft equipped for PBN application. No statement in the AFM. SB not available. Statement of compliance available from the aircraft manufacturer.	Establish if the statement of compliance is acceptable to the regulatory authority of the State of Registry of the aircraft.
4	Aircraft equipped for PBN application. No statement in the AFM. SB not available. Statement of compliance from the aircraft manufacturer not available.	Develop a detailed submission to the State of Registry showing how the existing aircraft equipment meets the PBN application requirements. OEM support should be solicited where possible.
5	Aircraft not equipped for PBN application.	Modify aircraft in accordance with the aircraft manufacturer's SB or develop a major modification in conjunction with an approved design organization in order to obtain an approval from the State of Registry (STC).

D. The TC is the approved standard for the production of a specified type/series of aircraft.

- The aircraft specification for that type/series, as part of the TC, will generally include a navigation standard.
- The aircraft documentation for that type/series will define the system use, operational limitations, equipment fitted and the maintenance practices and procedures.
- No changes (modifications) are permitted to an aircraft unless the CAA of the State of Registry either approves such changes through a modification approval process or STC, or accepts technical data defining a design change that has been approved by another State.

E. An alternate method of achieving the airworthiness approval of the aircraft for PBN operations is for the aircraft to be modified in accordance with approved data (e.g. STC, minor modification, FAA Form 8110-3).

F. One means of modifying an aircraft is the approved service bulletin (SB) issued by the aircraft manufacturer.

- The SB is a document approved by the State of Design to enable changes to the specified aircraft type, and the modification then becomes part of the type design of the aircraft. Its applicability will normally be restricted by airframe serial number.
- The SB describes the intention of the change and the work to be done to the aircraft.
- Any deviations from the SB require a design change approval; any deviations not approved will invalidate the SB approval.
- The State of Registry accepts the application of an SB and changes to the maintenance program, while the State of the Operator accepts changes to the maintenance program and approves changes to the MEL, training programs and operations specifications.
- An OEM SB may be obtained for current-production or out-of-production aircraft.

G. For recently manufactured aircraft, where the PBN capability is approved under the TC, there may be a statement in the AFM limitations section identifying the operations for which

the aircraft is approved. There is also usually a statement that the stated approval does not itself constitute an approval for an operator to conduct those operations.

H. In many cases for legacy aircraft, while the aircraft is capable of meeting all the airworthiness requirements of a PBN navigation specification, there may be no clear statement in the applicable TC or STC or associated documents (AFM or equivalent document).

- In such cases, the aircraft manufacturer may elect to issue an SB with an appropriate AFM update or instead may publish a compliance statement in the form of a letter, for simple changes, or a detailed aircraft-type-specific document for more complex changes.
- The State of Registry may determine that an AFM change is not required if it accepts the OEM documentation.

3.3 OPERATIONS

3.3.1 MINIMUM STANDARD OPERATING PROCEDURES

A. Standard operating procedures (SOPs) must be developed to cover both normal and non-normal (contingency) procedures for the systems used in the PBN operation. The SOPs must address—

1) Preflight planning requirements including the MEL and, where appropriate, RNP/RAIM prediction;

2) Actions to be taken prior to commencing the PBN operation;

3) Actions to be taken during the PBN operation; and

4) Actions to be taken in the event of a contingency, including the reporting to the operator and to the CAA of significant incidents such as—

- ♦ Navigation errors not associated with transitions from an inertial navigation mode to a radio navigation mode;
- ♦ Unexpected deviations in lateral or vertical flight path attributed to incorrect navigation data;
- ♦ Significant misleading information without failure warning;
- ♦ Total loss or multiple failures of the PBN navigation equipment; or
- ♦ Problems with ground navigation facilities leading to significant navigation errors.

B. When operating procedures contribute directly to the airworthiness demonstration (e.g. in RNP AR) they should be documented in the AFM or an equivalent document (e.g. FCOM) approved by the State of Registry.

General aviation pilots must ensure that they have suitable procedures/checklists, provided by the manufacturer, covering all these areas.

3.3.2 CONTROL OF OPERATING PROCEDURES

The SOPs must be adequately documented in the operations manual (OM) for commercial air operators and for general aviation operators of large or turbojet aircraft. For general aviation operators where an OM is not required, the PBN operating procedures must still be documented.

3.3.3 FLIGHT CREW & DISPATCH TRAINING & COMPETENCY

A flight crew training program and, if applicable, a dispatcher training program must cover all the tasks associated with the PBN operation as well as provide sufficient background to ensure a comprehensive understanding of all aspects of the operation.

3.3.4 CONTROL OF NAVIGATION DATABASE PROCEDURES

A. Navigation databases are required for all PBN navigation specifications except RNAV 10 and RNAV 5.

B. The procedures for maintaining currency, checking for errors and reporting errors to the navigation database supplier must be documented in the operations and maintenance manual.

Suppliers of the navigation data that comply with FAA AC 20-153 or have an LOA issued in accordance with EASA Opinion Nr. 01/2005 are considered acceptable without further evaluation.

3.3.5 PERFORMANCE RECORD

Navigation error reports should be recorded and analyzed to determine the need for any remedial action.

- Such action may involve the replacement of, or modifications to, the navigation equipment or changes to the operational procedures.
- All operator corrective action taken should be documented.

SECTION 4 OPERATIONAL APPROVAL PROCESS

4.1 GENERAL INTERNATIONAL REQUIREMENTS

4.1.1 COMPLETE CERTIFICATION REQUIREMENTS

Prior to operating a civil aircraft of Vietnam registry in airspace for which a must first—

1) Satisfactorily complete the process for granting of the proper authorizations;

2) Obtain CAAV-approval document for the specific aircraft or fleet.

4.1.2 CERTIFICATION EVALUATION REQUIRED

In making this certification evaluation, CAAV shall take into account the—

1) Type(s) of enroute and approach operations proposed;

2) Suitability of the aircraft, instruments and equipment for those operations;

3) Procedures for conformance with navigation specifications; and

4) Qualification of operator personnel for such operations

4.1.3 CRITERIA FOR GRANTING THE APPROVAL DOCUMENT

CAAV shall be satisfied that the—

1) The aircraft, instruments and equipment were designed and airworthiness-tested for the PBN operations proposed by the operator;

- The criteria specified in this paragraph will be applied after certification to all inspections involving PBN operations.
- Consistent satisfactory performance is absolutely necessary for continued PBN approval.

2) Operator has instituted appropriate procedures and training in respect to maintenance programs and practices necessary to ensure the continued airworthiness of the aircraft, instruments and equipment involved in the proposed PBN operations.

3) Operator has instituted adequate and appropriate operational procedures to ensure the safe accomplishment of the PBN operations;

4) Operator has ensured that all flight crew and flight dispatcher participants in the proposed PBN operations are trained and qualified; and

5) The operator has demonstrated that its personnel can conduct the PBN operations consistently and safely.

4.2 GENERAL VIETNAM REQUIREMENTS

4.2.1 CERTIFICATION PROCESS

While all certification proceeds through the same 5-phase process, whether is approval of a single document or a completely new airline, the lines between the phases do blur in a simple certification.

4.2.2 PRE-APPLICATION PHASE

A. It is prudent for the operator to submit a intent document (such as the POPS form). The CAAV will schedule a Pre-Application Meeting to discuss the submission of a complete formal application for the initial and additional PBN nav specification approvals.

B. During this meeting the CAAV will provide the operator the hard-copy and digital forms and documents and discuss their relevance to ensure a complete formal application. These documents will include—

1) AC 10-009 (PBN Certification)

2) Form 585A (PBN Application)

3) Form 585B (PBN Conformance Checklist)

4) Form 585C (Individual Aircraft PBN Conformance)

5) ICAO Doc 9613 (PBN Manual)

6) ICAO Doc 9997 (PBN Approval Manual)

A copy of these forms is provided in this AC in:
- Appendix B - Form 585A
- Appendix C - Form 585B
- Appendix D - Form 585C

- ICAO Doc 9997 contains a series of job aids which can be used in lieu of Forms 585A-B-C.to make apply for nav specification authorizations.
- These forms are keyed to ICAO SARPs, but the information they require is understood by the CAAV and will not cause a delay in processing the request.

C. The CAAV will also outline what other documents must be provided to have a “complete” application package for the PBN authorizations sought.

4.2.3 FORMAL APPLICATION REVIEW PHASE

When the formal application for the PBN authorization(s) is submitted, the CAAV will review the documents to ensure that all required documents are included. If the application package is complete, the CAAV will advise the operator that they are proceeding with the certification process. (If it is not, the entire application package will be returned.)

4.2.4 DOCUMENT EVALUATION PHASE

A. The CAAV will evaluate each document provided in the application package to ensure that all requirements for the requested PBN authorization(s) are met.

B. Document Evaluation Phase will be considered complete when all submitted documents have been—

1) Evaluated;

2) Found to be acceptable for use in aviation; and

3) Issued a formal instrument of approval or acceptance.

4.2.5 INSPECTION & DEMONSTRATION PHASE

A. The specific aircraft to be used will be inspected for PBN equipment capability and reliability.

B. Training-in-progress inspections of operations (flight crew and dispatcher) and maintenance training will be conducted, if applicable to the nav specification authorization sought.

C. The operator's ability to validation and maintain accurate navigation databases will be an emphasis item during the CAAV inspection and validation process.

D. If there is any doubt that the operator's personnel and equipment may not be capable of meeting the required navigation performance, the applicant may be issued an LOA to conduct PBN operations under the close supervision of a designated CAAV authorized person.

> Past performance of the operator's personnel with the PBN operations to meet the navigation specifications will be a key factor in the type of demonstration required when processing a new nav specification request.

E. The validation demonstration will be required for the issuance of an RNP-10 or RNP AR nav specification approval.

4.2.6 FINAL CAAV CERTIFICATION ACTIONS PHASE

A. This is the period of time that CAAV completes the necessary documentation to formalize the approval of the applicant for PBN approvals in specific aircraft type(s) and, if necessary, in specific airspace.

B. That approval will be in the form of—

1) For general aviation operators; an LOA valid for a period of 12 months; and

2) For AOC holders, a revision to the Aircraft Display operations specification (for each type of aircraft and authorized PBN nav specifications).

SECTION 5 CONTENTS OF FORMAL APPLICATION PACKAGE

5.1 GENERAL REQUIREMENTS

The following documents will be considered individually—

1) The completed PBN application form;

2) A completed PBN Conformance Checklist;

3) Schedule of events (if applicable)

4) Validation plan (if applicable)

> - The requirements for an SOE and Validation Plan will apply primarily to RNP-10, RNP-4 and RNP AR ARCH nav specifications.
> - These nav specs will be treated through separate 5-Phase certification processing by the CAAV.

5) Operations Manual-A (or revisions) that include PBN policies and procedures appropriate the desired navigation specification(s);

6) Operations Manual-C and navigation database particulars (if applicable) supporting the nav specifications sought;

7) Operations Manual-D (or revisions) that include flight crew and dispatcher training programs (curriculums) appropriate to the desired navigation specification(s);

8) Maintenance Control Manual (or revisions) that include general maintenance procedures related to aircraft PBN airworthiness and current status;

9) PBN maintenance training program (such as an MTM)

10) Summary of relevant past operating performance history (where available);

5.2 FOR AIRCRAFT TYPE

The following documents must be submitted for each aircraft type—

1) Description of aircraft Type Certificate data (or other acceptable document);
2) Operations Manual-B (or revisions) that include PBN standard operating procedures and limitations appropriate the desired navigation specification(s);
3) Aircraft type-specific PBN checklists including normal and non-normal (contingency) procedures;
4) Proposed Minimum Equipment List (MEL) revisions for PBN, if applicable; and
5) Current Master Minimum Equipment List (MMEL);
6) Aircraft and/or equipment maintenance procedures and program;
7) Manufacturer maintenance recommendations documents.

5.3 FOR INDIVIDUAL AIRCRAFT

The following documents must be submitted for each individual aircraft—

1) Completed copy of aircraft PBN conformity checklist;
2) AFM (or approved AFM supplement) demonstrating that aircraft is eligible for the desired PBN navigation specification(s);
3) If applicable, modification documents demonstrating that the aircraft is eligible for the desired PBN nav specs.

The CAAV will provided a copy of the Aircraft PBN Conformity Checklist during the Pre-Application Meeting.

5.4 FOR NAVIGATION EQUIPMENT

The following documents related to the specific PBN equipment required should be submitted with the application—

1) Maintenance Program with appropriate provisions for desired PBN navigation specification(s);
2) Database integrity procedures (may be in maintenance control manual); and
3) Database supplier subscription and approval.

5.5 AVAILABLE FOR CONSULTATION

The following documents (for each type of aircraft and equipment necessary for the PBN operations) must be available at the applicant's facilities for consultation—

1) Maintenance manuals;
2) Standard practices manuals; and
3) Illustrated parts catalogue.

- CAAV inspectors shall have unobstructed ability to refer to these documents.
- If this criteria is not met, copies of these manuals will be required to be submitted to the CAAV offices as a part of the application.

SECTION 6 AIRWORTHINESS CONSIDERATIONS

6.1 AIRWORTHINESS DEMONSTRATIONS

A. Airworthiness demonstration of aircraft equipment is usually accomplished in support of operational authorizations on a one-time basis at the time of Type Certification (TC) or Supplemental Type Certification (STC).

B. This demonstration is based upon the airworthiness criteria in place at that time.

C. The operating rules will continuously apply over time and may change after airworthiness demonstrations are conducted, or may be updated consistent with safety experience, additional operational credit or constraints may apply to operators or aircraft as necessary for safe operations.

D. The criteria related primarily to the airworthiness demonstration of systems or equipment is assumed through the proper validation of the data provided by the State of Design (or Manufacture) airworthiness demonstration.

