Agenda Item 3: Criteria and procedures for the approval of performance-based navigation operations

Status of development of new SRVSOP Advisory Circulars concerning the approval of aircraft and operators for advanced RNP (A-RNP) and RNP 0.3 operations

(Presented by the Secretariat)

SUMMARY

This working paper presents the progress made by the Regional Safety Oversight Cooperation System (SRVSOP) concerning performance-based navigation. In this regard, Appendix A presents the following draft advisory circulars (CA):

- ✓ CA 91-007 – Aircraft and operators approval for advanced RNP (A-RNP) operations; and
  CA 91-012 – Aircraft and operators approval for RNP 0.3 operations.

REFERENCE:

- Doc 9613 Fourth Edition 2013 – Performance-based navigation (PBN) Manual

ICAO stragetic objectives:	*A - Safety* *E – Environmental protection*

1 Background

1.1 The fourth edition of Doc 9613 – Performance-Based Navigation (PBN) Manual was published under the authority of the ICAO Secretary General in March 2013.

1.2 This edition contains advisory material, including criteria for the implementation of the following navigation specifications:

- ✓ Advanced RNP (A-RNP); and
- ✓ RNP 0.3.

1.3 In that same edition, the appendices to Doc 9613 address the following main elements:

- ✓ Radius to fix (RF) path terminator; and
- ✓ Fixed radius transition (FRT).

2 Work accomplished

2.1 With the drafting of Advisory Circulars 91-007 and 91-012 that establish the criteria for the approval of aircraft and operators for advanced RNP and RNP 0.2 operations, respectively, the Latin

American Regional Safety Oversight Cooperation System (SRVSOP) has completed the production of guidance material on all the navigation specifications described in the fourth edition of Doc 9613 – Performance-Based Navigation (PBN) Manual.

2.2 CA 91-007 – Aircraft and operators approval for advanced RNP (A-RNP) operations, provides specific criteria for the approval of aircraft and operators to conduct standard instrument departures (SID), en-route operations, standard instrument arrivals (STAR), and approaches. Based on a single evaluation, this CA enables civil aviation authorities (CAAs) of SAM States to issue the advanced RNP (A-RNP) authorisation, which covers the following navigation specifications:

Navigation specifications	***SRVSOP CA***
RNAV 5	AC 91-002
RNAV 1	AC 91-003
RNAV 2	AC 91-003
RNP 2	AC 91-005
RNP 1	AC 91-006
RNP APCH: LNAV - LNAV/VNAV	AC 91-008
RNP APCH: LP - LPV	AC 91-011

2.3 Likewise, A-RNP may be associated to the elements described in the following table:

Description	***Reference***	***Performance/Functionality***
Higher continuity	CA 91-007 paragraph 8.2.1.2 c)	Optional
RNP scalability	CA 91-007 Appendix 1, 1.4 a)	Optional
Constant radius arc to a fix / radius to a fix (RF)	CA 91-007 Appendix 4	**Required**
Fixed radius transition (FRT)	CA 91-007 Appendix 5	Optional
Time of arrival control (TOAC)	CA 91-007 Appendix 6 *(to be developed)*	Optional
Baro-VNAV	CA 91-010	Optional

2.4 In turn, CA 91-012 – Aircraft and operators approval for RNP 0.3 operations, covers mainly helicopters, although it may also be applied to fixed-wing aircraft. This is the first CA that exclusively addresses RNP operations by helicopters.

3 **Suggested action:**

3.1 The Meeting is invited to:

a) discuss and analyse the documents contained in Appendix A to this working paper, which will be presented for approval to next SAM/IG.

APPENDIX A

ADVISORY CIRCULAR
CA 91-007

AIRCRAFT AND OPERATOR APPROVAL FOR ADVANCED RNP (A-RNP) OPERATIONS

A-RNP JOB AID

ADVISORY CIRCULAR
CA 91-012

AIRCRAFT AND OPERATOR APPROVAL FOR RNP 0.3 OPERATIONS

RNP 0.3 JOB AID

ADVISORY CIRCULAR

CA : 91-007
DATE : 25/04/14
REVISION : Original
ISSUED BY : SRVSOP

SUBJECT: AIRCRAFT AND OPERATOR APPROVAL FOR ADVANCED RNP (A-RNP) OPERATIONS

1. PURPOSE

This advisory circular (AC) establishes criteria on aircraft and operators approval for Advanced RNP (A-RNP) operations.

An operator may use alternate means of compliance, provided those means are acceptable to the Civil Aviation Administration (CAA).

The future tense of the verb or the term “shall” apply to operators who choose to meet the criteria set forth in this AC.

2. RELEVANT SECTIONS OF THE LATIN AMERICAN AERONAUTICAL REGULATIONS (LAR) OR EQUIVALENT

LAR 91: Sections 91.1015 and 91.1640 or equivalents

LAR 121: Section 121.995 (b) or equivalent

LAR 135: Section 135.565 (c) or equivalent

3. RELATED DOCUMENTS

Annex 6	Operation of aircraft
	Part I – International commercial air transport – Aeroplanes
	Part II – International general aviation - Aeroplanes
Annex 10	Aeronautical communications
	Volume I: Radio navigation aids
Annex 15	Aeronautical information services
ICAO Doc 9613	Performance based navigation (PBN) manual
ICAO Doc 4444	Procedures for air navigation services – Air traffic management (PANS-ATM)
ICAO Doc 8168	Procedures for air navigation services - Aircraft operations
	Volume I: Flight procedures
	Volume II: Construction of visual and instrument flight procedures

4. DEFINITIONS AND ABBREVIATIONS

4.1 Definitions

a) **Aircraft-based augmentation system (ABAS)**.- A system which 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 the receiver autonomous integrity monitoring (RAIM).

b) **Area navigation (RNAV)**.- A navigation method that allows aircraft to operate on any desired flight path within the coverage of ground or space-based navigation aids, or within the limits of the capability of self-contained aids, or a combination of both methods.

Note.- *Area navigation includes performance-based navigation as well as other RNAV operations that do not meet the definition of performance-based navigation.*

c) **Flight technical error (FTE)**.- The FTE is the accuracy with which an aircraft is controlled, as measured by the indicated aircraft position with respect to the indicated command or desired position. It does not include procedural blunder errors.

d) **Global navigation satellite system (GNSS)**.- A generic term used by the International Civil Aviation Organization (ICAO) to define any global position, speed, and time determination system that includes one or more main satellite constellations, such as GPS and the global navigation satellite system (GLONASS), aircraft receivers and several integrity monitoring systems, including aircraft-based augmentation systems (ABAS), satellite-based augmentation systems (SBAS), such as the wide area augmentation systems (WAAS), and ground-based augmentation systems (GBAS), such as the local area augmentation system (LAAS).

Distance information will be provided, at least in the immediate future, by GPS and GLONASS.

e) **Global positioning system (GPS)**.- The global positioning system (GNSS) of the United States is a satellite-based radio navigation system that uses precise distance measurements to determine the position, speed, and time in any part of the world. The GPS is made up by three elements: the spatial, the control, and the user elements. The GPS spatial segment nominally consists of, at least, 24 satellites in 6 orbital planes. The control element consists of 5 monitoring stations, 3 ground antennas, and one main control station. The user element consists of antennas and receivers that provide the user with position, speed, and precise time.

f) **Navigation specifications**.- Set of aircraft and flight crew requirements needed to support performance-based navigation operations within a defined airspace. There are two kinds of navigation specifications:

Required Navigation Performance (RNP) Specification.- A navigation specification based on area navigation that includes the requirement for on-board performance monitoring and alerting, designated by the prefix RNP; *e.g.,* RNP 4, RNP APCH, RNP AR APCH.

Area Navigation (RNAV) Specification.- A navigation specification based on area navigation that does not include the requirement for on-board performance monitoring and alerting, designated by the prefix RNAV; *e.g.*, RNAV 5, RNAV 2, RNAV 1.

Note 1.- *The Manual on Performance-based Navigation (PBN) (Doc 9613), Volume II, contains detailed guidelines on navigation specifications.*

Note 2.- *The term RNP, formerly defined as "a statement of the navigation performance necessary for operation within a defined airspace", has been deleted from the Annexes to the Convention on International Civil Aviation because the RNP concept has been replaced by the PBN concept. In said Annexes, the term RNP is now only used within the context of the navigation specifications that require on-board performance control and alerting; e.g., RNP 4 refers to the aircraft and the operational requirements, including a lateral performance of 4 nautical miles (NM), with the requirement for on-board performance control and alerting as described in the PBN Manual of the International Civil Aviation Organization (ICAO) (Doc 9613).*

g) **Navigation system error (NSE)**.- The difference between the true position and the estimated position.

h) **Path definition error (PDE)**.- The difference between the defined path and the desired path at a given place and time.

i) **Performance-based navigation (PBN)**.- Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure, or in a designated airspace.

Note.- *Performance requirements are expressed in navigation specifications (RNAV and RNP specifications) in terms of accuracy, integrity, continuity, availability, and functionality needed for the proposed operation in the context of a particular airspace concept.*

j) **Receiver autonomous integrity monitoring (RAIM)**.- A technique used in a GPS receiver/processor to determine the integrity of its navigation signals, using only GPS signals or GPS signals enhanced with barometric altitude data. This determination is achieved by a consistency check among redundant pseudo-range measurements. At least one additional available satellite is required with respect to the number of satellites that are needed for the navigation solution.

k) **RNP operations**.- Aircraft operations that use an RNP system for RNP navigation applications.

l) **RNP system**.- An area navigation system that supports on-board performance monitoring and alerting.