Unless otherwise accepted by the CAAV, each aircraft should meet relevant criteria specified by the applicable aircraft manufacturer or avionics manufacturer for associated systems and equipment, such as

- Valid Type Certificated
- Appropriate STC records
- Compliance, assessment of status of any engineering orders, ADs, service bulletins or other compliance requirements.

6.2 CONTINUING AIRWORTHINESS/MAINTENANCE

6.2.1 MAINTENANCE PROGRAM

A. Unless otherwise approved by CAAV, each operator should have an approved maintenance program.

B. The approved maintenance program should include any necessary provisions to address the PBN navigation specification(s) in accordance with the operator's intended operation and the—

1) Manufacturers recommended maintenance program;

2) MRB requirements or equivalent requirements; or

3) Any subsequent Manufacturer, State of Design or CAAV designated requirements (e.g., ADs, mandatory service bulletins).

Emphasis should be on maintaining and ensuring total system performance, accuracy, availability, reliability, and integrity for the intended operations.

6.2.2 MAINTENANCE PROGRAM PROVISIONS

A. The maintenance program should be compatible with an operator's organization and ability to implement and supervise the program.

B. Maintenance personnel should be familiar with—

1) The operator's approved program;

2) Their individual responsibilities in accomplishing that program; and

3) The availability of any resources within or outside of the maintenance organization that maybe necessary to assure program effectiveness.

- ♦ Examples include getting applicable information related to the manufacturer's recommended maintenance program and getting information referenced in this AC such as service bulletin information).

C. Provision for PBN operations may be addressed as a specific program or may be integrated with the general maintenance program.

D. Regardless whether the maintenance program is integrated or is designated as a specific program for PBN, the maintenance program should at least address the following—

1) Maintenance procedures necessary to ensure continued airworthiness relative to PBN operations;

2) A procedure to revise and update the maintenance program;

3) A method to identify, record or designate personnel currently assigned responsibility in managing the program, performing the program, maintaining the program, or performing quality assurance for the program;

4) This includes identification of any service provider or sub-contractor organizations, or where applicable, their personnel;

5) Verification should be made of the PBN equipment, systems and configuration status for each aircraft brought into the maintenance or PBN program.

Unless otherwise accepted by the CAAV, each aircraft should meet relevant criteria specified by the applicable aircraft manufacturer or avionics manufacturer for associated systems and equipment.

6) Identification of modifications, additions, and changes which were made to qualify aircraft systems for the intended operation or minima, if other than as specified in the AFM, TC or STC.

7) Identification of additional maintenance requirements and log entries necessary to change PBN equipment status;

8) Any discrepancy reporting procedures that may be unique to the PBN program.

- If applicable, such procedures should be compatibly described in maintenance documents and operations documents;

9) Procedures which identify, monitor and report PBN system and component discrepancies for the purpose of quality control and analysis;

10) Procedures which define, monitor and report chronic and repetitive discrepancies;

11) Procedures which ensure aircraft remain out of PBN status until successful corrective action has been verified for chronic and repetitive discrepancies;

12) Procedures which ensure the aircraft system status is placarded properly and clearly documented in the aircraft log book, in coordination with maintenance control, engineering, flight operations, and dispatch, or equivalent;

13) Procedures to ensure the downgrade of an aircraft PBN capability status, if applicable, when maintenance has been performed by persons other than those trained, qualified, or authorized to use or approve procedures related to PBN operations;

14) Procedures for periodic maintenance of systems ground check, and systems flight check, as applicable;

- For example, following a heavy maintenance, suitable checks may need to be performed prior to maintenance release.

15) Provision should be made for periodic operational sampling of suitable performance.

At least one satisfactory operation under each approved specific nav spec should have been accomplished within a specified period approved for that operator, unless a satisfactory systems ground check has been accomplished.

- A recording procedure for both satisfactory and unsatisfactory results should be included.
- Fleet sampling is not generally acceptable in lieu of specific aircraft assessment.
- At least one satisfactory low visibility system operational use, or a satisfactory systems ground check, should be accomplished within 30 days, for an aircraft to remain in the desired PBN status.

6.3 INITIAL & CONTINUING MAINTENANCE TRAINING

A. Operator and contract maintenance personnel should receive initial and continuing training as necessary for an effective program, including—

1) Mechanics;
2) Maintenance controllers;
3) Avionics technicians;
4) Personnel performing maintenance inspection or quality assurance; and
5) Other engineering personnel if applicable.

B. The training curriculum should include specific aircraft systems and operator policies and procedures applicable to PBN operations.

6.3.1 CONTINUING TRAINING

A. Continuing training should be accomplished—

1) At least annually; and
2) When a person has not been involved in the maintenance of the specified aircraft or systems for an extended period of more than 6 months.

The CAAV recommends that the operator provide a special certification of maintenance personnel for PBN duties.

B. The training should at least include, as applicable—

1) An initial and recurrent training program for appropriate operator and contract personnel;
2) Personnel considered to be included are maintenance personnel, quality and reliability groups, maintenance control, and incoming inspection and stores, or equivalent organizations.
3) Training should include both classroom and at least some “hands-on” aircraft training for those personnel who are assigned aircraft maintenance duties. Otherwise, training may be performed—
   - In a classroom
   - By computer based training
   - In simulators
   - in an airplane or in any other effective combination of the above
   - consistent with the approved program, and considered acceptable to CAAV.
4) Subject areas for training should include—
   - Operational concepts
   - Aircraft types and systems affected
   - Aircraft variants and differences where applicable
   - Procedures to be used;
   - Manual or technical reference availability and use

- Processes, tools or test equipment to be used
- Quality control
- Methods for testing and maintenance release
- Sign-offs required
- Proper Minimum Equipment List (MEL) application
- General information about where to get technical assistance as necessary,
- Necessary coordination with other parts of the operator's organization (e.g., flight operations, dispatch), and
- Any other maintenance program requirements unique to the operator or the aircraft types or variants flown (e.g., human factors considerations, problem reporting)

5) Procedures for the use of outside vendors or vendor's parts that ensures compatibility to program requirements and for establishing measures to control and account for parts overall quality assurance

6) Procedures to ensure tracking and control of components that are "swapped" between systems for trouble shooting when systems discrepancies can not be duplicated.

These procedures should provide for total system testing and/or removal of aircraft from PBN status.

7) Procedures to assess, track and control the accomplishment of changes to components or systems pertinent to low visibility operations
   - For example, ADs, service bulletins, engineering orders, VAR requirements

8) Procedures to record and report PBN operation(s) that are discontinued/ interrupted because of system(s) malfunction

9) Procedures to install, evaluate, control, and test system and component software changes, updates, or periodic updates

10) Procedures related to the MEL remarks section use which identify PBN related systems and components, specifying limitations, upgrading and downgrading

11) Procedures for identifying PBN related components and systems as "RII" items, to provide quality assurance whether performed in-house or by contract vendors.

6.4 TEST EQUIPMENT/CALIBRATION STANDARDS

A. Test equipment may require periodic re-evaluation to ensure it has the required accuracy and reliability to return systems and components to service following maintenance.

- It is the operator's responsibility to ensure these standards are adhered to by contract maintenance organizations.
- Traceability to a national standard or the manufacturer's calibration standards should be maintained.

B. A listing of primary and secondary standards used to maintain test equipment which relate to PBN operations should be maintained.

6.5 MAINTENANCE RELEASE PROCEDURES

A. Procedures should be included to upgrade or downgrade systems status concerning PBN operations capability.

B. The appropriate level of testing should be specified for each component or system.

> The method for controlling operational status of the aircraft should ensure that flight crews, maintenance and inspection departments, dispatch and other administrative personnel as necessary are appropriately aware of aircraft and system status.

C. The manufacturer's recommended maintenance program or maintenance instructions should be considered when determining the role built-in-test-equipment (BITE) should play for return to service (RTS) procedures or for use as a method for PBN status upgrade or downgrade.

D. Contract facilities or personnel should follow the operator's CAAV-approved maintenance program to approve an aircraft for maintenance release.

> The operator is responsible for ensuring that contract organizations and personnel are appropriately trained, qualified, and authorized.

6.6 PERIODIC AIRCRAFT SYSTEM EVALUATIONS

A. The operator should provide a method to continuously assess or periodically evaluate aircraft system performance to ensure satisfactory operation for those systems applicable to PBN operations.

- An acceptable method for assuring satisfactory performance of a low visibility flight guidance system (e.g., autoland or HUD) is to periodically use the system and note satisfactory performance.

> Use of the flight guidance/automatic landing system by the flight crews should be encouraged to assist in maintaining its availability and reliability.

B. Periodic flight guidance system/autopilot system checks should be conducted in accordance with—

- Procedures recommended by the airframe or avionics manufacturer; or
- An alternate procedure approved by the CAAV.

C. For periodic assessment, a record should be established to show—

1) When and where the flight guidance/autopilot system was satisfactorily used, and

2) If performance was not satisfactory, to describe any remedial action taken.

> A record of that check such as a logbook entry or computer ACARS record showing satisfactory performance within the previous—
> - 6 months for RNP 10, or
> - 30 days for RNP AR APRCH.

6.7 CONFIGURATION CONTROL/SYSTEM MODIFICATIONS

A. The operator should ensure that any modification to systems and components approved for low visibility operations are not adversely affected when incorporating software changes, service bulletins, hardware additions or modifications.

B. Any changes to system components should be consistent with the aircraft manufacturer's, avionics manufacturer's, industry or CAAV accepted criteria or processes

6.8 RECORDS

A. The operator should keep suitable records (e.g., both the operator's own records and access to records of any applicable contract maintenance organization).

These records ensure that both the operator and CAAV can determine the appropriate airworthiness configuration and status of each aircraft intended for PBN operation.

B. Contract maintenance organizations should have appropriate records and instructions for coordination of records with the operator.

6.9 AIRWORTHINESS APPROVAL PROCESS

A. The Airworthiness approval process assures that each item of the RNAV equipment installed is of a kind and design appropriate to its intended function and that the installation functions properly under foreseeable operating conditions.

B. Additionally, the airworthiness approval process identifies any installation limitations that need to be considered for operational approval.

- Such limitations and other information relevant to the approval of the RNAV system installation are documented in the AFM, or AFM Supplement as applicable.

C. Information may also be repeated and expanded upon in other documents such as Pilot Operating Handbooks (POHs) or Flight Crew Operating Manuals (FCOMs).

6.10 APPROVAL OF RNAV SYSTEMS FOR RNAV-X OPERATION

A. The RNAV system installed should be compliant with a set of basic performance requirements described in the “navigation specification” which defines accuracy, integrity and continuity criteria.

B. The RNAV system installed should be compliant with a set of specific functional requirements described in the navigation specification.

C. For a multi-sensor RNAV system, an assessment should be conducted to establish which sensors are compliant with the performance requirement described in the navigation specification.

D. The RNAV system installed should have a navigation data base and should support each specific path terminator as required by the navigation specification.

For certain RNAV navigation applications, a navigation data base may be optional

E. The navigation specification generally indicates if a single or a dual installation is necessary to fulfil availability and/or continuity requirements.

- The Airspace Concept and Navaid infrastructure are key elements to decide if single or dual installation is necessary.

6.11 APPROVAL OF RNP SYSTEMS FOR RNP-X OPERATION

A. The RNP system installed should be compliant with a set of basic RNP performance requirement described in the navigation specification.

The RNP system should include an on board performance monitoring and alerting function.

B. The RNP system installed should be compliant with a set of specific functional requirement described in the navigation specification.

C. For a multi-sensor RNP system, an assessment should be conducted to establish sensors which are compliant with the RNP performance requirement described in the RNP specification.

D. The RNP system installed should have a navigation data base and should support path terminator as required by the navigation specification

SECTION 7 OPERATIONAL APPROVAL

A. The aircraft must be equipped with an RNAV system enabling the flight crew to navigate in accordance with operational criteria defined in the navigation specification.

B. The authority must be satisfied that operational programs are adequate.

C. Training programs and operations manuals should be evaluated.

7.1 GENERAL RNAV APPROVAL PROCESS

A. The operational approval process assumes first that the corresponding installation/ airworthiness approval has been granted.

B. During operation, the crew should respect AFM and AFM supplements limitations.

C. Normal procedures are provided in the navigation specification and detailed necessary crew action to be conducted during pre-flight planning, prior to commencing the procedure and during the procedure.

D. Abnormal procedures are provided in the navigation specification.

- These procedures should detail crew action in case of on-board RNAV system failure and in case of system inability to maintain the prescribed performance of the on board monitoring and alerting function.

E. The operator should have in place a system for investigation events of affecting the safety of operations to determine its origin (coded procedure, accuracy problem, etc)

F. Minimum equipment list (MEL) should identify the minimum equipment necessary to satisfy the navigation application

7.2 FLIGHT CREW TRAINING

Each pilot must receive appropriate training, briefing and guidance material in order to safely conduct the operation.

7.3 NAVIGATION DATABASE MANAGEMENT

Any specific requirement regarding the navigation data base should be provided in the navigation specification particularly if the navigation data base integrity should demonstrate compliance with DO 200A/EUROCAE ED 76 (data quality assurance process).

The demonstration required by this paragraph may be documented with a Letter of Acceptance (LOA), or other equivalent means acceptable to the CAAV.

SECTION 8 OPERATIONAL PROCEDURES

8.1 OPERATIONAL PROCEDURES

A. Appropriate operational procedures based on the approved operator program should be addressed.

Suitable operational procedures must be used by the operator and be used by flight crews prior to conducting PBN operations.

B. Operational procedures should consider the—

1) Pilot qualification and training program;

2) Airplane flight manual;

3) Crew coordination procedures;

4) Monitoring.

8.2 FLIGHT CREW PROCEDURES

A. Flight crew procedures should complement the technical contents of the navigation specification.

B. Flight crew procedures are usually embodied in the company operating manual.

C. These procedures could include, for example, that the flight crew notify ATC of contingencies (equipment failures, weather conditions) that affect the aircraft's ability to maintain navigation accuracy.

D. These procedures would also require the flight crew to state their intentions, coordinate a plan of action and obtain a revised ATC clearance in such instances.

E. Depending on the defined airspace, contingency procedures have been established to permit the flight crew to follow such established procedures in the event that it is not possible to notify ATC of their difficulties.

8.3 APPLICATION OF AFM PROVISIONS

A. The operator's procedures for PBN operations should be consistent with any AFM provisions specified in the normal or non-normal procedures sections during airworthiness demonstrations.

- Adjustments of procedures consistent with operator requirements are permitted when approved by the POI.

B. Operators should assure that no adjustments to procedures are made which invalidate the applicability of the original airworthiness demonstration.

C. Where navigation performance for a specific RNP can only be achieved by specific system modes (e.g.,coupled flight director or autopilot), the specific modes and associated RNP levels should be applied consistent with the AFM.

If not available in the AFM or Flight Crew Operating Manual (FCOM), RNP operations may be approved on a case by case basis, consistent with "fleet qualification" for RNP criteria.

D. Where operations are based on RNP, suitable flight manual provisions for RNP capability and uses should be provided.

8.4 CREW COORDINATION

A. Appropriate procedures for crew coordination should be established so that each flight crew member can carry out their assigned responsibilities.

B. Briefings prior to the applicable takeoff or approach should be specified to assure appropriate and necessary crew communications.

C. Responsibilities and assignment of tasks should be clearly understood by crew members.

8.5 MONITORING

A. Operators should establish appropriate monitoring procedures for each type of PBN operation.

B. Procedures should assure that adequate crew attention can be devoted to—

- Control of aircraft flight path
- Displacements from intended path
- Mode annunciations

SECTION 9 GENERAL CERTIFICATION GUIDANCE FOR SPECIFIC NAV SPECS

This Section provides applicable references and generic guidance that will be considered by the CAAV and should be considered in the operator's application.r

9.1 RNAV 10

9.1.1 GENERAL

A. RNAV 10 supports a 50 NM lateral and 50 NM longitudinal distance-based separation minima in oceanic or remote area airspace.

- Prior to the development of the PBN concept, RNAV 10 operations were authorized as RNP 10 operations.
- An RNAV 10 operational approval does not change any requirement nor does it affect operators that have already obtained an RNP 10 approval.

B. RNP 10 was developed and implemented at a time when the delineation between RNAV and RNP had not been clearly defined.

- Because the requirements for RNP 10 did not include a requirement for on-board performance monitoring and alerting,
- RNP 10 is more correctly described as an RNAV operation and hence is included in the PBN manual as RNAV 10.

C. Recognizing that airspace, routes, airworthiness and operational approvals have been designated as RNP 10, further declaration of airspace, routes, and aircraft and operator approvals may continue to use the term RNP 10, while the application in the PBN manual will be known as RNAV 10.

9.1.2 SYSTEM REQUIREMENTS

A. RNAV 10 is intended for use in oceanic and remote areas, and the navigation specification is based on the use of long range navigation systems (LRNS).

- The aircraft requirements are detailed in the PBN manual (Doc 9613), Volume II, Part B, Chapter 1, 1.3.4.

9.1.3 OPERATING PROCEDURES

The operating procedures are addressed in the PBN manual (Doc 9613), Volume II, Part B, Chapter 1, 1.3.5. The standard operating procedures adopted by operators flying on oceanic and remote routes should normally be generally consistent with RNAV 10 operations, although some additional provisions may need to be included. A review of the operator's procedure documentation against the requirements of the PBN manual and the (State) regulatory requirements should be sufficient to ensure compliance.

9.1.4 PILOT KNOWLEDGE & TRAINING

A. Pilot knowledge and training requirements are detailed in the PBN manual (Doc 9613), Volume II, Part B, Chapter 1, 1.3.10.

- Flight crews should possess the necessary skills to conduct RNAV 10 operations with minimal additional training.

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

9.2 RNAV 5

9.2.1 GENERAL

A. RNAV 5 supports continental en-route operations using a range of different positioning sensors. Prior to the introduction of PBN, basic RNAV (B-RNAV) was introduced in Europe and the Middle East. The RNAV 5 requirements are based upon B-RNAV, and any B-RNAV approval meets the requirements of RNAV 5 without further examination.

B. RNAV 5 is intended for en-route navigation where not all the airspace users are equipped with GNSS and where there is adequate coverage of ground-based radio navigation aids permitting DME/DME or VOR/DME area navigation operations.

C. An RNAV 5 route is dependent upon an analysis of the supporting NAVAID infrastructure. This analysis is the responsibility of the air navigation service provider.

9.2.2 SYSTEM REQUIREMENTS

The aircraft requirements are detailed in the PBN manual (Doc 9613), Volume II, Part B, Chapter 2, 2.3.3.

9.2.3 OPERATING PROCEDURES

The operating procedures are addressed in the PBN manual (Doc 9613), Volume II, Part B, Chapter 2, 2.3.4. Normal area navigation operating procedures will usually meet the requirements of RNAV 5.

9.2.4 PILOT KNOWLEDGE & TRAINING

A. The pilot knowledge and training requirements are detailed in the PBN manual (Doc 9613), Volume II, Part B, Chapter 2, 2.3.5.

- Flight crews should possess the necessary skills to conduct RNAV 5 operations with minimal additional training.

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

9.2.5 OPERATIONAL APPROVAL

A. The operational approval process for RNAV 5 is generally straightforward, given that most aircraft are equipped with area navigation systems which exceed the minimum requirements for RNAV 5.

B. In most cases the AFM will document RNAV 5 capability; failing that, many OEMs have issued statements of compliance and only occasionally will it be necessary to conduct an evaluation of aircraft capability.

C. With the exception of an amendment to the operations manual, The CAAV may decide that there is no further requirement for any additional documentation of RNAV 5 approval.

9.3 RNAV 1 & RNAV 2

9.3.1 GENERAL

A. RNAV 1 and RNAV 2 use GNSS or DME/DME positioning and support operations on—

1) ATS routes (continental en-route);

2) Standard instrument departures and arrivals (SIDs/STARs); and

3) Instrument approach procedures up to the final approach fix (FAF)/final approach point (FAP).

B. Because RNAV 1 and RNAV 2 operations can be based on DME/DME or DME/DME IRU, the NAVAID infrastructure must be assessed to ensure adequate DME coverage. This is the responsibility of the ANSP and is not part of the operational approval.

C. A single RNAV 1 and RNAV 2 approval is issued. An operator with an RNAV 1 and RNAV 2 approval is qualified to operate on both RNAV 1 and RNAV 2 routes. RNAV 2 routes may be promulgated in cases where the NAVAID infrastructure is unable to meet the accuracy requirements for RNAV 1.

9.3.2 SYSTEM REQUIREMENTS

A. The aircraft requirements are detailed in the PBN manual (Doc 9613), Volume II, Part B, Chapter 3, 3.3.3.

B. Aircraft equipped with stand-alone GNSS navigation systems should have track guidance provided via a CDI or HSI (a navigation map display may also be used for RNAV 2 routes). A lateral deviation display is often incorporated in the unit, but is commonly not of sufficient size or suitable position to allow either pilot to manoeuvre and adequately monitor cross-track deviation.

C. Caution should be exercised in regard to the limitations of stand-alone GNSS systems with respect to ARINC 424 path terminators. Path terminators involving an altitude termination are not normally supported due to a lack of integration of the lateral navigation system and the altimetry system.

- For example, a departure procedure commonly specifies a course after take-off until reaching a specified altitude (CA path terminator).

D. Using a basic GNSS navigation system it is necessary for the flight crew to manually terminate the leg on reaching the specified altitude and then navigate to the next waypoint, ensuring that the flight path is consistent with the departure procedure.

- This type of limitation does not preclude operational approval (as stated in the PBN manual functional requirements) provided the operator's procedures and crew training are adequate to ensure that the intended flight path and other requirements can be met for all SID and STAR procedures.

9.3.3 OPERATING PROCEDURES

The operating procedures are addressed in the PBN manual (Doc 9613), Volume II, Part B, Chapter 3, 3.3.4.

- Operators with en-route area navigation experience will generally meet the basic requirements of RNAV 1 and RNAV 2, and the operational approval should focus on procedures associated with SIDs and STARs.

9.3.4 PILOT KNOWLEDGE & TRAINING

A. The pilot knowledge and training requirements are detailed in the PBN manual (Doc 9613), Volume II, Part B, Chapter 3,

B. Most crews will already have some experience with area navigation operations, and much of the knowledge and training will have been covered in past training.

- Particular attention should be placed on the application of this knowledge to the execution of RNAV 1 and RNAV 2 SIDs and STARs, including connection with the en-route structure and transition to final approach.
- This requires a thorough understanding of the airborne equipment and its functionality and management.

9.4 RNP 4

9.4.1 GENERAL

RNP 4 supports 30 NM lateral and 30 NM longitudinal distance-based separation minima in oceanic or remote area airspace.

- Operators holding an existing RNP 4 operational approval do not need to be re-examined because the navigation specification is based upon U.S. FAA Order 8400.33.

9.4.2 SYSTEM REQUIREMENTS

The aircraft requirements are detailed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 1, 1.3.3.

9.4.3 OPERATING PROCEDURES

The operating procedures are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 1, 1.3.4.

- Some additional provisions may need to be added to the standard operating procedures to specifically address RNP 4 operations.

9.4.4 PILOT KNOWLEDGE & TRAINING

A. The pilot knowledge and training requirements are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 1, 1.3.5.

- Flight crews should possess the necessary skills to conduct RNP 4 operations with minimal additional training.

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

9.5 RNP 2

9.5.1 GENERAL

RNP 2 is intended to support en-route applications in oceanic, remote and continental airspace. The continuity requirements for continental applications are lower than those for oceanic/remote applications.

9.5.2 AIRCRAFT REQUIREMENTS

The aircraft requirements are detailed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 2, 2.3.3.

- The requirements for RNP 2 applications in oceanic/remote airspace are different to those for en-route continental airspace.
- In particular, oceanic/remote applications have a more strict continuity requirement which usually necessitates at least two long-range navigation systems.

9.5.3 OPERATING PROCEDURES

A. The operating procedures are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 2,

- Some additional provisions may need to be added to the standard operating procedures to specifically address RNP 2 operations.

B. A review of the operator's procedure documentation against the requirements of the PBN manual (Doc 9613) and VARs should be sufficient to ensure compliance.

9.5.4 PILOT KNOWLEDGE & TRAINING

A. The pilot knowledge and training requirements are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 2, 2.3.5.

- Flight crews should possess the necessary skills to conduct RNP 2 operations with minimal additional training.

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

9.5.5 OCEANIC/REMOTE REQUIREMENTS

A. Navigation equipage for oceanic/remote continental RNP 2 operations will require dual independent GPS long-range navigation systems with FDE to meet the continuity requirement.

B. Integration of positioning data from other sensors may be allowed provided that this does not cause the TSE to be exceeded.

- Manual entry/creation of waypoints using latitude and longitude values should be permitted to support flexible track ATS systems.

9.6 RNP 1

9.6.1 GENERAL

A. RNP 1 is intended to support arrival and departure procedures using GNSS positioning only.

B. Other than the sole requirement for GNSS there is no significant difference between the RNAV 1/RNAV 2 specification and RNP 1.

9.6.2 SYSTEM REQUIREMENTS

The aircraft requirements are detailed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 3, 3.3.3.

9.6.3 OPERATING PROCEDURES

The operating procedures are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 3, 3.3.4.

9.6.4 PILOT KNOWLEDGE & TRAINING

A. The pilot knowledge and training requirements are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 3, 3.3.5.

- Flight crews should possess the necessary skills to conduct RNP 1 operations with minimal additional training.

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

9.7 RNP APCH

9.7.1 GENERAL

A. RNP APCH is the general designator for PBN approach procedures that are not authorization required operations.

B. GNSS is used for all RNP APCH applications as follows—

- RNP APCH - LNAV - lateral positioning with GNSS (basic constellation);
- RNP APCH - LNAV/VNAV - lateral positioning with GNSS, vertical positioning with barometric inputs;
- RNP APCH - LPV - lateral and vertical positioning with SBAS;
- RNP APCH - LP - lateral positioning with SBAS.

C. The published RNP APCH OCA/H are treated as—

- MDA/H for LNAV and LP minima;
- MDA/H for LNAV/VNAV and LPV minima.

D. Operators currently approved to conduct RNAV(GNSS) approaches should qualify for RNP APCH - LNAV without further examination.

9.7.2 SYSTEM REQUIREMENTS

A. The aircraft requirements for RNP APCH to LNAV minima are detailed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 5, Section A, 5.3.3.

B. The aircraft requirements for RNP APCH to LNAV/VNAV minima are detailed in the PBN manual (Doc 613), Volume II, Part C, Chapter 5, Section A, 5.3.3, and Attachment A, 4.3.

C. The aircraft requirements for RNP APCH to LP and LPV minima are detailed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 5, Section B, 5.3.3.

9.7.3 OPERATING PROCEDURES

A. The operating procedures for RNP APCH to LNAV minima are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 5, Section A, 5.3.4.

B. The operating procedures for RNP APCH to LNAV/VNAV minima are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 5, Section A, 5.3.4, and Attachment A, 4.17.

C. The operating procedures for RNP APCH to LP and LPV minima are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 5, Section B, 5.3.4.

9.7.4 FLIGHT CREW KNOWLEDGE & TRAINING

A. The pilot knowledge and training requirements for RNP APCH to LNAV minima are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 5, Section A, 5.3.5.

B. The pilot knowledge and training requirements for RNP APCH to LNAV/VNAV minima are detailed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 5, Section A, 5.3.5, and Attachment A, 4.21.

C. The pilot knowledge and training requirements for RNP APCH to LP and LPV minima are detailed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 5, Section B, 5.3.5.