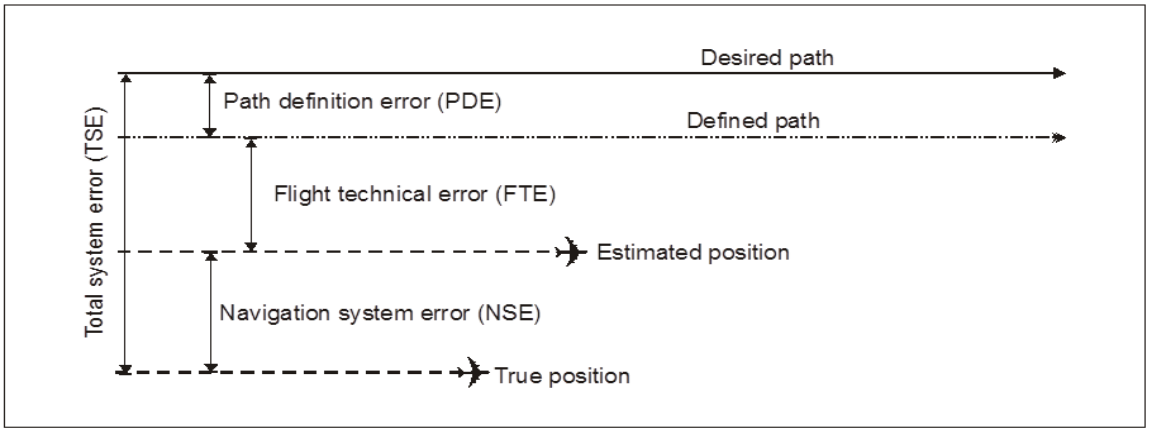
m) **Standard instrument arrival (STAR)**.- A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.

n) **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.

o) **Total system error (TSE)**.- The difference between the true position and the desired position. This error is equal to the vector sum of the path definition error (PDE), flight technical error (FTE), and navigation system error (NSE).

Note.- *On occasions, the FTE is known as path steering error (PSE), and the NSE as position estimation error (PEE).*

Total system error (TSE)



p) **Waypoint (WPT)**.- A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Waypoints area identified as either:

Fly-by waypoint.- A waypoint which requires turn anticipation to allow tangential interception of the next segment of a route or procedure.

Fly over waypoint.- A waypoint at which a turn is initiated in order to join the next segment of a route or procedure.

4.2 Abbreviations

a)	ABAS	Aircraft-based augmentation system
b)	AC	Advisory circular
c)	ADS	Automatic dependent surveillance

d)	ADS-B	Automatic dependent surveillance - broadcast
e)	ADS-C	Automatic dependent surveillance – contract
f)	AFCS	Automatic flight control system
g)	AFM	Aircraft flight manual
h)	A-RNP	Advanced RNP
i)	AIP	Aeronautical information publication
j)	AIRAC	Aeronautical information regulation and control
k)	ANP	Actual navigation performance
l)	ANSP	Air navigation service providers
m)	AP	Automatic pilot
n)	APV	Approach procedure with vertical guidance
o)	APV/baro-VNAV	Approach procedure with vertical guidance/Barometric vertical navigation
p)	ARP	Aerodrome reference point
q)	ASBU	Aviation system block upgrades
r)	ATC	Air traffic control
s)	ATM	Air traffic management
t)	ATN	Aeronautical telecommunication network
u)	ATS	Air traffic service
v)	baro-VNAV	Barometric vertical navigation
w)	CA	Advisory circular (SRVSOP)
x)	CA	Course to an altitude
y)	CAA	Civil Aviation Administration/Civil Aviation Authority
z)	CDI	Course deviation indicator
aa)	CDU	Control and display unit
bb)	CF	Course to a fix
cc)	CPDLC	Controler-pilot data link communications
dd)	Doc	Document
ee)	DCPC	Direct controller-pilot communication
ff)	DF	Direct to a fix
gg)	DME	Distance-measuring equipment
hh)	DV	Flight dispatcher (SRVSOP)
ii)	EASA	European Aviation Safety Agency
jj)	EHSI	Electronic horizontal situation indicator
kk)	EPE	Estimated position error
ll)	EPU	Estimated position uncertainty
mm)	FA	Course from a fix to an altitude

nn)	FAA	Federal Aviation Administration (United States)
oo)	FAF	Final approach fix
pp)	FAP	Final approach point
qq)	FAS	Final approach segment
rr)	FD	Flight director
ss)	FM	Course from a fix to manual termination
tt)	Fly-by WPT	Fly-by way-point
uu)	Flyover WPT	Flyover way-point
vv)	FMS	Flight management system
ww)	FRT	Fixed radius transition
xx)	FTE	Flight technical error
yy)	GA	General aviation
zz)	GANP	Global air navigation plan
aaa)	GBAS	Ground-based augmentation system
bbb)	GNSS	Global navigation satellite system
ccc)	GLONASS	Global navigation satellite system
ddd)	GPS	Global positioning system
eee)	GS	Ground speed
fff)	HAL	Horizontal alerting limit
ggg)	HIL	Horizontal integrity limit
hhh)	HM	Holding to manual termination
iii)	HPL	Horizontal protection level
jjj)	HSI	Horizontal situation indicator
kkk)	IF	Initial fix
lll)	IFP	Instrument flight procedure
mmm)	IFR	Instrument flight rules
nnn)	IMC	Instrument meteorological conditions
ooo)	IPC	Illustrated parts catalogs
ppp)	LAAS	Local area augmentation system
qqq)	LAR	Latin American Aeronautical Regulations
rrr)	LNAV	Lateral navigation
sss)	LOA	Letter of authorisation/letter of acceptance
ttt)	LOI	Loss of integrity
uuu)	MCDU	Multifunction control and display unit
vvv)	MCM	Maintenance control manual
www)	MEL	Minimum equipment list
xxx)	MIO	Operations inspector manual (SRVSOP)

yyy)	NM	Nautical mile
zzz)	NAA	National airworthiness authority
aaaa)	NAVAID	Navigation aid
bbbb)	NDB	Non-directional radio beacon
cccc)	NOTAM	Notice to airmen
dddd)	NPA	Non-precision approach
eeee)	NSE	Navigation system error
ffff)	LNAV	Lateral navigation
gggg)	OACI	International Civil Aviation Organization
hhhh)	OM	Operations manual
iiii)	OEM	Original equipment manufacturer
jjjj)	OpSpecs	Operations specifications
kkkk)	PA	Precision approach
llll)	PANS-ATM	Procedures for air navigation services - Air traffic management
mmmm)	PANS-OPS	Procedures for air navigation services - Aircraft operations
nnnn)	PBN	Performance-based navigation
oooo)	PDE	Path definition error
pppp)	PEE	Position estimation error
qqqq)	PF	Pilot flying
rrrr)	PINS	Point-in-space
ssss)	POH	Pilot operating handbook
tttt)	P-RNAV	Precision area navigation
uuuu)	PSE	Path steering error
vvvv)	RAIM	Receiver autonomous integrity monitoring
wwww)	RF	Constant radius arc to a fix / Radius to fix
xxxx)	RNAV	Area navigation
yyyy)	RNP	Required navigation performance
zzzz)	RNP APCH	Required navigation performance approach
aaaaa)	RNP AR APCH	Required navigation performance authorisation required approach
bbbbb)	RTCA	Radio Technical Commission for Aviation
ccccc)	SBAS	Satellite-based augmentation system
ddddd)	SID	Standard instrument departure
eeeee)	SIS	Signal-in-space
fffff)	SRVSOP	Regional Safety Oversight Cooperation System
ggggg)	STAR	Standard instrument arrival
hhhhh)	STC	Supplemental type certificate
iiiii)	TF	Track to a fix

jjjjj)	TOAC	Time of arrival control
kkkkk)	TOGA	Take-off/go-around
lllll)	TSE	Total system error
mmmmm)	TSO	Technical standard order
nnnnn)	VA	Heading to an altitude
ooooo)	VI	Heading to an intercept
ppppp)	VM	Heading to a manual termination
qqqqq)	VMC	Visual meteorological conditions
rrrrr)	VNAV	Vertical navigation
sssss)	VOR	Very high frequency omnidirectional radio range
ttttt)	WAAS	Wide area augmentation system
uuuuu)	WGS	World geodetic system
vvvvv)	WPT	Waypoint

5. INTRODUCTION

5.1 The Advanced RNP (A-RNP) is designed for operations in oceanic/remote airspace, on the continental en-route structure, on arrival and departure routes and approaches.

5.2 This AC provides specific criteria on aircraft and operators approval for A-RNP operations on air traffic service (ATS) routes, standard instrument departures (SIDs), standard instrument arrivals (STARs) and approaches.

5.3 The qualification and operational authorizations encompass oceanic, remote, en-route, terminal area and approach operations, significantly reducing the amount of individual assessments associated with multiple, existing navigation specifications (or new ones that may be added), to only those aspects of operator criteria or operational examination that are not covered by the A-RNP qualification or operator approval.

5.4 The A-RNP also provides specific criteria for a single assessment of aircraft eligibility that will apply to more than one navigation accuracy requirement and multiple applications across all phases of flight.

5.5 With respect to the lateral navigation accuracy and functional requirements that pertain to other navigation applications that have been included in the area navigation (RNAV) and required navigation performance (RNP) advisory circulars published by the Latin American Regional Safety Oversight Cooperation System (SRVSOP), those shown in Table 1 are considered as being addressed in full by this navigation specification.

Table 1 - Navigation specifications addressed by A-RNP

Navigation specification	*SRVSOP PBN advisories circulars*
RNAV 5	AC 91-002
RNAV 1	AC 91-003
RNAV 2	AC 91-003
RNP 2	AC 91-005
RNP 1	AC 91-006

Navigation specification	*SRVSOP PBN advisories circulars*
RNP APCH: LNAV - LNAV/VNAV	AC 91-008
RNP APCH: LP - LPV	AC 91-011

5.6 For en-route and terminal applications, this navigation specification has requirements that only address the lateral aspects of navigation. For approaches, the lateral navigation accuracy and functional requirements are also addressed, while the vertical navigation (VNAV) requirements along the final approach segment (FAS) are as described within the RNP APCH navigation specification in SRVSOP AC 91-008 and/or AC 91-011, and are not reproduced in this AC.

5.7 This navigation specification, in common with others, may be associated in terms of an airspace design through either routes or instrument flight procedures (IFPs) with other functional elements included in this AC either as paragraphs or appendixes or through other AC, as shown in Table 2.

Table 2 - Additional functional elements

Description	*Reference*	*Performance/Functionality*
Higher continuity	8.2.1.2 c)	Optional
RNP scalability	Appendix 1, 1.4 a)	Optional
Radius to fix (RF)	Appendix 4	**Required**
Fixed radius transition (FRT)	Appendix 5	Optional
Time of arrival control (TOAC)	Appendix 6 *(to be developed)*	Optional
Baro-VNAV	CA 91-010	Optional

5.8 An A-RNP aircraft qualification can be more broadly applicable to multiple navigation specifications without the need for re-examination of aircraft eligibility. This enables an operator's approved procedures, training, etc., to be common to multiple navigation applications. The A-RNP aircraft qualification will also facilitate multiple operational specification approvals.

5.9 This AC does not address all the requirements that may be specified for operation on a particular route or in a particular area. These requirements are specified in other documents such as operating rules, aeronautical information publications (AIPs) and the *Regional Supplementary Procedures* (ICAO Doc 7030).

5.10 While operational approval primarily relates to the navigation requirements of the airspace, operators and flight crew are still required to take account of all operational documents relating to the airspace that are required by the appropriate State authority before conducting flights into that airspace.

5.11 For A-RNP some features/requirements may be required in one flight phase and optional or unnecessary in another. No distinctions are made regarding this flight phase association in providing a general set of criteria covering all phases and navigation applications. Where such differences are deemed important or the operational need is for one application, a more application specific navigation specification, e.g. RNP 1, is expected to be used instead.

5.12 The area navigation capability required for A-RNP will encompass the lateral aspects of the desired flight path. The predictability and performance monitoring and alerting for the lateral flight path will support a number of applications including closely spaced tracks, RNP departures/arrivals, and RNP approaches.

5.13 The accuracy, integrity and continuity requirements of this RNP navigation specification may enable implementation in airspace where there is no conventional navigation available. Alternatively, where conventional navigation is available, this will allow the decommissioning of existing very high frequency omnidirectional radio range (VOR) and non-directional radio beacon (NDB) facilities. This navigation specification also permits the implementation of higher density routes where, presently, there is insufficient ground NAVAID infrastructure to support such operations.

5.14 The A-RNP operation relies solely on the integrity of the RNP system without recourse to conventional means of navigation, such as VOR or NDB.

5.15 As conventional navigation may not be available, reversionary operation must be achieved by other means. Carriage of a single RNP system is considered generally acceptable such that where more stringent requirements (e.g. dual RNP system) exist, these carriage requirements must be promulgated through the State AIP and/or in Doc 7030. It is recommended that the Air navigation service provider (ANSP) develop alternate means to manage a system-wide failure. The solution for the implementation of a particular operation is expected to be established through safety cases.

5.16 This navigation specification provides guidance and criteria for the range of navigation accuracies identified by the PBN specifications listed in Table 1. It is intended that this navigation specification may also be applied for other navigation accuracy requirements not covered by the ones listed, e.g. less than 1 NM in terminal airspace applications. However, it is expected that the criteria of RNAV/RNP advisory circulars developed by the SRVSOP will be followed in determining how the operational requirements and application correlate to this navigation specification.

5.17 Where the final determination results in the identification of the A-RNP navigation specification as the appropriate standard, but where a different navigation accuracy requirement is necessary, this may require a re-examination of this aspect of aircraft qualification and compliance.

5.18 It is envisaged that A-RNP will be implemented in support of the ICAO Aviation System Block Upgrades (ASBU) and Global Air Navigation Plan (GANP).

Note.- *It should be noted that the application and implementation of A-RNP is complex. As such, adherence to the principles and processes described in this AC, is encouraged.*

6. GENERAL CONSIDERATIONS

6.1 Navigation aid infrastructure

a) A-RNP is based upon Global navigation satellite system (GNSS).

b) Multi-Distance-measuring equipment (DME) ground infrastructure is not required but may be provided based upon the State requirements, operational requirements and available services.

c) The detailed requirements of the operation will be set out in the State AIP and, where regional requirements are appropriate, will be identified in Doc 7030.

d) ANSPs should ensure operators relying on GNSS are required to have the means to predict the availability of GNSS fault detection (e.g. Aircraft-based augmentation system/Receiver autonomous integrity monitoring – ABAS/RAIM) to support the required navigation accuracy along the RNP route or procedure.

e) The on-board RNP system, GNSS avionics, the ANSP or other entities, may provide a prediction capability.

f) The AIP should clearly indicate when prediction capability is required and acceptable means to satisfy that requirement.

6.2 Communications and ATS surveillance

a) ATS surveillance may be used to mitigate the risk of gross navigation errors, provided that the procedure lies within the ATS surveillance and communications service volumes, and the ATS resources are sufficient for the task. For certain A-RNP navigation applications, radar

surveillance may be required.

b) Where ATS surveillance relies upon the same system that supports the navigation function [e.g. Automatic dependent surveillance (ADS)], consideration has to be given to the risks associated with loss of navigation function, the impact on the ATS surveillance function and the requirement for appropriate mitigation techniques. This will typically be addressed through the regional or local State safety case prepared in support of the application.

c) The provisions relating to separation minima, including the communications and ATS surveillance requirements can be found in Annex 11 and PANS-ATM (Doc 4444) for the appropriate application. Controller-pilot data link communications (CPDLC) [Future air navigation system 1/A (FANS1/A)] and Automatic dependent surveillance - contract (ADS-C) or Automatic dependent surveillance - broadcast (ADS-B), or CPDLC [Aeronautical telecommunication network (ATN)] or ADS-B may be used providing they support the reporting rate required for the applications.

6.3 Obstacle clearance, route spacing and horizontal separation

a) Guidance for the application of A-RNP is provided in the Procedures for air navigation services – Aircraft operations (PANS-OPS) (Doc 8168) and Procedures for air navigation services – Air traffic management (PANS-ATM) (Doc 4444). It should be noted that the application of navigation accuracies of less than 1.0 NM, or where the operational requirement dictates a navigation accuracy greater than 1.0 NM with tenths of nautical miles, will be determined by the availability of appropriate procedure design and route spacing criteria

6.4 Publications

a) The State AIP should clearly indicate that the navigation application is A-RNP.

6.5 Parallel offset considerations

a) Where parallel offsets are applied and a course change exceeds 90 degrees, the navigation system can be expected to terminate the offset no later than the fix where the course change occurs. The offset may also be terminated if the route segment ends at a hold fix.

7. AIRWORTHINESS AND OPERATIONAL APPROVAL

7.1 For a commercial air transport operator to be granted a A-RNP approval, it must comply with two types of approvals:

a) the airworthiness approval, issued by the State of registry; and

b) the operational approval, issued by the State of the operator.

7.2 For general aviation operators, the State of registry will determine whether or not the aircraft meets the applicable A-RNP requirements and will issue the operational approval (*e.g.*, letter of authorisation – LOA).

7.3 Before filing the application, operators shall review all aircraft qualification requirements. Compliance with airworthiness requirements or equipment installation alone does not constitute operational approval.

7.4 This navigation specification provides technical and operational criteria but does not imply a need for recertification if an aircraft has been assessed in a prior qualification. Any operator with RNP operational approvals consistent with this navigation specification may conduct RNP or RNAV operations whose designated navigation accuracy is 0.3 (final approach only), 1, 2 and 5 NM, and which may have specified functional attributes, e.g. RF legs or FRTs (see Appendices 4 and 5 of this AC). It is expected that with A-RNP, the manufacturer's airworthiness approval/assessment will only be performed once and will be considered applicable to multiple applications. For the operators it is expected that operator procedures, maintenance, dispatch and other operations processes that satisfy the A-RNP criteria will be considered acceptable for RNAV 1, RNAV 2, RNAV 5, RNP 2, RNP 1 and RNP APCH operations down to LNAV and LNAV/VNAV minima (see SRVSOP AC 91-008). However,

it is still recognized that the CAA granting the operational approval will still perform an assessment of the operator with due consideration given (i.e. credit) for any prior examinations and approvals, resulting in an abbreviated review and shorter approval cycle.

7.5 For other applications besides the ones just addressed, there may be additional requirements associated with the operation that will be factored into the assessment and reviews for the operational approval, even though the aircraft navigation performance may be satisfactory.

7.6 Existing manufacturer compliance findings and operator approvals that follow regulatory guidance consistent with the navigation specifications for RNAV 1, RNAV 2, RNAV 5, RNP APCH operations down to LNAV and LNAV/VNAV minima, RNP 1, and RNP 2 are not impacted by this navigation specification for the associated operations. If a manufacturer or operator has already obtained such approvals, a re-examination of the aircraft or operator for those operations relative to A-RNP by the CAA is unnecessary. In this latter case, the manufacturer and operator may only need to undertake the A-RNP airworthiness qualification and operator criteria to facilitate acceptance and flexibility for new applications predicated upon A-RNP capability or performance not covered by existing navigation specifications.

Note.- *Where appropriate, States may refer to previous operational approvals in order to expedite this process for individual operators where performance and functionality are applicable to the current request for operational approval.*

8. AIRWORTHINESS APPROVAL

8.1 Aircraft eligibility

a) The aircraft eligibility has to be determined through demonstration of compliance against the relevant airworthiness criteria and the requirements of 8.2. The aircraft original equipment manufacturer (OEM) or the holder of installation approval for the aircraft, e.g. Supplemental type certificate (STC) holder, will demonstrate compliance to the CAA and the approval can be documented in manufacturer documentation (e.g. service letters). Aircraft flight manual (AFM) entries are not required provided the CAA accepts manufacturer documentation.

b) The aircraft OEM or the holder of installation approval for the aircraft should document demonstration of compliance with the A-RNP capability and highlight any limitations of functionality and performance.