D. Successful RNP APCH operations depend on sound flight crew knowledge and training. The type of navigation system has a significant effect on the conduct of this type of procedure, and flight training must take this factor into account.

- Crews operating aircraft equipped with basic stand-alone systems typically require significantly more flight training than crews operating FMS-equipped aircraft.
- The amount of training will vary depending on the flight crew's previous area navigation experience.

9.7.5 NAVIGATION DATABASE

A. RNP APCH operations are critically dependent on valid data.

B. Although the navigation database should be obtained from a qualified source, operators must also have procedures in place for the management of data.

- Experienced area navigation operators who understand the importance of reliable data will normally have such procedures established; however less experienced operators may not fully understand the need for comprehensive management procedures and may need to develop or improve existing procedures.

C. It should be noted that despite the requirement for the database supplier to comply with RTCA DO-200A/EUROCAE ED-76, data errors will still occur.

9.8 RNP 0.3

9.8.1 GENERAL

RNP 0.3 is primarily intended to support helicopter operations - en-route, arrivals, departures and approaches.

- However, it does not exclude fixed wing operations where the demonstrated performance is sufficient to meet the functional and accuracy requirements for all phases of flight.

9.8.2 SYSTEM REQUIREMENTS

The aircraft requirements are detailed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 7, 7.3.3.

9.8.3 OPERATING PROCEDURES

The operating procedures are addressed in the PBN manual (Doc 9613) Volume II, Part C, Chapter 7, 7.3.4.

- Some additional provisions may need to be added to the standard operating procedures to specifically address RNP 0.3 operations.

9.8.4 PILOT KNOWLEDGE & TRAINING

A. The pilot knowledge and training requirements are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 7, 7.3.5.

- Flight crews should possess the necessary skills to conduct RNP 0.3 operations with minimal additional training.

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

9.8.5 ADVANCED RNP (A-RNP)

9.8.6 GENERAL

A. A-RNP is intended to support operations in oceanic airspace and en-route continental airspace, on SIDs, on STARs and on approaches.

B. It is intended to provide a single assessment of aircraft eligibility covering a range of accuracy requirements across all phases of flight. It incorporates RNAV 5, RNAV 2, RNAV 1, RNP 2, RNP 1 and RNP APCH (A and/or B).

- Fixed radius turn functionality within terminal airspace (RF) is a requirement while fixed radius turn functionality in the en-route (FRT) is an option.
- RNP scalability, time of arrival control (TOAC) and Baro-VNAV functionalities are all optional. Higher continuity requirements are applied for RNP 2 in oceanic/remote airspace.
- The navigation specification does not specifically address the oceanic and remote applications RNAV 10 and RNP 4, and an operator would need to obtain separate approval before operating with an A-RNP approved aircraft in such airspace.
- It is not anticipated that this additional application will represent a significant burden to the operator particularly if the aircraft already meets the RNP 2 oceanic criteria.

9.8.7 AIRCRAFT REQUIREMENTS

The aircraft requirements are detailed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 4, 4.3.3 and Appendices 1, 2 and 3 to Part C.

- An aircraft approved for A-RNP will meet the requirements of all the above-mentioned navigation specifications.

9.8.8 OPERATING PROCEDURES

The operating procedures are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 4, 4.3.4.

- Some additional provisions may need to be added to the standard operating procedures to specifically address A-RNP operations.

9.8.9 PILOT KNOWLEDGE & TRAINING

A. The pilot knowledge and training requirements are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 4, 4.3.6.

- Flight crews should possess the necessary skills to conduct A-RNP operations with minimal additional training.

B. Where additional training is required, this can normally be achieved by bulletin, computer-based training or classroom briefing.

- Flight training is not normally required.

9.9 RNP AR

9.9.1 GENERAL

A. RNP AR APCH is the designator for PBN approach procedures that require additional levels of scrutiny, control and authorization.

- RNP AR APCH applications can range from simple straight-in approaches, with a minimum track-keeping accuracy requirement of RNP 0.3 in final approach and RNP 1 at all other times, to complex curved approaches with RF legs used in the final and the missed approach and minimum track-keeping accuracies as low as RNP 0.1.
- Moreover, in addition to the RNP AR APCH procedures designed according to the Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual (Doc 9905), there are a number of RNP AR APCH procedures in commercial use which have been designed according to private, proprietary criteria.

B. GNSS, an inertial reference system and a VNAV system are required for all RNP AR APCH applications.

- DME/DME updating may be used as a reversionary system if the required navigation accuracy can be maintained in a specific operation, although explicit authorization is required. VOR updating shall not be used.

9.9.2 SYSTEM REQUIREMENTS

The aircraft requirements are detailed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 6, 6.3.3.

9.9.3 RNP AR APCH OPERATIONS

The operating procedures are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 6, 6.3.4.

- Most manufacturers have developed recommended procedures for RNP AR APCH procedures. Although the manufacturer's recommendations should be followed, the operational approval should include an independent evaluation of the operator's proposed procedures.
- RNP AR APCH operating procedures should be consistent with the operator's normal procedures where possible in order to minimize any human factors elements associated with the introduction of PBN operations.

9.9.4 FLIGHT CREW KNOWLEDGE & TRAINING

A. The pilot knowledge and training requirements are addressed in the PBN manual (Doc 9613), Volume II, Part C, Chapter 6, 6.3.5. RNP AR APCH operations depend on sound flight crew knowledge and training.

B. The type of navigation system has a significant effect on the conduct of this type of procedure, and flight training must take this factor into account.

- The amount of training will vary depending on the flight crew's previous area navigation experience; however the following is provided as a guide.

9.9.5 GROUND TRAINING

Ground training including computer-based training and classroom briefings shall include all required elements of the syllabus detailed in the PBN manual.

9.9.6 SIMULATOR TRAINING

Briefings and simulator sessions should cover all elements of the intended operation or the minimum number of approaches stipulated in the PBN manual.

- Proficiency may be achieved in normal uncomplicated operations in a short period of time; however, additional flight time needs to be scheduled to ensure competency in the management of approach changes, go-around, holding and other functions, including due consideration of human factors.
- Where necessary, initial training should be supplemented by operational experience in VMC or under supervision.
- The minimum functionality of the flight simulation training device used for RNP AR APCH simulator training is listed in Appendix F to this AC.

9.9.7 NAVIGATION DATABASE

A. RNP AR APCH operations are critically dependent on valid data.

B. Any RNP AR APCH in the database must first be validated formally by the operator by—:

1) Comparing the data in the database with the procedure published on the chart;

2) Flying the entire procedure either in a simulator or in the actual aircraft in VMC to ensure that there is complete consistency and there are no disconnects;

3) Comparing subsequent database updates with the validated master to ensure that there are no discrepancies.

C. The navigation database shall be obtained from a qualified source, and operators must also have procedures in place for the management of data.

D. Even qualified database suppliers who comply with RTCA DO-200A/EUROCAE ED/76 cannot guarantee that the databases will be error-free.

- Operators must have procedures in place to ensure, for every AIRAC, that the RNP AR procedure in the database is exactly the same as the RNP AR procedure that was initially validated.

9.9.8 TAWS DATABASE

The procedure validation process should include a compatibility check with the installed TAWS. The TAWS data should only be obtained from a qualified source and operators should have procedures in place for the management of the TAWS data.

9.9.9 SAFETY ASSESSMENTS

A. The RNP AR procedure design criteria in Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual (Doc 9905) assume that any event leading the aircraft to exit the lateral (2 x RNP) or vertical (VEB) extent of the obstacle clearance volume may have hazardous repercussions.

B. In order to ensure that the TLS of the intended operation is met, the acceptability of the repercussions of aircraft failures with respect to the RNP AR application must be addressed (PBN manual, Volume II, RNP AR navigation specifications, 6.3.3.2.7 and 6.3.3.4.1.2.).

C. Demonstration of compliance with those requirements may be part of the aircraft qualification criteria assessed during the airworthiness approval or may be the subject of a demonstration as part of the operational approval.

D. Whatever the methodology followed, operational approval stakeholders should ensure that the aircraft compliance documented in the airworthiness approval or the demonstrated compliance performed during the operational approval properly satisfies the 10-7 RNP AR lateral and vertical airspace containment limits.

E. The applicant should demonstrate that any contingency procedures and operational limitations used to satisfy this objective are well understood and are applied by the applicant's flight crews.

- Furthermore, when States have decided to implement a "State-wide" RNP AR operational approval process, stakeholders should ensure that any demonstration is representative and is applicable to all public RNP AR procedures, including the most challenging ones.

F. The CAA should ensure that a clear statement is available from the applicant as to whether the aircraft State of Design approval has included the demonstration of compliance in the airworthiness approval of the aircraft or whether demonstration of compliance will be the operator's responsibility to be satisfied during the operational approval.

1) If the published RNP AR value in the applicant's AFM includes the potential degradation of performance under aircraft failures and if the RNP AR level at which the aircraft has been qualified satisfies the RNP AR level required by the intended application, no additional failure demonstration should be required during the operational approval process, provided the applicant is able to give evidence through documentation obtained from the aircraft manufacturer qualification dossier.

2) If the published RNP AR value in the applicant's AFM does not include the potential degradation of performance under aircraft failures or if the RNP AR level at which the aircraft has been qualified does not satisfy the RNP AR level required by the intended application, the CAAV will require a demonstration from the applicant, additional to the

RNP AR aircraft qualification, that the containment criteria are satisfied (including consideration of engine failure in addition to system failures) for the intended application.

- ♦ To do so, the applicant needs to obtain from the aircraft manufacturer the detailed list of failures that may degrade the RNP AR performance.
- ♦ The applicant then has to assess the effect of those failures with respect to the intended operation using simulation means qualified as representative of the aircraft configuration approved for RNP AR.

G. In both cases, all contingency procedures and operational limitations required to support the demonstration that the TLS of the intended application is satisfied must be applied during the training program.

9.9.10 FLIGHT OPERATIONAL SAFETY ASSESSMENT (FOSA)

In certain circumstances, such as for RNP < 0.3 applications, approaches in areas of high terrain and other difficult conditions, or approaches in complex high traffic density environments, a flight operational safety assessment (FOSA) may need to be completed. Further guidance on how to conduct a FOSA is provided at Appendix E of this AC.

9.9.11 DOCUMENTATION SUPPORTING THE APPLICATION FOR APPROVAL

A. Support data and information collated during the AR qualification and compliance assessment may include inputs from one or all of the following: aircraft manufacturer, avionics supplier and operator.

B. Support documentation will vary in form and location of content depending on the governing regulations, business processes and procedures, and other practices that may apply. Each is an acceptable means of compliance. The result is there will not be a 1 for 1 correlation between one manufacturer's documentation and another's, or one operator and another.

- ● However, what should be clear from any documentation set is what is relevant and applicable to the PBN application and the associated operational approval, e.g. this could range from a single document whose content clearly addresses RNP AR requirements only for regulatory approval, to a documentation set comprised of multiple documents with clearly identified sections for RNP AR indexed to the application requirements.

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APPENDIX A
Navigation Specifications Published to Date

Flight Phase								
Navigation specification	En-route oceanic/ remote	En-route continental	Arrival	Approach				Departure
				Initial	Intermediate	Final	Missed	
RNAV 10	10							
RNAV 5[a]		5	5					
RNAV 2[b]		2	2					2
RNAV 1[b]		1	1	1	1		1[c]	1
RNP 4	4							
RNP 2	2	2						
Advanced RNP[d]	2[e]	2 or 1	1	1	1	0.3	1[c]	1
RNP 1			1[f]	1	1		1[c]	1[e]
RNP 0.3[g]		0.3	0.3	0.3	0.3	—	0.3	0.3
RNP APCH				1	1	0.3[h]	1[c] or 0.3[i]	
RNP AR APCH				1-0.1	1-0.1	0.3-0.1	1-0.1[j]	

Notes:

a) *RNAV 5 is an en-route navigation specification which may be used for the initial part of a STAR outside 30 NM and above MSA.*

b) *RNAV 1 and RNAV 2 are issued as a single approval.*

c) *Applies only once 50 m (40 m Cat H) obstacle clearance has been achieved after the start of climb.*

d) *A-RNP also permits a range of scalable RNP lateral navigation accuracies.*

e) *Optional; requires higher continuity.*

f) *Beyond 30 NM from the airport reference point (ARP), the accuracy value for alerting becomes 2 NM.*

g) *The RNP 0.3 specification is primarily intended for helicopter operations.*

h) *The RNP APCH navigation specification is divided into two sections. RNP 0.3 is applicable to RNP APCH Section A (LNAV and LNAV/VNAV). Different angular performance requirements are applicable to RNP APCH Section B (LP and LPV).*

i) *This value applies during the initial straight ahead missed approach segment for RNP APCH Section B (LP and LPV).*

j) *If less than RNP 1 is required in the missed approach, the reliance on inertial to cater for loss of GNSS in final means that accuracy will slowly deteriorate, and any accuracy value equal to that used in final can be applied only for a limited distance.*

APPENDIX B
PBN Application Form

APPLICATION FOR PERFORMANCE BASED NAVIGATION APPROVAL

INSTRUCTIONS
Print or type. Do not write in shaded areas, these are for CAAV use only. Submit original only to the Flight Safety Standards Department or a CAAV Authorized Person. If additional space is required, use an attachment

A. APPLICANT INFORMATION:

1. NAME OF APPLICANT OR HOLDER	2. PERMANENT ADDRESS (*Street or Postal Number*)			
3. CENTRAL TELEPHONE & FAX NUMBERS	4. CITY	STATE/PROVINCE	MAIL CODE	COUNTRY

B. MANAGEMENT CONTACTS:

1. NAME & TITLE OF OPERATIONS DIRECTOR	PHONE #	E-MAIL
2. NAME & TITLE OF TRAINING DIRECTOR	PHONE #	E-MAIL
3. NAME & TITLE OF MAINTENANCE DIRECTOR	PHONE #	E-MAIL

C. AIRCRAFT TO BE OPERATED:

1. AIRCRAFT MMS:	2. AIRCRAFT REGISTRATION(S):

D. SCOPE OF APPLICATION: ☐ Initial Request ☐ Additional Request

ADD	NAVIGATION-RELATED APPROVALS	ADD	NAVIGATION-RELATED APPROVALS	ADD	SPECIAL AREA APPROVALS
☐	1. RNAV/RNP-10	☐	8. RNP-1	☐	1. NAT / NAM
☐	2. RNAV-5	☐	9. RNP 0.3	☐	2. PAC / RAC
☐	3. RNAV-2	☐	10. RNP APRCH	☐	3. SAM / RAC
☐	4. RNAV-1	☐	11. RNP-AR-APRCH	☐	4. MID ASIA / RAC
☐	5. RNP-4	☐	12, Baro VNAV	☐	5. NORPAC
☐	6. RNP-2	☐	13. Other:	☐	6. CEPAC
☐	7. Advanced RNP	☐	14. Other:	☐	7. NAT-HLA

E. ADDITIONAL APPLICATION ATTACHMENTS:

☐ 1.PBN Conformance Checklist	☐ 5.MEL (with PBN adaptation)	☐ 9. Modification Approval Document
☐ 2.AFM (or AFM Supplement)	☐ 6.Relevant Maintenance Program	☐ 10. Database Supplier Approval
☐ 3.Relevant Operations Manuals	☐ 7.Related Maintenance Procedures	☐ 11. Aircraft PBN Conformity Cklst(s):
☐ 4.PBN Crew Training Programs	☐ 8.Database Integrity Procedures	☐ 12. Other (see reverse):

If more space is needed to list application contents, please enter on reverse.