Note- *Requests for approval to use optional functionality (e.g. FRT) should address the aircraft and operational requirements as described in the corresponding paragraps, appendixes and AC included in Table 2 of this AC.*

8.2 Aircraft requirements

a) This section describes the aircraft performance and functional criteria for aircraft to qualify for applications requiring A-RNP. Aircraft eligible for A-RNP operations must meet all of the requirements of this section. The significant functional and performance requirements for A-RNP described herein are for RF legs, parallel offsets, RNAV holding, and the options for scalability, higher continuity, FRTs and TOAC.

b) Approved RNP AR systems are considered to meet the system performance monitoring and alerting requirements without further examination. However, this navigation specification contains additional functional requirements that are not included with the RNP AR APCH navigation specification, e.g. RF, RNAV holding, parallel offset and FRT. If such capabilities have been demonstrated and are contained in an approved RNP AR system, documentation of compliance may be all that is necessary. If such capabilities are added to an RNP AR system or part of a new RNP system, they will be subject to typical regulatory reviews, demonstrations, tests and approval.

c) To determine systems eligibility, the CAA should consider acceptance of manufacturer documentation of compliance for A-RNP, e.g. FAA ACs 90-105 (), 20-138 () or equivalents.

d) Communications and ATS surveillance equipment must be appropriate for the navigation application.

e) Some features/requirements may be required in one flight phase and optional or unnecessary in another. No distinctions are made regarding this flight phase association in providing a general set of criteria spanning all phases and navigation applications. Where such differences are deemed important, or the operational need is for one application, a more application-specific navigation specification, e.g. RNP 1 should be used instead.

8.2.1 On-board performance monitoring and alerting

8.2.1.1 General

a) On-board performance monitoring and alerting is required. This section provides the criteria for a total system error (TSE) form of performance monitoring and alerting that will ensure a consistent evaluation and assessment of compliance that can be applied across all of the possible applications as stated in 5.

b) The aircraft navigation system, or aircraft navigation system and flight crew in combination, is required to monitor the TSE, and to provide an alert if the accuracy requirement is not met or if the probability that the TSE exceeds two times the accuracy value is larger than 10^{-5}. To the extent operational procedures are used to satisfy this requirement, the crew procedure, equipment characteristics, and installation should be evaluated for their effectiveness and equivalence. Examples of information provided to the flight crew for awareness of navigation system performance include “Estimated position uncertainty - EPU”, “ACTUAL”, “Actual navigation performance - ANP”, and “Estimated position error - EPE”. Examples of indications and alerts provided when the operational requirement is or can be determined as not being met include “UNABLE RNP”, “Nav Accur Downgrad”, GNSS alert, loss of GNSS integrity, TSE monitoring [real time monitoring of navigation sytem error (NSE) and flight technical error (FTE) combined], etc. The navigation system is not required to provide both performance and sensor-based alerts, e.g. if a TSE-based alert is provided, a GNSS alert may not be necessary.

8.2.1.2 System performance

a) **Accuracy.-** During operations in airspace or on routes or procedures designated as RNP, the lateral TSE must be within the applicable accuracy (±0.3 NM to ±2.0 NM) for at least 95 per cent of the total flight time. The along-track error must also be within ± the applicable accuracy for at least 95 per cent of the total flight time. To satisfy the accuracy requirement, the 95 per cent FTE should not exceed one half of the applicable accuracy except for a navigation accuracy of 0.3 NM where the FTE is allocated to be 0.25.

Note.- *The use of a deviation indicator is an acceptable means of compliance for satisfying the FTE part of the lateral TSE with the scaling commensurate with the navigation application*.

b) **Integrity.-** Malfunction of the aircraft navigation equipment is classified as a major failure condition under airworthiness guidance material (i.e. 1×10^{-5} per hour).

c) **Continuity.-** Loss of function is classified as a minor failure condition for applications predicated on this navigation specification. Where a State or application establishes a classification of major, the continuity requirement may be typically satisfied by carriage of dual independent navigation systems.

d) **Signal-in-space (SIS).-** For GNSS RNP system architectures, the aircraft navigation equipment shall provide an alert if the probability of SIS errors causing a lateral position error greater than two times the applicable accuracy (2 × RNP) exceeds 1×10^{-7} per hour.

Note 1.- *The lateral TSE includes positioning error, FTE, PDE and display error. For procedures extracted from the on-board navigation database, PDE is considered negligible due to the navigation database requirements (12), and pilot knowledge and training (11).*

Note 2.- *For RNP systems where the architecture is an integrated, multi-sensor capability and where GNSS integrity is incorporated into a 2 × RNP integrity alert consistent with RTCA/EUROCAE DO-236/ED-75 when performance cannot be met, a separate GNSS integrity alert is not required.*

8.2.2 Criteria for specific navigation services

This section identifies unique issues for the navigation sensors.

a) **Global navigation satellite system (GNSS).-** The sensor must comply with the guidelines in FAA AC 20-138() or FAA AC 20-130A. For systems that comply with FAA AC 20-138(), the following sensor accuracies can be used in the total system accuracy analysis without additional substantiation: GNSS sensor accuracy is better than 36 meters (95 per cent), and augmented GNSS (GBAS or SBAS) sensor accuracy is better than 2 meters (95 per cent). In the event of a latent GNSS satellite failure and marginal GNSS satellite geometry, the probability the TSE remains within the procedure design obstacle clearance volume must be greater than 95 per cent.

Note.- *GNSS-based sensors output a horizontal integrity limit (HIL), also known as a horizontal protection level (HPL) (see FAA AC 20-138() and RTCA/DO-229D for an explanation of these terms). The HIL is a measure of the position estimation error assuming a latent failure is present. In lieu of a detailed analysis of the effects of latent failures on the TSE, an acceptable means of compliance for GNSS-based systems is to ensure the HIL remains less than twice the navigation accuracy, minus the 95 per cent of FTE, during the RNP operation.*

b) **Inertial reference system (IRS).-** An IRS must satisfy the criteria of SRVSOP LAR 121 Appendix G or equivalent. While Appendix G defines the requirement for a 2 NM per hour drift rate (95 per cent) for flights up to 10 hours, this rate may not apply to an RNP system after loss of position updating. Systems that have demonstrated compliance with LAR 121, Appendix G, can be assumed to have an initial drift rate of 8 NM/hour for the first 30 minutes (95 minutes) without further substantiation. Aircraft manufacturers and applicants can demonstrate improved inertial performance in accordance with the methods described in Appendix 1 or 2 of FAA Order 8400.12A.

Note.- *Integrated GPS/INS position solutions reduce the rate of degradation after loss of position updating. For "tightly coupled" GPS/IRUs, RTCA/DO-229C, Appendix R, provides additional guidance.*

c) **Distance measuring equipment (DME).-** For RNP procedures and routes, the RNP system may only use DME updating when authorized by the CAA. The manufacturer should identify any operating constraints (e.g. manual inhibit of DME) in order for a given aircraft to comply with this requirement.

Note 1.- *This is in recognition of States where a DME infrastructure and capable equipped aircraft are available, those States may establish a basis for aircraft qualification and operational approval to enable use of DME. It is not intended to imply a requirement for implementation of DME infrastructure or the addition of RNP capability using DME for RNP operations.*

Note 2.- *This does not imply an equipment capability must exist providing a direct means of inhibiting DME updating. A procedural means for the flight crew to inhibit DME updating or executing a missed approach if reverting to DME updating may meet this requirement.*

d) **VHF Omni-directional range station (VOR).-** For RNP procedures, the RNAV system must not use VOR updating. The manufacturer should identify any operating constraints (e.g. manual inhibit of VOR) in order for a given aircraft to comply with this requirement.

Note.- *This does not imply an equipment capability must exist providing a direct means of inhibiting VOR updating. A procedural means for the flight crew to inhibit VOR updating or executing a missed approach if reverting to VOR updating may meet this requirement.*

e) **For multi-sensor systems**, there must be automatic reversion to an alternate RNAV sensor if the primary RNAV sensor fails. Automatic reversion from one multi-sensor system to another multi-sensor system is not required.

8.3 Functional requirements

Appendix 1 contains the functional requirements that meet the criteria of this AC.

8.4 Continued airworthiness

a) The operators of aircraft approved to perform A-RNP operations, must ensure the continuity of the technical capacity of them, in order to meet technical requirements established in this AC.

b) Each operator who applies for A-RNP operational approval shall submit to the CAA of State of registry, a maintenance and inspection program that includes all those requirements of maintenance necessary to ensure that navigation systems continue fulfilling the A-RNP approval criteria.

c) The following maintenance documents must be revised, as appropriate, to incorporate A-RNP aspects:

1) Maintenance control manual (MCM);

2) Illustrated parts catalogs (IPC); and

3) Maintenance program.

d) The approved maintenance program for the affected aircrafts should include maintenance practices listed in maintenance manuals of the aircraft manufacturer and its components, and must consider:

1) that equipment involved in the A-RNP operation should be maintained according to directions given by manufacturer's components;

2) that any amendment or change of navigation system affecting in any way A-RNP initial approval, must be forwarded and reviewed by the CAA for its acceptance or approval of such changes prior to its implementation; and

3) that any repair that is not included in the approved/accepted maintenance documentation, and that could affect the integrity of navigation performance, should be forwarded to the CAA for acceptance or approval thereof.

e) Within the A-RNP maintenance documentation must be presented the training program of maintenance personnel, which inter alia, should include:

1) PBN concept;

2) A-RNP application;

3) equipment involved in an A-RNP operation; and

4) MEL use.

9. OPERATIONAL APPROVAL

Airworthiness approval alone does not authorise an applicant or operator to conduct A-RNP operations. In addition to the airworthiness approval, the applicant or operator must obtain an operational approval to confirm the suitability of normal and contingency procedures in connection to the installation of a given piece of equipment.

Concerning commercial air transport, the assessment of an application for A-RNP operational approval is done by the State of the operator, in accordance with standing operating rules [*e.g.*, LAR 121.995 (b) and LAR 135.565 (c)] or equivalents supported by the criteria described in this AC.

For general aviation, the assessment of an application for A-RNP operational approval is carried out by the State of registry, in accordance with standing operating rules (*e.g.*, LAR 91.1015 and LAR 91.1640 or equivalents) supported by the criteria established in this AC.

9.1 Requirements to obtain operational approval

9.1.1 In order to obtain A-RNP approval, the applicant or operator will take the following steps, taking into account the criteria established in this paragraph and in Sections 10, 11, 12, and 13:

a) *Airworthiness approval*.- Aircraft shall have the corresponding airworthiness approvals, pursuant to Section 8 of this CA.

b) *Application*.- The operator shall submit the following documentation to the CAA:

1) *A-RNP operational approval application;*

2) *Description of aircraft equipment*.- The operator shall provide a configuration list with details of the relevant components and the equipment to be used for A-RNP operations. The list

shall include each manufacturer, model, and equipment version of GNSS equipment and software of the installed FMS.

3) *Airworthiness documents related to aircraft eligibility*.- The operator shall submit relevant documentation, acceptable to the CAA, showing that the aircraft is equipped with RNP systems that meet the A-RNP requirements, as described in Paragraph 8 of this AC. For example, the operator will submit the parts of the AFM or AFM supplement that contain the airworthiness statement.

4) *Training programme for flight crews and flight dispatchers (DV)*

(a) Commercial operators (*e.g.*, LAR 121 and LAR 135 operators) will present to the CAA the A-RNP training curriculums to show that the operational procedures and practices and the training aspects described in Paragraph 11 have been included in the initial, upgrade or recurrent training curriculums for flight crews and DV.

Note.- *It is not necessary to establish a separate training programme if the A-RNP training identified in Paragraph 11 has already been included in the training programme of the operator. However, it must be possible to identify what aspects of A-RNP are covered in the training programme.*

(b) Private operators (*e.g.*, LAR 91 operators) shall be familiar with and demonstrate that they will perform their operations based on the practices and procedures described in Paragraph 11.

5) *Operations manual and checklists*

(a) Commercial operators (*e.g.*, LAR 121 and 135 operators) must review the operations manual (OM) and the checklists in order to include information and guidance on the operating procedures detailed in Paragraph 10 of this AC. The appropriate manuals must contain the operating instructions for navigation equipment and contingency procedures. The manuals and checklists must be submitted for review along with the formal application in Phase 2 of the approval process.

(b) Private operators (*e.g.*, LAR 91 operators) must operate their aircraft based on the practices and procedures identified in Paragraph 10 of this CA.

6) *Minimum Equipment List (MEL)*.- The operator will send to the CAA for approval any revision to the MEL that is necessary to conduct A-RNP operations. If an A-RNP operational approval is granted based on a specific operational procedure, operators must modify the MEL and specify the required dispatch conditions.

7) *Maintenance*.- The operator will submit for approval a maintenance programme to conduct A-RNP operations.

8) *Training programme for maintenance personnel*.- Operators will submit the training curriculums that correspond to maintenance personnel in accordance with Paragraph 8.4 e).

9) *Navigation data validation programme*.- The operator will present the details about the navigation data validation programme as described in Appendix 2 to this AC.

c) *Training*.- Once the amendments to manuals, programmes, and documents submitted have been accepted or approved, the operator will provide the required training to its personnel.

d) *Validation flight*.- The CAA may deem it advisable to perform a validation flight before granting the operational approval. Such validation could be performed on commercial flights. The validation flight will be carried out according to Chapter 12, Volume II, Part II of the operations inspector manual (MIO) of the Regional Safety Oversight Cooperation System (SRVSOP).

e) *Issuance of the approval to conduct A-RNP operations*.- Once the operator has successfully completed the operational approval process, the CAA will grant the operator the authorization to conduct A-RNP operations.

1) LAR 121 and/or 135 operators.- For LAR 121 and/or LAR 135 operators, the CAA will issue

the corresponding operations specifications (OpSpecs) that will reflect the A-RNP approval.

2) *LAR 91 operators*.- For LAR 91 operators, the CAA will issue a letter of authorization (LOA).

10. OPERATING PROCEDURES

10.1 The operator and flight crews will become familiar with the following operating and contingency procedures associated with A-RNP operations.

a) **Pre-flight planning**

1) Operators and pilots intending to conduct RNP operations requiring A-RNP capability should indicate the appropriate application in the flight plan.

2) The on-board navigation data must be current and appropriate to the route being flown and for potential diversions. Navigation databases are expected to be current for the duration of the flight. If the AIRAC cycle is due to change during flight, operators and pilots should establish procedures to ensure the accuracy of navigation data, including suitability of navigation facilities used to define the routes and procedures for flight.

3) Operators using GNSS equipment should confirm the availability of RAIM by using RAIM availability prediction software taking account of the latest GNSS NOTAMs. Operators using SBAS augmentation should also check the relevant SBAS NOTAMs to determine the availability of SBAS. Notwithstanding preflight analysis results, because of unplanned failure of some GNSS or DME elements (or local interference), pilots must realize that integrity availability (or GNSS/DME navigation altogether) may be lost while airborne which may require reversion to an alternate means of navigation. Therefore, pilots should assess their capability to navigate in case of failure of the primary sensor or the RNP system.

b) **General operating procedures**

1) Operators and pilots should not request or file RNP routes, SIDs, STARs or approaches unless they satisfy all the criteria in the relevant State documents. The pilot should comply with any instructions or procedures identified by the manufacturer, as necessary, to comply with the performance requirements in this chapter.

Note.- *Pilots are expected to adhere to any AFM limitations or operating procedures required to maintain the RNP for the operation.*

2) At system initialization, pilots must confirm the navigation database is current and verify that the aircraft position has been entered correctly. Pilots must not fly an RNP route, SID, STAR or approach unless it is retrievable by name from the on-board navigation database and conforms to the chart. An RNP route, SID, STAR or approach should not be used if doubt exists as to the validity of the procedure in the navigation database.

Note.- *Flight crew may notice a slight difference between the navigation information portrayed on the chart and their primary navigation display. Differences of 3 degrees or less may result from equipment manufacturer's application of magnetic variation and are operationally acceptable.*

3) Cross-checking with conventional NAVAIDs is not required as the absence of integrity alert is considered sufficient to meet the integrity requirements. However, monitoring of navigation reasonableness is suggested, and any loss of RNP capability shall be reported to ATC. While operating on RNP Routes, SIDs, STARs or approaches, pilots are encouraged to use flight director and/or autopilot in lateral navigation mode, if available. Flight crew should be aware of possible lateral deviations when using raw path steering data or navigation map displays for lateral guidance in lieu of flight director. When the dispatch of a flight into RNP operations is predicated on use of the autopilot/flight director at the destination and/or alternate, the dispatcher/flight crew must determine that the autopilot/flight director is installed and operational.

c) **Manual entry of RNP**

If the navigation system does not automatically retrieve and set the navigation accuracy from the on-board navigation database for each leg segment of a route or procedure, the flight crew's operating procedures should ensure the smallest navigation accuracy for the route or procedure is manually entered into the RNP system.

d) **SID specific requirements**

1) Prior to flight, pilots must verify their aircraft navigation system is operating correctly and the correct runway and departure procedure (including any applicable en-route transition) are entered and properly depicted. Pilots who are assigned an RNP departure procedure and subsequently receive a change of runway, procedure or transition must verify the appropriate changes are entered and available for navigation prior to take-off. A final check of proper runway entry and correct route depiction, shortly before take-off, is recommended.

2) **Engagement altitude.-** The pilot must be able to use RNP equipment to follow flight guidance for lateral navigation no later than 153 m (500 ft) above the airport elevation. The altitude at which guidance begins on a given route may be higher (e.g. climb to 304 m (1 000 ft) then direct to …).

3) Pilots must use an authorized method (lateral deviation indicator/navigation map display/flight director/autopilot) to achieve an appropriate level of performance.

4) **GNSS aircraft.-** When using GNSS, the signal must be acquired before the take-off roll commences. For aircraft using FAA Technical standard order (TSO)-C129a equipment, the departure airport must be loaded into the flight plan in order to achieve the appropriate navigation system monitoring and sensitivity. For aircraft using FAA TSO-C145a/C146a equipment, if the departure begins at a runway waypoint, then the departure airport does not need to be in the flight plan to obtain appropriate monitoring and sensitivity.

e) **STAR specific requirements**

1) Prior to the arrival phase, the flight crew should verify that the correct terminal route has been loaded. The active flight plan should be checked by comparing the charts with the map display (if applicable) and the multifunction control and display unit (MCDU). This includes confirmation of the waypoint sequence, reasonableness of tracks and distances, any altitude or speed constraints, and, where possible, which waypoints are fly-by and which are fly-over. If required by a route, a check will need to be made to confirm that updating will exclude a particular NAVAID. A route must not be used if doubt exists as to the validity of the route in the navigation database.

Note.- *As a minimum, the arrival checks could be a simple inspection of a suitable map display that achieves the objectives of this paragraph.*

2) The creation of new waypoints by manual entry into the RNP system by the flight crew would invalidate the route and is not permitted.

3) Where the contingency procedure requires reversion to a conventional arrival route, necessary preparations must be completed before commencing the RNP route.