F. APPLICABLE AIRCRAFT FLIGHT MANUAL (SUPPLEMENT) SUPPORTING REFERENCE(S):
Approved flight manual references for this fleet show the following airworthiness approval(s) for navigation system installation (check all applicable)

YES	REFERENCE	YES?	REFERENCE	YES	REFERENCE
☐	1. FAA AC 20-130A	☐	7. FAA TSO-C129a+	☐	13. JAA JTSO-2C115()
☐	2. FAA AC 25-15	☐	8. FAA TSO-C115()	☐	14. JAA JTSO-2C129a
☐	3. FAA AC 25-14	☐	9. FAA AC 90-94	☐	15. JAA GEN TGL 10
☐	4. FAA AC 90-45	☐	10. FAA Order 8400-12A	☐	16. JAA AMG 20X2
☐	5. FAA TSO-C145	☐	11. FAA Notice 8110-60	☐	17. ICAO DOC 7030/4
☐	6. FAA TSO-C146	☐	12. RNP-10	☐	18. Other (see reverse):

G. ADDITIONAL INFORMATION PERTINENT TO THIS APPLICATION: This space is provided for inclusion of information could not be inserted in the available category and spaces provided on front of form.

H. APPLICANT'S CERTIFICATION— The undersigned certify that all statements and answers provided on this application form and as attachments are complete and true to the best of my knowledge and agree that they are to be considered as part of the basis for issuance of any PBN approval.		
A person shall not with intent to deceive or make any false representation for the purpose of procuring for himself or any other person the grant, issue, renewal or variation of any approval.	DATE	OPERATIONS DIRECTOR SIGNATURE:
	DATE#	TRAINING DIRECTOR SIGNATURE:
	DATE:	MAINTENANCE DIRECTOR SIGNATURE:

I. CAAV CERTIFICATION:		
1. ☐ APPROVED with the associated authorizations bearing the number shown above. . ☐ Initial . ☐ Renewal . ☐ All Requests Granted . ☐ Limitations		2. ☐ DISAPPROVED
3. Signature	4. Title	5. Date

APPENDIX C
PBN Conformance Checklist

CONFORMANCE CHECKLIST FOR PERFORMANCE BASED NAVIGATION APPROVAL

INSTRUCTIONS
Print or type. Do not write in shaded areas, these are for CAAV use only. Submit original only to the Flight Safety Standards Department or a CAAV Authorized Person. If additional space is required, use an attachment

A. APPLICANT INFORMATION:		
1. NAME OF APPLICANT OR HOLDER	2. DATE OF APPLICATION	3. AIRCRAFT M/M/S

B. CONFORMANCE FOR PBN AUTHORIZATION: *(Check all that apply)* ☐ Initial Request ☐ Additional Request

☐	1. RNAV/RNP-10	☐	5. RNP-4	☐	9. RNP 0.3
☐	2. RNAV-5	☐	6. RNP-2	☐	10. RNP APRCH
☐	3. RNAV-2	☐	7. Advanced RNP	☐	11. RNP-AR-APRCH
☐	4. RNAV-1	☐	8. RNP-1	☐	12, Baro VNAV

C	Maintenance Documents	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Relevant parts of the MEL have been revised to reflect system requirements (redundancy levels) appropriate to the intended PBN operations?	☐	☐		
2	Proposed maintenance program includes all PBN related maintenance requirements prescribed by the manufacturer or design organization?	☐	☐		

D	PBN Maintenance Procedures	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Procedures for handling and storage of PBN database files including uploads to the aircraft?	☐	☐		
2	Procedures for operating equipment for handling of the PBN database (use of, handling and periodic testing?	☐	☐		
3	Procedures for downgrading a non-compliant aircraft?	☐	☐		
4	Procedures for monitoring and reporting of repetitive defects?	☐	☐		
5	Procedures for reporting to FOCA?	☐	☐		

E	Database Integrity Assurance Procedures	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Operator procedures for nav database supplier evaluation?	☐	☐		
2	Operator procedures for integrity checks and use of software tools?	☐	☐		
3	Operator procedures for reporting discrepancies to the database supplier?	☐	☐		
4	Operator procedures for notifying flight crews of irregularities with nav database?	☐	☐		
5	Operator process for updating the navigation database?	☐	☐		

F	Navigational Databases	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Service provider arrangements ensure the packed navigation databases are delivered to the operator at least one week prior to the AIRAC effective date?	☐	☐		
2	Company policy/procedures require that the correct version of the navigation database is loaded on the aircraft in a timely manner?	☐	☐		
3	Company policy/procedures require that any database errors/omissions reported by the suppliers are addressed expeditiously by flight crew briefing/removal of procedures, etc	☐	☐		
4	Company policy/procedures require that any database errors/omissions reported by the flight crew are addressed expeditiously by flight crew briefing/removal of procedures and reported back to the database suppliers	☐	☐		
5	Company policy/procedures require that the version of the loaded navigation database is checked for validity by the flight crew prior to departure	☐	☐		
6	Company policy/procedures require that prior to use after being loaded into the area navigation system, the procedure is checked against the chart, by the flight crew, for waypoint sequence, waypoint transition, leg length, magnetic bearing, altitude constraint and speed constraint	☐	☐		

G	PBN Preflight Planning Requirements	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Company policy/procedures require that the on-board navigation database, where applicable, must be current and must contain the appropriate procedures, routes, waypoints and NAVAIDS	☐	☐		
2	Company policy/procedures require that a check must be carried out on the availability of appropriate NAVAIDS, including, where appropriate, RNP or RAIM prediction. Any relevant NOTAMs must be addressed	☐	☐		
3	Company policy/procedures require that an alternate approach must be identified in the event of loss of PBN capability	☐	☐		
4	Company policy/procedures require flight crew verification of aeroplane PBN-RNAV/RNP approval for operations planned?	☐	☐		
5	Company policy/procedures require flight crew verification of applicable PBN-RNAV/RNP time limits for the operations planned?	☐	☐		
6	Company policy/procedures require flight crew verification of applicable requirements for GPS (RAIM, FDE)?	☐	☐		
7	Company policy/procedures require that the flight plan should contain the appropriate statements of capability applicable to the PBN operations anticipated during the flight	☐	☐		

H	PBN Preflight Procedures	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Company policy/procedures require that the appropriate installed equipment must be serviceable?	☐	☐		
2	Company policy/procedures require flight crew verification of NAV database validity/currency?	☐	☐		
3	Company policy/procedures require flight crew external aircraft inspection of navigation system antennas?	☐	☐		
4	Company policy/procedures require flight crew review of technical log regarding possible PBN restrictions?	☐	☐		
5	Company policy/procedures require, if applicable, flight crew uses MEL to assess any maintenance defects that might restrict PBN operations?	☐	☐		

I	Prior to Commencing the PBN Operation	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Company policy/procedures require that if all the criteria are not met, the PBN procedure must not be requested	☐	☐		
2	Company policy/procedures require that if offered a clearance for a procedure whose criteria cannot be met, ATC must be advised "UNABLE..."	☐	☐		
3	Company policy/procedures require that the loaded procedure must be checked against the chart	☐	☐		
4	Company policy/procedures require that it must be confirmed that the correct sensor has been selected and any NAVAID de-selection is complete, if required	☐	☐		
5	Company policy/procedures require that it must be confirmed that a suitable RNP value has been selected, if appropriate, and the navigation performance is adequate for the procedure	☐	☐		
6	Flight crew procedures to review possible alternate routings, especially those required by contingency procedures?	☐	☐		

J	During the PBN Operation	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Company policy/procedures require that manufacturer's instructions/procedures must be adhered to	☐	☐		
2	Company policy/procedures require that appropriate displays must have been selected	☐	☐		
3	Company policy/procedures require that lateral and, where appropriate, vertical deviation must not exceed prescribed values	☐	☐		
4	Flight crew procedures to re-assess minimum NAV equipment and communication requirements before entering a defined area using PBN?	☐	☐		
5	Flight crew procedure for positive position check prior to entering the PBN area?	☐	☐		
6	Company policy/procedures require that altitude and speed constraints must be observed	☐	☐		
7	Flight crew cross-check procedures to identify NAV errors?	☐	☐		

8	Company policy/procedures require that the procedure must be discontinued if there are integrity alerts, if the navigation display is flagged as invalid or if the integrity alerting function is not available	☐	☐		
9	If applicable, Flight crew procedures for use of INS/IRS NAV systems without automatic radio NAV update?	☐	☐		
10	Flight crew procedures for use of GPS?	☐	☐		

K	In Event of a Contingency	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Company policy/procedures require that ATC must be advised of any loss of PBN capability and a proposed course of action	☐	☐		
2	Contingency procedures applicable to the type of PBN equipment and defined airspace?	☐	☐		
3	Contingency procedures for navigation errors not associated with transitions from an inertial navigation mode to a radio navigation mode	☐	☐		
4	Contingency procedures for unexpected deviations in lateral or vertical flight path attributed to incorrect navigation data	☐	☐		
5	Contingency procedures for significant misleading information without failure warning	☐	☐		
6	Contingency procedures for total loss or multiple failures of the PBN navigation equipment	☐	☐		
7	Contingency procedures for problems with ground navigation facilities leading to significant navigation errors	☐	☐		
8	Contingency procedures for a communications failure	☐	☐		
9	Flight crew guidance for reversion to and use of other NAV aids in case of PBN failure?	☐	☐		

L	After-Flight Procedures	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Company policy/procedures require that the required reporting of navigation errors or malfunctions should be completed as applicable	☐	☐		

M	PBN Training: Flight Crew	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Qualification requirements for flight crews for PBN operations?	☐	☐		
2	Training program requiring initial and recurrent training for flight crew tasks and decisions in PBN operations?	☐	☐		
3	Flight crew training curriculums which include PBN training modules with subject elements and minimum events?	☐	☐		
4	Procedures for PBN qualification under supervision with CAAV designated representative or qualified crew member as applicable?	☐	☐		
5	Procedures for re-establishing flight crew PBN qualification / currency after a defined period of in-activity?	☐	☐		

N	PBN Ground Training Elements: Flight Crew	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	*Area navigation principles.* Area navigation is the basis for all PBN operations, and the same general knowledge is applicable to all navigation specifications. Pilots with previous experience with area navigation operations may not be familiar with some of the more advanced features such as radius to fix (RF) legs, fixed radius transitions, required time of arrival or the application of vertical navigation	☐	☐		
2	*Navigation system principles.* Flight crews should have a sound knowledge of the navigation system to be used. The relevance of the navigation system to the particular PBN operation should be clearly established. For example, knowledge of inertial navigation and updating is relevant to requirements for some oceanic and remote navigation specifications, as is knowledge of GNSS for RNP APCH operations	☐	☐		
3	*Equipment operation and functionality.* Considerable variation exists in the operation of navigation equipment, cockpit controls, displays and functionality. Crews with experience on one type of installation or aircraft may require additional training on another type of equipment. Special attention should be paid to the differences between stand-alone GNSS equipment and flight management systems with GNSS updating and degraded modes of operation such as loss of integrity or loss of GNSS	☐	☐		
4	*Flight planning.* Knowledge of the relevant aspects of each of the navigation specifications that relate to flight planning is required	☐	☐		
5	*Operating procedures.* The complexity of operating procedures varies	☐	☐		

	considerably between different PBN operations. RNP APCH and RNP AR APCH require a detailed knowledge of standard operating procedures for both normal and non-normal operations				
6	*Operating limitations.* Operating limitations (e.g. time limits, minimum equipment) vary both between and within the navigation specifications, and flight crews need to be able to recognize this and plan accordingly. Alternative means of navigation or other contingency procedures must be addressed. Flight crews need to be aware of the ATC procedures that may be applicable to the particular PBN operation	☐	☐		