4) Route modifications in the terminal area may take the form of headings or "direct to" clearances and the flight crew must be capable of reacting in a timely fashion. This may include the insertion of tactical waypoints loaded from the database. Manual entry or modification by the flight crew of the loaded route, using temporary waypoints or fixes not provided in the database, is not permitted.

5) Pilots must verify their aircraft navigation system is operating correctly, and the correct arrival procedure and runway (including any applicable transition) are entered and properly depicted.

6) Although a particular method is not mandated, any published altitude and speed constraints must be observed. Approaches using temporary waypoints or fixes not provided in the navigation database are not permitted.

f) **Contingency procedures**

1) The pilot must notify ATC of any loss of the RNP capability (integrity alerts or loss of navigation), together with the proposed course of action. If unable to comply with the requirements of an RNP SID or STAR, pilots must advise ATS as soon as possible. The loss of RNP capability includes any failure or event causing the aircraft to no longer satisfy the A-RNP requirements of the route.

2) In the event of communications failure, the flight crew should continue with the A-RNP SID or STAR in accordance with the published lost communications procedure.

11. TRAINING PROGRAMMES

11.1 The training programme for flight crews and flight dispatchers (DV) shall provide sufficient training (*e.g*. using flight training devices, flight simulators or aircraft) on the aircraft´s RNP system to the extent necessary. The training programme will include the following topics:

a) The meaning and proper use of aircraft equipment/navigation suffixes;

b) Procedure characteristics as determined from chart depiction and textual description:

1) Depiction of waypoint types (fly-over, fly-by, RF and FRT), altitude and speed restrictions and path terminators as well as associated aircraft flight paths; and

2) Required navigation equipment for operation on RNP routes, SIDs, and STARs;

c) RNP system-specific information:

1) Levels of automation, mode annunciations, changes, alerts, interactions, reversions, and degradation;

2) Functional integration with other aircraft systems;

3) The meaning and appropriateness of route discontinuities as well as related flight crew procedures;

4) Monitoring procedures for each phase of flight (for example, monitor PROG or LEGS page);

5) Types of navigation sensors (GNSS) used by the RNP system and associated system prioritization/weighting/logic;

6) Turn anticipation with consideration to speed and altitude effects;

7) Interpretation of electronic displays and symbols; and

8) Automatic and/ or manual setting of the required navigation accuracy;

d) Understand the performance requirement to couple the autopilot/flight director to the navigation system’s lateral guidance on RNP procedures, if required;

e) The equipment should not permit the flight crew to select a procedure or route that is not supported by the equipment, either manually or automatically (e.g. a procedure is not supported if it incorporates an RF leg and the equipment does not provide RF leg capability). The system should also restrict pilot access to procedures requiring RF leg capability or FRTs if the system can select the procedure, but the aircraft is not otherwise equipped (e.g. the aircraft does not have the required roll steering autopilot or flight director installed);

f) RNP equipment operating procedures, as applicable, including how to perform the following actions:

1) Verify currency and integrity of aircraft navigation data;

2) Verify successful completion of RNP system self-tests;

3) Initialize navigation system position;

4) Retrieve and fly a SID or a STAR with appropriate transition;

5) Adhere to speed and/or altitude constraints associated with a SID or STAR;

6) Select the appropriate STAR or SID for the active runway in use and be familiar with procedures to deal with a runway change;

7) Verify waypoints and flight plan programming;

8) Perform a manual or automatic runway update (with take-off point shift, if applicable);

9) Fly direct to a waypoint;

10) Fly a course/track to a waypoint;

11) Intercept a course/track. (Fly vectors, and rejoin an RNP route/procedure from the "heading" mode);

12) Determine cross-track error/deviation. More specifically, the maximum deviations allowed to support A-RNP must be understood and respected;

13) Where applicable, the importance of maintaining the published path and maximum airspeeds while performing RNP operations with RF legs or FRTs;

14) Insert and delete route discontinuity;

15) Remove and reselect navigation sensor input;

16) When required, confirm exclusion of a specific NAVAID or NAVAID type;

17) When required by the State aviation authority, perform gross navigation error check using conventional NAVAIDs;

18) Change arrival airport and alternate airport;

19) Perform parallel offset function if capability exists. Pilots should know how offsets are applied, the functionality of their particular RNP system and the need to advise ATC if this functionality is not available;

20) Perform RNAV holding function;

21) Flight crew contingency procedures for a loss of RNP capability; and

22) Manual setting of the required navigation accuracy;

Note.- *Operators are strongly encouraged to use manufacturer recommended training and operating procedures.*

g) Operator-recommended levels of automation for phase of flight and workload, including methods to minimize cross-track error to maintain route centre line; and

h) R/T phraseology for RNAV/RNP applications.

12. NAVIGATION DATABASE

a) The operator must obtain the navigation database from a supplier complying with RTCA DO 200A/EUROCAE Document ED 76, Standards for Processing Aeronautical Data, and the database must be compatible with the intended function of the equipment. Regulatory authorities recognize compliance to the referenced standard using an LOA or other equivalent document.

b) Discrepancies that invalidate an RNP Route, SID or STAR must be reported to the navigation database supplier and the affected route, SID or STAR must be prohibited by an operator's notice to its flight crew.

c) For RNP procedures, the database supplier is discouraged from substitution of path terminators in lieu of those specified in the original AIP data. Where this is necessary, there must be coordination with the State or service provider to gain operational acceptability and

approval for such substitutions.

d) Aircraft operators should consider the need to conduct ongoing checks of the operational navigation databases in order to meet existing quality system requirements.

13. OVERSIGHT, INVESTIGATION OF NAVIGATION ERRORS, AND WITHDRAWAL OF A-RNP APPROVAL

a) The operator will establish a process to receive, analyse, and follow up on navigation errors reports in order to determine appropriate corrective action.

b) Information indicating the potential for repeated errors may require modification of an operator´s training programme.

c) Information attributing multiple errors to particular pilots may necessitate remedial training or license review.

d) Repeated navigation error occurrences attributed to specific piece of navigation equipment should result in the cancellation of the approval for the use of that equipment.

APPENDIX 1

FUNCTIONAL REQUIREMENTS

1.1 Displays – guidance, situation and status

Item	*Function/Feature*	*Description*
a)	Continuous display of deviation.	1. The navigation system must provide the capability to continuously display to the pilot flying, on the primary flight instruments for navigation of the aircraft, the aircraft position relative to the RNP defined path. 2. For operations where the required minimum flight crew is two pilots, the means for the pilot not flying to verify the desired path and the aircraft position relative to the path must also be provided. 3. The display must allow the pilot to readily distinguish whether the cross-track deviation exceeds the navigation accuracy (or a smaller value). 4. The numeric display of deviation on a map display with an appropriately scaled deviation indicator is generally considered acceptable for monitoring deviation. 5. Moving map displays without an appropriately scaled deviation indicator may be acceptable depending on the task, flight crew workload, display characteristics, flight crew procedures and training.
b)	Identification of the active (To) waypoint.	The navigation system must provide a display identifying the active waypoint either in the pilot's primary optimum field of view, or on a readily accessible and visible display to the flight crew.
c)	Display of distance and bearing.	The navigation system must provide a display of distance and bearing to the active (To) waypoint in the pilot's primary optimum field of view. Where not viable, a readily accessible page on a control display unit, readily visible to the flight crew, may display the data.
d)	Display of groundspeed and time.	The navigation system must provide the display of groundspeed and time to the active (To) waypoint in the pilot's primary optimum field of view. Where not viable, a readily accessible page on a control display unit, readily visible to the flight crew, may display the data.
e)	Desired track display.	The navigation system must have the capability to continuously display to the pilot flying the aircraft desired track. This display must be on the primary flight instruments for navigation of the aircraft.
f)	Display of aircraft track.	The navigation system must provide a display of the actual aircraft track (or track angle error) either in the pilot's primary optimum field of view, or on a readily accessible and visible display to the flight crew.
g)	Failure annunciation.	The aircraft must provide a means to annunciate failures of

Item	*Function/Feature*	*Description*
		any aircraft component of the RNP system, including navigation sensors. The annunciation must be visible to the pilot and located in the primary optimum field of view.
h)	Slaved course selector.	The navigation system must provide a course selector automatically slaved to the RNP computed path.
i)	Display of distance to go.	The navigation system must provide the ability to display distance to go to any waypoint selected by the flight crew.
j)	Display of distance between flight plan waypoints.	The navigation system must provide the ability to display the distance between flight plan waypoints.
k)	Display of deviation.	The navigation system must provide a numeric display of the lateral deviation with a resolution of 0.1 NM or less.
l)	Display of active sensors.	The aircraft must display the current navigation sensor(s) in use. It is recommended that this display be provided in the primary optimum field of view. ***Note.-*** *This display is used to support operational contingency procedures. If such a display is not provided in the primary optimum field of view, crew procedures may mitigate the need for this display if the workload is determined to be acceptable.*

1.2 Path definition and flight planning

Item	*Function/Feature*	*Description*
	Maintaining tracks and leg transitions.	The aircraft must have the capability to execute leg transitions and maintain tracks consistent with the following ARINC 424 path terminators: *ARINC 424 path terminators* Initial fix (IF) Course to a fix (CF) Direct to a fix (DF) Track to a fix (TF) Radius to fix (RF), see Appendix 4 Course to an altitude (CA) Course from an fix to an altitude (FA) Heading to an altitude (VA) Course from a fix to manual termination (FM) Heading to a manual termination (VM) Heading to an intercept (VI) Holding to manual termination (HM)