O	PBN Flight Training Elements: Flight Crew	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	*En-route (oceanic, remote and continental).* In general flight training is not required for en-route operations.	☐	☐		
2	*Arrival and departure.* Because arrival and departure operations require strict adherence to track during periods of higher workload and may be associated with minimum terrain clearance and reduced route spacing, crews need to be fully conversant with the operation of the navigation system. Consequently, unless crews have significant appropriate operational experience, simulator or flight training must be provided. Particular care should be taken when this type of operation is conducted with stand-alone GNSS equipment where functional limitations require crew intervention.	☐	☐		
3	RNP APCH operations training using stand-alone GNSS equipment, particularly in a single- pilot aircraft, normally requires multiple in-flight exercises, each with preflight and post-flight briefing.	☐	☐		
4	Considerable attention should be given to the programming and management of the navigation system, including in-flight re-programming, holding, multiple approaches, mode selection and recognition, human factors and the navigation system functionality	☐	☐		
5	Approaches conducted in FMS-equipped aircraft are generally much easier to manage because the aircraft are usually equipped with map displays which aid situational awareness.	☐	☐		
6	Additional training should be provided to ensure familiarity and competency in operations which involve changes to the planned approach, system alerting and missed approaches.	☐	☐		
7	Attention should also be given to the method of vertical navigation to LNAV minima, to LNAV/VNAV minima and to LPV minima	☐	☐		
8	RNP AR APCH operations require that all aspects of the operation are carefully addressed and appropriate attention is given to training. The safety of the RNP AR operation is often predicated upon the fact that the crew procedures provide a significant mitigation for a number of the hazards associated with the procedure. However, mitigations vary widely depending upon the cockpit displays and the RNP system functionality.	☐	☐		
9	RNP AR APCH operations require that all aspects of the operation are carefully addressed and appropriate attention is given to training. The safety of the RNP AR operation is often predicated upon the fact that the crew procedures provide a significant mitigation for a number of the hazards associated with the procedure. However, mitigations vary widely depending upon the cockpit displays and the RNP system functionality.	☐	☐		

P	PBN Training: Ground Personnel	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Qualification requirements for flight dispatchers and other persons supporting PBN operations?	☐	☐		
2	Training program for ground staff requiring initial and recurrent training for tasks supporting PBN operations?	☐	☐		
3	Training curriculums for ground staff which include PBN training modules with subject elements and minimum events?	☐	☐		

Q	PBN Training: Maintenance Personnel	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Qualification requirements for maintenance personnel supporting PBN operations?	☐	☐		
2	Training program requiring initial and recurrent training for maintenance personnel for tasks supporting PBN operations?	☐	☐		
3	Training curriculums for maintenance personnel which include PBN training modules with subject elements and minimum events?	☐	☐		

End of Appendix

APPENDIX D
Individual Aircraft PBN Conformance

INDIVIDUAL AIRCRAFT CONFORMITY FOR PERFORMANCE BASED NAVIGATION

INSTRUCTIONS
Print or type. Do not write in shaded areas, these are for CAAV use only. Submit original only to the Flight Safety Standards Department or a CAAV Authorized Person. If additional space is required, use an attachment

A. APPLICANT INFORMATION:

1. NAME OF APPLICANT OR HOLDER	2. DATE OF APPLICATION

B. AIRCRAFT TO BE OPERATED:

1. AIRCRAFT MMS:	2. AIRCRAFT REGISTRATION:	2. AIRCRAFT SERIAL NUMBER:

C. NAVIGATION APPROVALS REQUESTED FOR AIRCRAFT

YES	NAV SPECIFICATION	YES	NAV SPECIFICATION	YES	NAV SPECIFICATION
☐	1. RNAV/RNP-10	☐	4. RNP-4	☐	7. RNP 0.3
☐	2. RNAV-5	☐	5. RNP-2	☐	8. RNP APRCH
☐	2. RNAV-2	☐	5. Advanced RNP	☐	8. RNP AR APRCH
☐	3. RNAV-1	☐	6. RNP-1	☐	9. Baro-VNAV

D. NAVIGATION SYSTEM MANUFACTURER/ MODEL INSTALLED:

	System #1	System #2	System #3	System #4
MAKE:				
MODEL:				
TSO:				

E. TYPE DESIGN APPROVAL: The type design approval for this aircraft and system configuration is found in-

	DOCUMENT		DOCUMENT		DOCUMENT
☐	1. Type Design	☐	4. FAA STC	☐	6. Other CAA STC
☐	2. Service Bulletin	☐	5. JAA STC	☐	7. CAA Major Modification
☐	3. Other:				

F	Configuration	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	The aircraft complies with the titles and numbers of all modifications, in addition and changes which were made in order to substantiate the incorporation of the CMP standard in the aircraft?	☐	☐		
2	The CMP is established and provided for assessment?	☐	☐		

G	Systems Installation	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Single navigation system installed?	☐	☐		
2	Dual navigation systems installed?	☐	☐		
3	Single long-range navigation system installed?	☐	☐		
4	Dual independent long-range navigation systems installed?	☐	☐		
5	Triple independent long-range navigation systems installed?	☐	☐		

H	Navigation System Capability	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	The aeroplane position is automatically determined from VOR/DME sensors?	☐	☐		
2	The aeroplane position is automatically determined from INS/IRS systems with automatic updating from suitable radio based navigation equipment?	☐	☐		
3	The aeroplane position is automatically determined from INS/IRS systems without automatic updating from suitable radio based navigation equipment?	☐	☐		
4	The aeroplane position is automatically determined from independent (stand-alone) GPS systems?	☐	☐		
5	The aeroplane position is automatically determined from FMS / Multisensor navigation systems integrating	☐	☐		

I	Applicable PBN Limitations	Applicable	Not Applicable	Manual References Chapter, Paragraph	Acceptable
1	Will aircraft operation in designated RNAV-5 airspace is limited to a maximum 2-hour time limit because the INS/IRS system installation does not have automatic navigation updating of INS/IRS position?	☐	☐		
2	Will aircraft operations in designated RNP-10 or NAT-MNPS airspace is limited to a maximum 6.2-hour time limit because the INS/IRS system installation does not have automatic navigation updating of INS/IRS position?	☐	☐		
3	For RNAV operations based on stand-alone GPS navigation equipment, the availability of GPS integrity is confirmed and obtained from RAIM prediction program that is provided in the GPS unit in the aeroplane?	☐	☐		
4	For RNAV operations based on stand-alone GPS navigation equipment, the availability of GPS integrity is confirmed and obtained from RAIM prediction program run outside the aeroplane?	☐	☐		
5	The aircraft is limited to RNAV flights where maximum RAIM outages do not exceed 5 minutes if equipped with a stand-alone GPS approved iaw TSO-C129, which does not provide pseudorange step detection and health word checking functions?	☐	☐		
6	The aircraft is limited to RNAV flights where maximum RAIM outages do not exceed 5 minutes if equipped with a stand-alone GPS approved iaw TSO-C129, which does not provide pseudorange step detection and health word checking functions?	☐	☐		
7	Aircraft has dual long range communication (LRCS) equipment (HF Voice / Data Link, SATCOM, etc.) installed and operational for the conduct of extended overwater operations?	☐	☐		

J. ADDITIONAL INFORMATION PERTINENT TO THIS APPLICATION:
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K. APPLICANT'S CERTIFICATION— The undersigned certifies that all statements and answers provided on this aircraft conformity report are complete and true to the best of my knowledge and agree that they are to be considered as part of the basis for issuance of any PBN approval.

A person shall not with intent to deceive:or make any false representation for the purpose of procuring for himself or any other person the grant, issue, renewal or variation of any such ...approval...	DATE:	MAINTENANCE DIRECTOR SIGNATURE:

L. PBN CONFORMITY ACCEPTABLE:

1. ☐ **APPROVED** (Aircraft added to the operations specifications with PBN authority.

☐ Initial ☐ Renewal ☐ All Requests Granted ☐ Limitations

2. ☐ **DISAPPROVED**

3. Signature of Approving Official	4. Title	5. Date

APPENDIX E
Flight Operational Safety Assessments (FOCA)

1. Why is a FOSA needed?

A. In some cases the operational needs of stakeholders lead to procedure designs which may or may not comply with Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual (Doc 9905) but which require the aircraft to be operated in a manner that was not considered in its airworthiness approval.

B. A FOSA is intended to address this nominal mismatch.

C. When RNP AR APCH is being implemented it is for a specific reason, e.g. improved access, safety, efficiency. The FOSA process helps to ensure that the operational needs, the limits of safe and efficient aircraft performance, the means of assuring repeatable and predictable flight operations, the means of safe flight operations when faced with aircraft failures and hazardous conditions, etc., are understood by all relevant stakeholders. As a result the aircraft operations, procedure design, contingency arrangements, training and maintenance will all be at the level necessary for flight and operational safety.

2. When should a FOSA be conducted?

A FOSA should be conducted for each RNP AR approach procedure where the more stringent aspects of the nominal procedure design criteria (as per Doc 9905) are applied (i.e. RF legs after the FAF, RNP missed approaches less than 1.0, RNP final approaches less than 0.3) or where the application of the default procedure design criteria is in an operating environment with special challenges or demands.

3. How should a FOSA be carried out?

A. The FOSA should ensure that for each specific set of operating conditions, aircraft and environment, all failure conditions are assessed and, where necessary, mitigations are implemented to meet the safety criteria. The assessment should give proper attention to the inter-dependence of the elements of procedure design, aircraft capability, crew procedures and operating environment.

B. The functional areas presented in paragraph 4 have been identified as elements to assess collectively in a typical FOSA. The FOSA should act as the "glue" to combine and analyse the risks associated with the RNP AR system.

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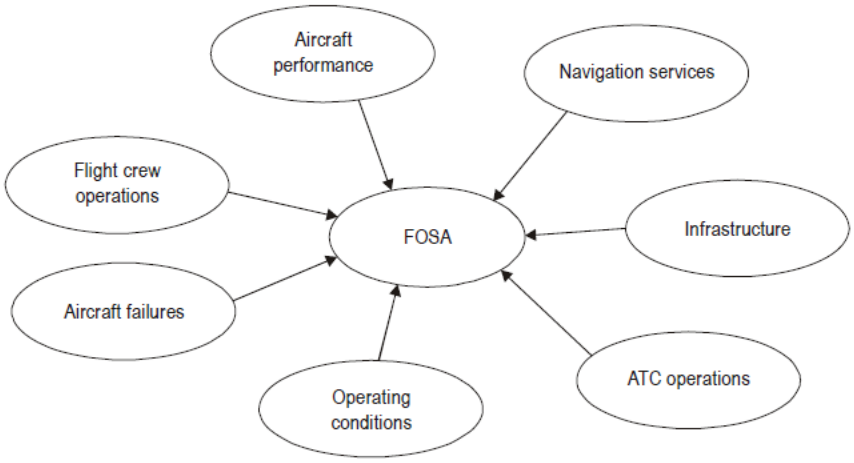
4. Required Depth of a FOSA

The depth of a FOSA and the associated level of resources are very important issues for stakeholders. Three factors that influence the required depth of a FOSA are—



1) how challenging the proposed procedure design is relative to the airworthiness approval/ qualification;

2) the operational and obstacle environment; and

3) the previous experience of stakeholders and the availability of appropriate previous safety assessments.

5. Airworthiness Approval/Qualification

A. In order to meet the RNP AR eligibility requirements (the PBN manual (Doc 9613), Volume II, Part C, 6.3.3) the manufacturer needs to establish that the criteria for assessing probable failures during the aircraft qualification demonstrated that the aircraft trajectory is maintained—

1) within 1 x RNP of the lateral track, 95 per cent of the flight time; and

2) within the vertical path, 99.7% of flight time.

B. Proper documentation of this demonstration in the aircraft flight manual (AFM), AFM extension, or appropriate aircraft operational support document alleviates the need for operational evaluations.

C. RNP-significant improbable failure cases should also be assessed to show that, under these conditions, the aircraft can be safely extracted from the procedure. Failure cases may include dual system resets, flight control surface runaway and complete loss of flight guidance function.

D. The aircraft performance demonstration during the operational evaluations can be based on a mix of analyses and flight technical evaluations using expert judgment. Aircraft performance in the event of failures, as well as in normal conditions, should therefore be available in the AFM or an equivalent document.

6. Operational & Obstacle Environment

A. If the procedure is being introduced for noise alleviation purposes and there are no obstacles close to the route (within 2 x RNP), a less detailed FOSA may be appropriate. No FOSA is required if the default RNP values of 1, 1, 0.3 and 1 are used for the procedure.

B. If a very complex and challenging procedure is being introduced for better access to a runway surrounded by challenging terrain/obstacles, a more detailed FOSA may be considered advisable (if no prior examination/ assessment is found to be applicable - see below).

7. Previous experience of stakeholders and availability of appropriate previous FOSAs

A. The specific history and circumstances of the RNP AR APCH implementation and the associated stakeholders will affect the depth of the FOSA. Important factors include whether:

1) a new procedure is being developed, or one already exists, that is flown by other carriers and/or by other aircraft types;

2) relevant FOSAs exist for the procedure or for other similar applications;

3) a carrier with an RNP-certified aircraft already has the manufacturer's AFM, operations manual, crew procedures, dispatch guidance, minimum equipment criteria for RNP, compliance assessments, etc., that were considered valid from a previous similar RNP AR application;

4) the ANSP and regulator(s) have previous experience with RNP AR approaches and FOSA at this airport or similar locations.

B. When it is determined that no FOSA has to be performed, a rationale should be provided, e.g. "not applicable as covered by basic aircraft certification and/or prior operational approvals and FOSA".

8. How to Conduct a FOSA

A. Overview of the main steps

Within aviation a number of safety assessment methodologies are in use. There is usually a large degree of commonality between them, and it is difficult to identify one as clearly the best in all situations. The method illustrated below was developed to be consistent with previous FOSA material and more general safety assessment material.