		Where approval is sought for FRT in association with this navigation specification, the RNP system must have the capability to create FRTs between route segments, based upon the data contained in the aircraft navigation system database - see Appendix 5 of this AC. ***Note 1.-*** *Path terminators and the FRT are defined in ARINC 424, and their application is described in more detail in RTCA/EUROCAE documents DO-236B/ED-75B and DO-201A/ED-77.* ***Note 2.-*** *The list of path terminators includes a number that introduce variability in the flight path to be flown by the aircraft. For all RNP applications, the preferred path terminators are IF, DF, TF, and RF. Other path terminators may be used on the understanding that they will introduce less repeatability, predictability and reliability of aircraft lateral path performance.* ***Note 3.-*** *For the VA, VM and VI path terminators, if the aircraft is unable to automatically execute these leg transitions, they should be able to be manually flown on a heading to intercept a course or to go direct to another fix after reaching a procedure-specified altitude.*
b)	Leg transition.	Fly-by and fly-over fixes. The aircraft must have the capability to execute fly-by and fly-over fixes. For fly-by turns, the navigation system must limit the path definition within the theoretical transition area defined in EUROCAE ED-75B/ RTCA DO-236B. The fly-over turn is not compatible with RNP flight tracks and will only be used when there is no requirement for repeatable paths. FRTs: Where approval is sought for FRTs, the aircraft must have the capability to execute the function in accordance with Appendix 5 of this AC.
c)	Intercepts.	The RNP system should provide the ability to intercept the final approach at or before the final approach fix (FAF). This functional capability must provide the pilot with the ability to rejoin the published final approach track following a period when the aircraft has been flown manually or in Automatic flight control system (AFCS) heading mode, following ATC vectors to support final approach sequencing. The implementation method and visual information (MCDU and primary displays (map display/EHSI)) shall be sufficient to enable the correct re-acquisition of the track with a minimum of manual intervention on the MCDU. Due account must be taken of the workload associated with the re-acquisition and the impact of errors in leg sequencing.
d)	Holding.	A holding procedure will only normally be required at defined holding points on entry to terminal airspace. However, holding may be required by ATC at any point. A hold shall be defined by a point, the turn direction, an inbound track and an outbound distance. This data may be extracted from the database for published holds or may be manually entered for ad hoc ATC holds. ***Note.-*** *It is highly desirable that the RNP system provide a holding capability that includes the computation of the hold flight path, guidance*

		and/or cues to track the holding entry and path. The system with the minimum of crew intervention must be capable of initiating, maintaining and discontinuing holding procedures at any point and at all altitudes.
e)	Parallel offset.	Parallel offsets provide a capability to fly offset from the parent track, as defined by the series of waypoints. The turn defined for the parent track (fly-by or FRT) shall be applied in the offset track. Parallel offsets are applicable only for en-route segments and are not foreseen to be applied on SIDs, STARs or approach procedures. The activation of an offset shall be clearly displayed to the flight crew and the cross-track deviation indication during the operation of the offset will be to the offset track.
f)	Offset execution.	The system should be capable of flying tracks offset by up to 20 NM from the parent track. The presence of an offset should be continuously indicated; Tracks offset from the parent track shall be continued for all ATS route segments and turns until either: – Removed by the crew; or – Automatically cancelled following: • Amendment of the active flight plan by executing a "Direct-To"; • Commencement of a terminal procedure; • Where a course change exceeds 90°, the RNP system may terminate the offset at the fix where the course change occurs. The offset may also be terminated if the route segment ends at a hold fix. The flight crew shall be given advance notice of this cancellation. The cross-track offset distance should be manually entered into the RNP system to a resolution of 1 NM or better. Where parallel offsets are applied, the lateral track keeping requirement of RNP must be maintained referenced to the offset track. Where FRTs are applied, the offset track must be flown with the same turn radius as the parent track. The cross-track offset distance should be manually entered into the RNP system to a resolution of 1 NM or better. Where parallel offsets are applied, the lateral track-keeping requirement of RNP must be maintained referenced to the offset track.
g)	Entry and recovery from	Transitions to and from the offset track must maintain an

	offsets.	intercept angle of between 30° and 45°.
h)	Capability for a “direct-to” function.	The navigation system must have a “direct-to” function the flight crew can activate at any time. This function must be available to any fix. The navigation system must also be capable of generating a geodesic path to the designated “To” fix without “S-turning” and without undue delay.
i)	Altitudes and/or speeds associated with published terminal procedures.	Altitudes and/or speeds associated with published terminal procedures must be extracted from the navigation database.
j)	Capability to load procedures from the navigation database.	The navigation system must have the capability to load the entire procedure(s) to be flown into the RNP system from the on-board navigation database. This includes the approach (including vertical angle), the missed approach and the approach transitions for the selected airport and runway.
k)	Means to retrieve and display navigation data.	The navigation system must provide the ability for the flight crew to verify the procedure to be flown through review of the data stored in the on-board navigation database. This includes the ability to review the data for individual waypoints and for NAVAIDs.
l)	Magnetic variation.	For paths defined by a course (e.g. CF and FA path terminators), the navigation system should use the appropriate magnetic variation value in the navigation database.
m)	Changes in navigation accuracy.	The RNP system should automatically retrieve and set the navigation accuracy for each leg segment of a route or procedure from the on-board navigation database. When a change occurs to a smaller navigation accuracy, e.g. from RNP 1.0 to RNP 0.3, the change must be complete by the first fix defining the leg with the smaller navigation accuracy requirement. The timing of this change must also consider any latency in alerting from the RNP system. When the RNP system cannot automatically set the navigation accuracy for each leg segment, any operational procedures necessary to accomplish this must be identified. ***Note.-*** *One acceptable means to meet this requirement may be to require the flight crew to manually set the smallest navigation accuracy the route or procedure uses before commencing the route or procedure (i.e. prior to the ÍAF).* If the navigation accuracy for the RNP system has been set manually by the flight crew and following an RNP system change to the navigation accuracy required (e.g. the next flight path segment contains a different navigation accuracy), the RNP system should provide an alert to the flight crew.
	Automatic leg sequencing.	The navigation system must provide the capability to automatically sequence to the next leg and display the sequencing to the flight crew in a readily visible manner.

1.3 System

Item	*Function/Feature*	*Description*
a)	*Design assurance.*	The system design assurance must be consistent with at least a major failure condition for the display of misleading lateral or vertical guidance in RNP applications.
b)	*Navigation database.*	The aircraft navigation system must use an on-board navigation database, containing current navigation data officially promulgated for civil aviation, which can be updated in accordance with the AIRAC cycle; and allow retrieval and loading of procedures into the RNP system. The stored resolution of the data must be sufficient to achieve negligible PDE. The on-board navigation database must be protected against flight crew modification of the stored data. When a procedure is loaded from the database, the RNP system must fly the procedure as published. This does not preclude the flight crew from having the means to modify a procedure or route already loaded into the RNP system. However, the procedures stored in the navigation database must not be modified and must remain intact within the navigation database for future use and reference. The aircraft must provide a means to display the validity period for the on-board navigation database to the flight crew. The equipment should not permit the flight crew to either manually or automatically select a route that is not supported. A route is not supported if it incorporates an FRT and the equipment does not provide FRT capability. The RNP system should also restrict pilot access to routes requiring FRTs if the equipment can support the route, but the aircraft is not otherwise equipped (e.g. the aircraft does not have the required roll steering autopilot or flight director installed). ***Note.-*** *An alternate means of satisfying this requirement is to remove such routes from the navigation database.*

1.4 Optional capability

Item	*Function/Feature*	*Description*
a)	*RNP scalability*	The RNP system must be capable of manual or automatic entry and display of navigation accuracy requirements in tenths of NM between 0.3 and 1.0 NM. The RNP system must provide lateral deviation

Item	*Function/Feature*	*Description*
		displays and alerting appropriate to the selected navigation accuracy and application. ***Note.-*** *One means by which this can be achieved is as described in RTCA MOPS DO-283A. Another means is to develop lateral deviation displays and alerting as per RTCA/EUROCAE MASPS DO-236B/ED-75B.* ***Note.-*** *It is recognized that aircraft and equipment that are based upon GNSS standards such as RTCA DO-208() and DO-229() have RNP capabilities for lateral deviation and alerting that are generally associated with navigation accuracies of 0.3, 1.0, and 2.0 NM only. Such capability exists in a large portion of the aircraft fleet but may not be extended to other navigation accuracies or the means of compliance specified herein. Additionally, some of this fleet does provide the capability to select other navigation accuracies. Therefore, before a manufacturer implements or an operator applies this functional capability, it is recommended that they determine the effects of the resolution of a number of issues including:* *1) How their aircraft and systems will be affected or accommodated operationally when different navigation accuracy requirements are needed;* *2) Is there a basis for implementing improved functionality or operating procedures; and* *3) How such systems will need to be qualified, used by the flight crew and operationally approved.*

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APPENDIX 2

NAVIGATION DATA VALIDATION PROGRAMME

1. INTRODUCTION

The information stored in the navigation database defines the lateral and longitudinal guidance of the aircraft for A-RNP. Navigation database updates are carried out every 28 days. The navigation data used in each update are critical to the integrity of every A-RNP route. This appendix provides guidance on operator procedures to validate the navigation data associated with the A-RNP operations.

2. DATA PROCESSING

a) The operator will identify in its procedures the person responsible for the navigation data updating process.

b) The operator must document a process for accepting, verifying, and loading navigation data into the aircraft.

c) The operator must place its documented data process under configuration control.

3. INITIAL DATA VALIDATION

3.1 The operator must validate every A-RNP route to ensure compatibility with the aircraft and to ensure that the resulting paths are consistent with the published routes. As a minimum, the operator must:

a) compare the navigation data of A-RNP routes to be loaded into the FMS with valid charts and maps containing the published routes; and

b) once the A-RNP routes are validated, a copy of the validated navigation data shall be kept and maintained in order to compare them with subsequent data updates.

4. DATA UPDATING

Upon receiving a navigation data update and before using such data on the aircraft, the operator must compare the update with the validated routes. This comparison must identify and resolve any discrepancy in the navigation data. If there are significant changes (any change affecting the path or the performance of the route) in any part of the route, and if those changes are verified through the initial data, the operator must validate the amended route in accordance with the initial validation data.