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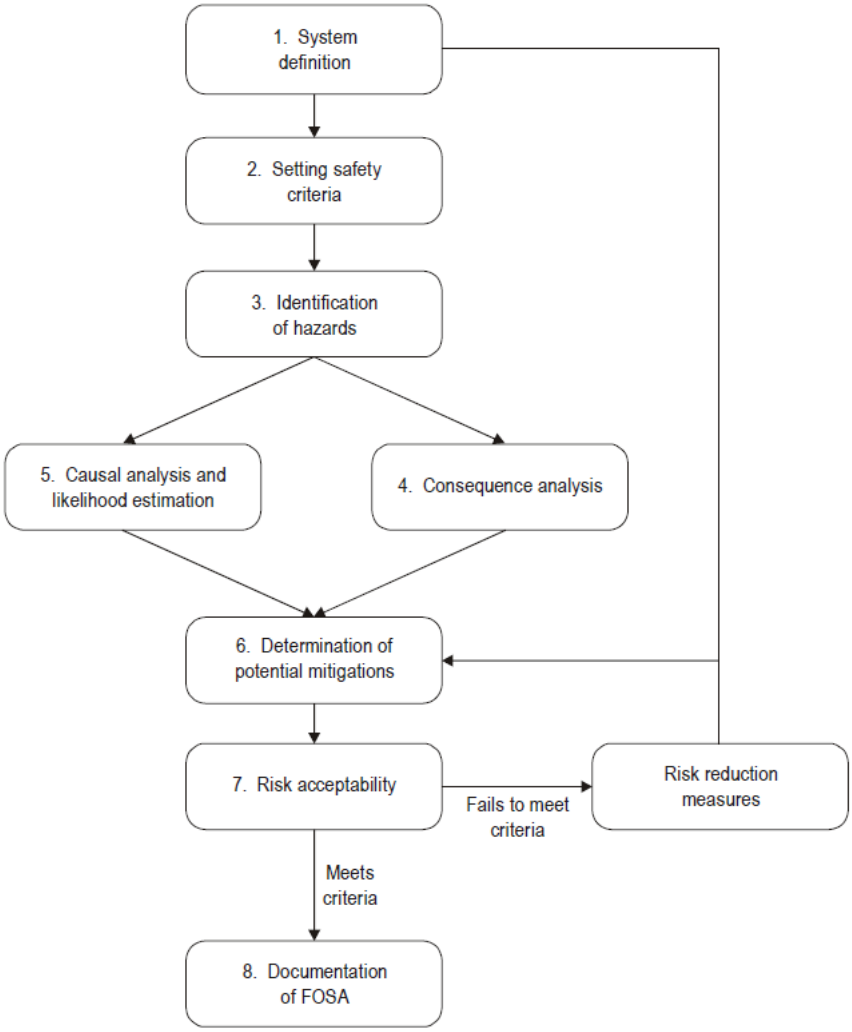
It is likely that many organizations planning RNP AR approaches will already have their own safety assessment processes in place. It is expected that the steps below will be represented within these processes.



9. Details of each step

Step 1 — System definition

A. The following information should be gathered with respect to the proposed RNP AR APCH procedure:

1) the proposed procedure design and details of the proposed operations including FMS coding issues;

2) aircraft information, e.g. compliance documents against applicable States regulations, in particular the aircraft RNP system performance under operational, rare, normal and non-normal conditions which should be documented to support the FOSA exercise;

3) flight crew procedures and training;

4) dispatch procedures and training;

5) proposed minimum equipment list (or RNP AR required equipment list);

6) any special maintenance requirements;

7) airport and airspace environment;

8) navigation infrastructure;

9) ATC facilities (including surveillance and communications), procedures and intended training with respect to RNP AR operations; and

10) monitoring programme.

B. This should be used to put together a system description which is suitable and sufficient to conduct the FOSA. It should be ensured that all relevant elements are included, i.e. not just equipment hardware but human aspects, procedures, software, firmware and environmental aspects. As part of this step, assumptions made in AR guidance documents will need to be checked and validated.

C. With the system defined it is recommended that a small group of experts spend a short amount of time to identify the difficult elements of the approach, any human factors issues and any key hazards. This information will help to understand the exact requirements and necessary outcomes of the FOSA process. Subsequently an estimation of the depth of analysis required and the effort needed to complete the FOSA can be made.

Step 2 — Setting safety criteria

D. Safety criteria can be quantitative or qualitative. The PBN manual notes that a FOSA is likely to use a mix of quantitative and qualitative analysis so it would be expected that the safety criteria reflect this. The following criteria have been found to be useful and practical:

1) Quantitative safety objective criteria. Quantitative criteria work best in the airworthiness domain where relevant data on equipment failure rates are available and where consequences can be precisely defined. It should be noted that conversions between different units (e.g. per flight hour to per approach) need to take account of exposure times.

- In the flight operations domain, human factors and the influence of procedures and training make it much more difficult to derive meaningful quantitative criteria. Hence qualitative criteria such as the following are generally more useful.

2) Risk reduced as far as reasonably practicable (AFARP). This criterion is commonly used in aviation. It is sometimes referred to as the ALARP criterion, reducing risk as low as reasonably practicable. It is generally used in a qualitative manner although it can be used quantitatively via cost-benefit analysis. In the context of the FOSA it can be applied globally to the system, i.e. the system as a whole has reduced the risk AFARP, and it can also be applied hazard by hazard.

- Risk reduced AFARP/ALARP is a flexible criterion suited to the mixture of techniques used in a FOSA. It has been found to be readily accepted by stakeholders in RNP AR case studies and has helped to define what extra risk reduction measures were needed by the AO and ANSP.

3) Risk no greater than current operations. In a safety conscious industry such as aviation, great care is taken to ensure that operations do not become riskier; rather there is a drive to continue the downward trend in accident rates. This is potentially a useful criterion to apply hazard by hazard to check that there are adequate mitigations in place to ensure no risk increase. Potential difficulties with this relative criterion are—

(a) Sometimes it is very difficult even for aviation experts to compare the risks from different approach types.

(b) There is a range of risk associated with current approach operations (historically non-precision approaches are significantly higher risk than precision approaches).

Hence the conclusions from use of this criterion will depend on what is being compared.

(c) Some regulations require that the ATM risk should decrease in the future as traffic rises. Being as safe as today may not be good enough.

E. Therefore some care needs to be taken with this "no risk increase" criterion. On its own it will probably not be sufficient, but together with the other criteria above it can be part of a practical package. If a relative criterion is used, the other approach type for comparison needs to be defined in the same level of detail as described above in Step 1 for the RNP AR approach.

F. The choice of safety criteria is very important. It is advisable for AOs to consult with their regulators before undertaking a FOSA. Some regulators may be wary of an RNP AR approach that increases risk compared to an existing PA, for example, even if the new procedure meets an AO's existing risk tolerability matrix. This could prevent an operational approval from being granted. The AFARP/ALARP principle is likely to be an important and possibly the most practical part of the criteria used in a FOSA.

Step 3 — Identification of hazards

G. There are a range of techniques that have been used in aviation to identify hazards.1 Some of these are based on analysis by a single person and others use a group of experts working as a team. Given the need for a FOSA to make use of a mix of disciplines, a group-based approach is likely to be the most successful.

H. The term hazard is used in this document to refer to events that form convenient pinch points between sets of consequences and causes. Hazard can be defined as "a condition that could credibly cause or contribute to an aircraft incident or accident. (This may include a natural hazard or a condition with the potential for causing injuries or death to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function, as it relates to the safe operation of aircraft)". This broader definition is covered by the full set of hazards, causes and consequences that would be generated in a FOSA.

I. The following points can help maximize the effectiveness of group-based hazard identification:

1) ensure use of an experienced facilitator to guide the group;

2) gather the required mix of skills and knowledge, i.e.:

(a) procedure designers;

(b) aircraft and avionics manufacturers, if available;

(c) technical support experts;

(d) pilots (from relevant aircraft operators and test pilots if available);

(e) AIM experts;

(f) ATCOs and ATC representatives with knowledge of airspace planning and technical facilities; and

(g) regulators.

J. Representatives from other disciplines which could be useful in a FOSA include flight operations, dispatch, maintenance and safety and quality. Running an effective group session involves obtaining a balance of skills but also having a manageable size of group.

Step 4 — Consequence analysis and severity evaluation

K. The manner in which the consequences2 of hazards are analyzed will depend on the hazards. Aircraft failures will use the failure condition effects and severity classification detailed in the national advisory circulars/acceptable means of compliance and will have to satisfy the quantitative safety objectives set forth in the PBN manual and related documents. In this context, consequences are related to quantitative lateral and vertical excursions and, in the case of excursion beyond the 2 x RNP lateral corridor, whether or not the aircraft remains manoeuvrable and able to make a safe extraction. To assess consequences in this manner will require simulations. Where relevant analysis already exists from RNP certification activity this should be used and not duplicated.

L. For hazards in many of the other FOSA functional areas, human failures and procedural issues have a dominant effect. It is very difficult to assign a single severity level or determine a quantified excursion for such hazards. Thus the consequences are better described qualitatively for most of these other hazards. This information can then be used in the decision-making process concerning whether mitigations are sufficient to control risk to an acceptable level.

Step 5 — Causal analysis and likelihood estimation

M. The likelihood of aircraft equipment failures will already have been analyzed in the existing aircraft system safety assessment (SSA) documents. These often employ techniques that can model complex trees/chains linking multiple causes to the hazard. Data generally exists to populate these models and enable robust quantification of the hazard likelihood. This enables a check to be made that the safety objectives can be met. This work will already have been done during RNP AR certification activities, and it should not be necessary for the manufacturer to supply detailed technical analyses. Details of the hazards considered and their likelihood category should be sufficient for the FOSA.

N. For most of the other functional areas, where human failures and procedural issues have a dominant effect, such detailed quantification either may not be possible or may not be useful. A possible qualitative method used in the case studies was:

1) identify and document the relevant causes of the hazard;

2) map the causal mitigations (see Step 6) to these causes;

3) consider the likelihood of these causes implicitly when judging whether the mitigations are sufficient.

O. At the end of Step 5, potential combinations and sequences of causes leading to hazards and subsequent sequences of events to various consequences (from Step 4) will be apparent. It is important that common cause failures (CCFs) within these combinations and sequences are identified and their importance assessed. Critical CCFs that can significantly increase risk levels will need additional mitigations.

Step 6 — Determination of mitigations

P. Mitigations that reduce the chance of a hazard occurring (causal mitigations) and mitigations that reduce the severity of hazard consequences/effects should be considered and documented. Splitting out the potential causes and consequences can help this process.

Q. As part of the analysis of consequential mitigations it would be expected that contingency procedures would be fully worked out covering a range of challenging hazards (e.g. double FMS loss, loss of GNSS) occurring at various critical locations (e.g. in the RF leg, early in the procedure potentially requiring long extraction, at DA/ DH).

R. It is usually helpful to identify mitigations that are already in place or planned and then to allow the FOSA group time to also identify potential extra mitigations. Some of these potential extra mitigations may later be rejected as not needed or not practicable. However, this part of the process is a key stage in demonstrating that risk has been reduced AFARP.

Step 7 — Determination of risk acceptability

S. For aircraft failure hazards, the normal airworthiness criteria from 14 CFR 25.1309 will be used together with the PBN manual, Volume II, Part C, Chapter 6, 6.3.3, i.e.:

1) Criteria for assessing probable failures during the aircraft qualification will demonstrate that the aircraft trajectory is maintained within a 1 x RNP corridor, and 22 m (75 ft) vertical. Proper documentation of this demonstration in the AFM, AFM extension, or appropriate aircraft operational support document alleviates the operational evaluations.

2) RNP-significant improbable failure cases should be assessed to show that, under these conditions, the aircraft can be safely extracted from the procedure. Failure cases might include dual system resets, flight control surface runaway and complete loss of flight guidance function.

3) The aircraft performance demonstration during the operational evaluations can be based on a mix of analyses and flight technical evaluations using expert judgment.

T. For most of the other hazards the most direct way to determine risk acceptability is for the expert group to look at the mitigations and decide if residual risk is acceptable. In making this decision the group will be making sure that risk is not going to be higher than current operations and that it has been reduced AFARP.

U. If the safety criteria are not satisfied, the FOSA steps in paragraph 8 show the need to consider further risk reduction measures either feeding back to Step 6 or potentially to a system re-design, e.g. updated procedure design, in Step 1.

Step 8 — Documentation of FOSA

V. Expected contents of a FOSA document include:

- introduction (including justification for the introduction of an RNP AR APCH, benefits, etc.);
- description of the system;
- overview of the safety assessment process and safety criteria used;
- analysis of procedures, including airport environment and procedure design;
- identification of relevant hazards, causes and consequences;
- documentation of relevant mitigations and determination of risk acceptability for RNP AR operations;
- key issues to be monitored in trials and in operations;
- assumptions and open items to be validated and closed out;
- conclusions/recommendations;
- appendices with supporting information, i.e. minutes from group sessions, hazard identification tables, hazard logs with action tracking.

10. Human Factors Issues

Normal operating procedures

A. The PBN manual contains guidance and requirements concerning:

1) revision of the minimum equipment list (MEL) to address RNP AR requirements;

2) use of autopilot and flight director;

3) dispatch RNP assessment;

4) NAVAID exclusion;

5) navigation database currency;

6) in-flight considerations including required equipment to start RNP AR approaches, RNP management, lateral and vertical deviation monitoring, special go-around procedures, altimeter setting and cross- checking and several others.

B. These have been developed based on the accumulated knowledge of RNP AR/SAAAR approaches conducted to date. An AO will need to develop a compliance checklist against these procedures when developing the system description.

Abnormal and contingency procedures

C. The PBN manual also contains guidance on procedures for flight crew reacting to a variety of possible equipment failures including:

- engine failure during approach or missed approach;
- loss of GNSS updates;
- degradation of external signal-in-space;
- failure of the RNP system components (e.g. failures of a GPS sensor, the flight director or automatic pilot).

D. Manufacturers will be able to supply detailed lists of equipment failures for which procedures should be available, e.g.:

- loss of one auto-pilot (AP);
- loss of both APs;
- loss of NAV mode before or during approach;
- loss of GPS as primary navigation (on one side);
- loss of GPS as primary navigation (on both sides);
- navigation accuracy downgrade (on one side);
- navigation accuracy downgrade (on both sides);
- GPS position disagrees with the FMS.

Training requirements

E. The PBN manual contains guidance and requirements concerning training for flight crew and dispatchers. For flight crew there is detailed guidance on the contents of ground training segments and flight training segments plus how these should be evaluated. The training covers the normal procedures and abnormal/contingency procedures listed above. Each pilot must complete at least two RNP approach procedures that employ the unique RNP AR

APCH characteristics of the operator's approved procedures, one procedure culminating in a landing and one in a missed approach.

F. Manufacturers may supply additional training guidance specific to the relevant aircraft types.

Recurrent training

The PBN manual also contains guidance on recurrent training. An AO should incorporate recurrent RNP training that employs the unique (AR) approach characteristics of the operator's approved procedures as part of the overall programme. A minimum of two RNP AR APCHs must be flown by each pilot for each duty position (pilot flying and pilot monitoring), with one culminating in a landing and one culminating in a missed approach, and may be substituted for any required "precision-like" approach.

FOSA and HF issues

G. Having used the information in the previous sections to establish what is to be proposed, the subsequent FOSA steps establish the adequacy of the procedures and training for the specific RNP AR procedure.

H. The simple approach adopted in the case studies was to involve groups with knowledge of the proposed procedures and training in the specific hazards to directly determine the adequacy of the procedures and training. Where potential improvements were identified these were listed for further consideration under Steps 6 and 7 of the FOSA.

11. FOSA & ANSP Considerations

ANSP's role in a FOSA

A. The personnel from an ANSP may be asked to participate in a FOSA, particularly in the case of a new RNP AR procedure being implemented.

B. An ANSP may fulfil the following roles:

1) providing relevant information in Step 1, "System definition", of the FOSA including the proposed procedure design, ATC facilities, procedures, intended controller training and navigation infrastructure;

2) participating in safety workshops addressing hazard identification, consequence and causal analysis and helping to determine appropriate risk mitigations (Steps 3 to 6 of the FOSA);

3) reviewing and providing comments on the FOSA documentation.4.1.3Typically an ANSP will supply procedure designers, controllers, ATC engineers, AIM experts and airspace planners to carry out these roles.

C. In addition to participating in these formal steps of the FOSA, it is likely that the procedure designer will also liaise at an early stage with the AO to understand the key operational needs for the RNP AR APCH.

How an ANSP can use FOSA outputs

D. There will be many outputs from the AO's FOSA that the ANSP can use. For an RNP AR APCH where the main safety issues relate to separation from terrain, typically in low traffic density situations, FOSA outputs of use to the ANSP will include the following:

1) the impact of the procedure design on the flight crew. The procedure may be compliant with ICAO's RNP AR procedure design guidance but could still lead to unacceptable or unnecessary increases in pilot workload. Feedback from the FOSA could lead to the ANSP's procedure designer needing to make changes;

2) adequacy of ATC phraseology including clearance for the RNP AR APCH;

3) adequacy of ATC procedures relating to constraints on any vectoring or "direct to", provision of local pressure data, any changes in monitoring and in the event of RNP-related aircraft failures;

4) adequacy of ATC training given the hazard identification and analysis performed for the FOSA.

E. For an RNP AR APCH where the main safety issues relate to separation from other traffic, perhaps in a busy terminal/airport environment, additional useful FOSA outputs could include analysis of the:

1) adequacy of ATC procedures to handle mixed-mode traffic (RNP AR and other approach types) including how to identify aircraft with different approach capabilities and how to handle potentially different missed approach paths;

2) adequacy of existing monitoring systems, e.g. non-transgression zones;

3) impact of wide area GNSS failure on multiple aircraft.

F. It is anticipated that more detailed guidance with respect to traffic separation safety issues will be provided in a subsequent version of this document.

G. These and similar outputs can be brought into the ANSP safety assessment and analyzed using the existing ANSP safety assessment processes.

Additional issues to include in an ANSP safety case

H. Within an ANSP safety case, as well as documenting the safety assessment of the ATM aspects of a new RNP AR APCH, an ANSP may also need to cover the following safety assurance activities:

1) demonstration that the revised ATM system operates correctly and safely through ATC simulations. If, for example, a new RNP AR APCH procedure is being introduced for closely spaced parallel approaches this could represent a significant ATM change with implications for controller workload. A consideration of the dynamics via fast and/or real-time simulation may be required evidence from a regulator. Real-time simulations can also be used to investigate controller reaction to hazards identified in the FOSA. When a new RNP AR APCH involves only minimal ATC changes, such ATC simulations would not be required;

2) flight trials under controlled conditions to ensure that the initial implementation is safely managed. An ANSP will be involved in the coordination between the AO and the regulator to ensure that flight trials occur initially only in VMC conditions, or only with a limited subset of aircraft and crews, for example. The ANSP will sometimes also collect data, e.g. radar track data, during these trials and early operations to provide evidence to support the safety case;

3) an RNP monitoring programme to record and investigate any ATM significant events.

I. In addition, an ANSP safety case will need to demonstrate how ATM assumptions and open issues from the FOSA have been closed out, e.g. testing for GNSS interference prior to implementation, investigation of terrain masking, checks on accuracy of obstacle and terrain survey data, etc.

12. Simulations, Trials & Monitoring

Simulations and trials

A. Simulations (additional to those carried out during the airworthiness approval) can provide valuable support to the safety assessment. Reasons for conducting simulations could be to:

1) help evaluate alternative procedure designs;

2) evaluate the significance of a hazard for the proposed procedure design in a specific operating environment;

3) familiarize a carrier new to RNP AR APCH with some of the key safety issues.

B. In the absence of any failures, simulations may investigate:

1) varying cross-winds;

2) increasing aircraft speeds above the recommended values on final approach and missed approach to study the impact on guidance in the RF legs; and

3) guidance in heavy tailwinds (well beyond what would realistically be flown).

C. In addition, the following failures may be simulated:

1) one-engine inoperable in cross-wind during the RF leg;

2) manually steering away from centerline to observe what indications are provided to the crew;

3) 10-hPa pressure setting error to observe the TAWS alert parameters;

4) map shift; and

5) autopilot disconnect just before the RF leg.

Note: Aircraft operators' simulators are unlikely to be able to model as wide a range of failures as the development simulators used by aircraft manufacturers. Therefore assistance from aircraft manufacturers may be required. From a safety perspective simulations must reflect real situations as accurately as possible. There is a need to be able to judge how close the simulation is to reality. Additional hazards and risks can be introduced if simulations do not reflect real-world circumstances.

D. Trials can also be used to address safety issues, for example:

1) Initial flights can be conducted in VMC to check the navigation database.

2) A carrier new to RNP AR APCH might elect for an extended trial period in order to train flight crew, dispatchers, etc., and to check that the operational procedures are robust. This can help pro

3) The safety of the proposed operation may be demonstrated by the track-keeping achieved under different meteorological conditions and different system failures/ contingencies.

E. Trials may have extra mitigations associated with them which would not be subsequently used in full operations, e.g. VMC conditions, compulsory use of autopilot.

F. Some States operate a process of "interim authorization", where for the first 90 days and at least 100 AR approaches in each aircraft type, the operator will be authorized to conduct RNP approaches with AR using minima associated with RNP 0.3.

- For approach procedures with no line of minima associated with RNP 0.3, the procedure must be flown in VMC.

- The interim authorization is removed after completion of the applicable time period and number of approaches and upon a review of the reports from the RNP AR monitoring programme by the regulator.
- In certain circumstances it has been possible to use flight evaluation to determine if an operation is possible.

Monitoring programme

G. The PBN manual notes the requirement for an RNP monitoring programme.

H. In the context of this FOSA guidance material it should be highlighted that:

1) One of the outputs of a FOSA should be an identification of key safety performance indicators that will be part of the RNP monitoring programme. Some likely candidates for safety performance indicators are already listed the PBN manual; however, a local FOSA may identify certain hazards as the main risk drivers, and therefore monitoring the precursors to these hazards will be important to controlling risk during the operational phase.

2) A FOSA may also identify key assumptions or open issues which are difficult to validate without operational data. Again these should be fed forward to the monitoring programme.

I. Compared to other types of approaches (e.g. ILS approaches) there are still relatively few RNP AR approaches worldwide. Thus it is important to pool information from monitoring programmes to see whether the predictions from FOSAs (e.g. on deviation frequencies) are realistic.

End of FOCA Appendix

APPENDIX F
Simulator Functionally & Qualification: RNP AR APCH

A. A statement of compliance is required that attests to the fact that the simulation of the navigation systems (i.e. EGPWS, GPS, IRS, FMS) and flight guidance systems accurately replicate the operator's equipment and is based on original equipment manufacturer's (OEM) or aircraft manufacturer's design data. A statement of compliance template should be made available by the regulatory authority.

B. While there are no requirements for airport-specific models (e.g. FAA 14 CFR Part 60, Class I or Class II models) to be used in the qualification of a flight simulation training device (FTSD) for RNP AR APCH training, any visual model must employ real-world terrain modelling. Furthermore, approved RNP AR APCH applications must be used. Generic airport models may be approved for use in training where airport recognition in the visual segment portion of the RNP/AR approach is not critical to completion of the training task. In these cases, a generic airport with a real-world visual terrain model may be utilized. In addition, any terrain awareness and warning system (TAWS/EGPWS) must provide correct terrain feedback (Class A terrain display) and warnings consistent with the specific approach being trained.

C. Evidence must be provided that the FSTD is equipped and operated in accordance with a valid aircraft cockpit configuration and complies with all applicable software versions or limitations. The operator should ensure that the simulator has the capabilities to support the simulation of any manufacturer required, or operator adapted, normal and non-normal procedures, including appropriate aircraft/system-specific failures and relevant operating conditions (obtained from the appropriate OEM or vendor), for inclusion in the flight training programme.

D. The following items should be addressed in the statement of compliance:

Simulator PBN RNP AR capability

- Airframe
  - Model
  - Engines
  - Winglets
  - Other airframe unique options
- Flight guidance and flight management system
  - Part numbers for all software and hardware components
- Autoflight options
- Autothrust
- Air data system
- PFD
- Flight mode annunciation
- TAWS
  - GPS position as a direct input to keep terrain on navigation display
  - Peaks and obstacle function
  - Database currency

Operator and crew policies and procedures

- AFM or equivalent documentation providing all training assumptions taken in the framework of RNP AR qualification of the aircraft
- FCOMs
- QRH
- Checklist

Ability to generate failures and degradation

- GPS faults
- CDU faults and failures
- Display unit failures
- Flight guidance system failures
- Loss of NAV or approach modes
- Loss of deviation or performance information
- Loss of TAWS data or display
- TAWS terrain discrepancies
- Dual loss of GPS sensors
- FMS/GPS position disagreements
- FMS failures or downgrades

Visuals

- Ability to add airports to the visual database
- Use of generic airport with TAWS (possibility to set a generic visual with "flat terrain" in a way so as to avoid spurious GPWS warning or crash simulator generated by an inaccurate generic visual terrain)
- Runway coordinates must match AIP
- Visual terrain is accurate and does not cause spurious TAWS alerts (or flat terrain option in visual settings)

Navigation database considerations

- Procedure service provider/developer test databases and loading media
- Coordination required with multiple parties associated with process
  - Aircraft OEM
  - FMS/FGS vendor
  - Operator
  - FSTD vendor
  - Navigation database packing service provider
  - Flight training provider

Evaluation criteria

—Normal performance and functionality:

- Up-to-date database with display of validity period
- Operable Class A TAWS identical to the aircraft
- Dual FMSs, dual GPSs, dual autopilots and at least a single IRU and all must be operable
- Statement of compliance with the OEM systems included in the eligible configuration of RNP AR aircraft qualification
- Ability to load the entire RNP/AR approach procedure to be flown from the on-board navigation database
- Ability to verify the RNP/AR procedure to be flown through a review of the individual waypoints
- Either an equipment capability or an operational procedure to provide a direct means of inhibiting sensor updating (VOR/DME), if required
- FSTD autopilot/flight director able to fly an RF leg, comply with the aircraft's bank angle limits, able to maintain lateral track navigation without exceeding the RNP value while encountering strong tailwinds
- Upon initiating a go-around or missed approach (through activation of TOGA or other means), the lateral flight guidance mode should remain in LNAV. If the aircraft cannot remain in LNAV after TOGA is selected, then procedures to re-engage LNAV while remaining within 1 x RNP must be demonstrated and verified in the FSTD. The FSTD must permit re-engagement of LNAV by 400 ft AGL.

—Non-normal performance and functionality:

- The navigation system must have the ability to monitor the achieved navigation performance and to alert the pilot when the RNP requirements are not being met (i.e. "UNABLE RNP")
- The instructor's operating panel must have the capability to induce the malfunction of an "UNABLE RNP" alert or other alert message that would cause a missed approach during an RNP AR APCH (e.g. FMS failure, GPS failure, AP failure, loss of guidance, loss of FD/FDE, engine failure, extreme wind/turbulence). The malfunction must appear realistic to the pilots.

—Demonstration mode:

The ability to demonstrate cockpit effects induced by remote or very remote failure combinations at a faster rate than real time would be advantageous, the objective being to illustrate and consolidate the theoretical knowledge received during the ground course. The FTSD should clearly indicate that the training situation is not in real time ("demo mode" displayed in front of the visual scene). Example effects could include:

- FMS/GPS position disagree
- FMS 1/FMS 2 position disagree
- Inconsistency between the terrain display and one or both FMS FPL displays
- Effect of position radio navigation update
- High/low temperature impact on non-compensated Baro-VNAV FPA
- Loss of GPS, GPS primary lost, navigation accuracy downgraded
- IRS drift effect.

End of Advisory Circular

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