5. NAVEGATION DATA SUPPLIERS

Navigation data suppliers must have a letter of acceptance (LOA) in order to process these data (*e.g.*, FAA AC 20-153 or the document on the conditions for the issuance of letters of acceptance to navigation data suppliers by the European Aviation Safety Agency – EASA (EASA IR 21 Subpart G) or equivalent documents). A LOA recognises the data supplier as one whose data quality, integrity and quality management practices are consistent with the criteria of DO-200A/ED-76. The database supplier of an operator must have a Type 2 LOA and its respective suppliers must have a Type 1 or 2 LOA. The CAA may accept a LOA issued to navigation data suppliers or issue its own LOA.

6. AIRCRAFT MODIFICATIONS (DATABASE UPDATE)

If an aircraft system necessary for A-RNP operations is modified (*e.g.*, change of

software), the operator is responsible for validating the A-RNP routes with the navigation database and the modified system. This can be done without any direct assessment if the manufacturer confirms that the modification has no effect on the navigation database or on path calculation. If there is no such confirmation by the manufacturer, the operator must perform an initial validation of the navigation data with the modified system.

APPENDIX 3

A-RNP APPROVAL PROCESS

a) The A-RNP approval process consists of two types of approvals, airworthiness and operational. Although the two have different requirements, they must be considered in one single process.

b) This process is an orderly method used by the CAA to make sure that the applicants meet the established requirements.

c) The approval process is made up by the following phases:

1) Phase one: Pre-application

2) Phase two: Formal application

3) Phase three: Documentation evaluation

4) Phase four: Inspection and demonstration

5) Phase five: Approval

d) In *Phase one - Pre-application*, the CAA calls the applicant or operator to a pre-application meeting. At this meeting, the CAA informs the applicant or operator of all the operational and airworthiness requirements that it must meet during the approval process, including the following:

1) the contents of the formal application;

2) the review and evaluation of the application by the CAA;

3) the limitations (if any) applicable to the approval; and

4) conditions under which the A-RNP approval could be cancelled.

e) In *Phase two – Formal Application*, the applicant or operator submits the formal application along with all the relevant documentation, as established in Paragraph 9.1.1 b) of this AC.

f) In Phase three – *Documentation evaluation*, the CAA evaluates all the documentation and the navigation system to determine their eligibility and the approval method to be followed in connection with the aircraft. As a result of this analysis and evaluation, the CAA may accept or reject the formal application along with the documentation.

g) In *Phase four – Inspection and demonstration*, the operator will provide training to its personnel and will carry out the validation flight, if required.

h) In *Phase five* - Approval, the CAA issues the A-RNP approval once the operator has met the airworthiness and operational requirements. For LAR 121 and 135 operators, the CAA will issue the OpSpecs, and for LAR 91 operators, a LOA.

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APPENDIX 4

RADIUS TO FIX (RF) PATH TERMINATOR

1. INTRODUCTION

1.1 Background

This appendix addresses ARINC 424 RF path terminator functionality when used in association with A-RNP navigation specification. RF legs are a required capability for use with A-RNP rather than a minimum requirement. This functionality can be used in the initial and intermediate approach segments, the final phase of the missed approach, SIDs and STARs. The application of this appendix in the final approach or the initial or intermediate phases of the missed approach is prohibited. Such procedure segments wishing to apply RF would have to use the RNP AR specification.

1.2 Purpose

1.2.1 This appendix provides guidance to CAAs implementing instrument flight procedures (IFPs) where RF legs are incorporated into terminal procedures.

1.2.2 For the ANSP, it provides a consistent CAA recommendation on how to implement RF legs. For the operator, it provides training requirements. This appendix is intended to facilitate operational approval for existing RNP systems that have a demonstrated RF leg capability. An operational approval based upon this standard allows an operator to conduct operations on procedures containing RF legs globally.

1.2.3 This appendix also provides airworthiness and operational criteria for the approval of an RNP system incorporating an RF leg capability. Although the ARINC 424 RF leg functionality in this appendix is identical to that found in the RNP AR specification, the approval requirements when applied in association with A-RNP are not as constraining as those applied to RNP AR. This is taken into account in the related obstacle protection and route spacing criteria. ICAO Doc 9905 provides a continuous lateral protection of 2 × RNP for RNP AR applications, on the basis that the certification and approval process provides assurance that the integrity and continuity of the navigation solution will meet 10^{-7}. The demanding integrity and continuity requirements for RNP AR do not apply to the RF functionality described here as ICAO Doc 8168 provides additional buffers in the RF design criteria.

2. IMPLEMENTATION CONSIDERATIONS

2.1 Application of RF legs

2.1.1 The RF leg should be used when there is a requirement for a specific fixed radius curved path in a terminal procedure. The RF leg is defined by the arc centre fix, the arc initial fix, the arc ending fix and the turn direction. The radius is calculated by the navigation computer as the distance from the arc centre fix to the arc ending fix. RNP systems supporting this leg type provide the same ability to conform to the track-keeping accuracy during the turn as in the straight line segments. RF legs are intended to be applied where accurate repeatable and predictable navigation performance is required in a constant radius turn.

2.1.3 RF legs may be used on any segment of a terminal procedure except the FAS, the Initial missed approach phase or the intermediate missed approach phase. The criteria for designing procedures with RF legs are detailed in PANS-OPS (ICAO Doc 8168).

Note.- *Although the RF leg is designed to be applied within the extent of terminal procedures, during higher flight level/altitude segments aircraft may become bank angle limited. When designing terminal procedures with curved path segments, consideration should be given to the interface between the terminal procedure (SID or STAR) and the ATS route structure and whether it is more appropriate to implement the curved path segment through use of the FRT. The FRT design feature within an ATS route structure is provided for any such curved path requirements as part of the A-RNP specification.*

2.2 IFP design considerations and assumptions

2.2.1 The radius of turn depends upon the ground speed of the aircraft and the applied bank angle. From an IFP design perspective, the maximum ground speed of the aircraft is determined by the maximum allowable IAS, the turn altitude and the maximum tail wind. IFP design criteria for maximum IAS, turn altitude, bank angle and maximum tailwind are described in detail in PANS-OPS (ICAO Doc 8168).

2.2.2 When speed restrictions are required for departures they will be placed on the RF leg exit waypoint or a subsequent waypoint as required. For arrivals, the speed restriction should be applied to the waypoint associated with the beginning of the RF leg (path terminator of preceding leg).

2.2.3 The inbound and outbound legs will be tangential to the RF leg.

2.2.4 The requirements of an RF leg may be continued through to a sequential RF leg when implementing wrap-around instrument procedures, e.g. departures.

2.2.5 The procedure will be subjected to comprehensive validation checks prior to publication in order to assure flyability by the intended aircraft types.

3. GENERAL CONSIDERATIONS FOR USE OF RF LEGS

3.1 Benefits

RF legs provide a predictable and repeatable ground track during a turn and prevent the dispersion of tracks experienced in other types of turn construction due to varying aircraft speeds, turn anticipation, bank, roll rate, etc. Therefore, RF legs can be employed where a specified path must be flown during a turn. Additionally, because an RF leg traverses a specified distance it can be used to maintain aircraft longitudinal spacing between aircraft having the same speed. This is not necessarily true with other turn constructions such as fly-by transitions, because of the varying turn paths aircraft execute.

3.2 Publication considerations

Guidance for charting RF legs is provided in PANS-OPS (ICAO Doc 8168). The requirement for RF functionality must be clearly marked on the chart.

3.3 ATC coordination

3.1.1 It is expected that ATC will be familiar with RF leg benefits and their limitations, e.g. speed. ATC shall not allocate a speed that exceeds a constraint associated with the (design) flyability of an RF leg.

3.1.2 Aircraft must be established on the inbound track to the RF leg prior to it being sequenced by the navigation system. ATC must therefore not issue a Direct To clearance to a waypoint beginning an RF leg or a vector to intercept an RF leg.

4. AIRCRAFT REQUIREMENTS

4.1 RNP system-specific information

4.1.1 The navigation system should not permit the pilot to select a procedure that is not supported by the equipment, either manually or automatically (e.g. a procedure is not supported if it incorporates an RF leg and the equipment does not provide RF leg capability).

4.1.2 The navigation system should also prohibit pilot access to procedures requiring RF leg capability if the system can select the procedure, but the aircraft is not otherwise equipped (e.g. the aircraft does not have the required roll steering autopilot or flight director installed).

Note 1.- *One acceptable means to meet these requirements is to screen the aircraft's on-board navigation database and remove any routes or procedures the aircraft is not eligible to execute. For example, if the aircraft is not eligible to complete RF leg segments, then the database screening could remove all procedures containing RF leg segments from the navigation database.*

Note 2.- *Another acceptable means of compliance may be pilot training to identify and prohibit the use of procedures containing RF legs.*

4.2 On-board performance monitoring and alerting

The navigation system must have the capability to execute leg transitions and maintain a track consistent with an RF leg between two fixes. The lateral TSE must be within ±1 × RNP of the path defined by the published procedure for at least 95 per cent of the total flight time for each phase of flight and each autopilot and/or flight director mode requested.

Note 1.- *Industry standards for RF defined paths can be found in RTCA DO-236B/EUROCAE ED-75B (Sections 3.2.5.4.1 and 3.2.5.4.2).*

Note 2.- *Default values for FTE can be found in RTCA DO-283A. FAA AC 120-29A, 5.19.2.2 and 5.19.3.1, also provides guidance on establishing FTE values.*

4.3 System failure modes/annunciations

4.3.1 The RNP system shall provide a visible alert within the pilot's primary field of view when loss of navigation capability and/or loss of integrity (LOI) are experienced.

4.3.2 Any failure modes that have the potential to affect the RF leg capability should be identified. Failure modes may include loss of electrical power, loss of signal reception, RNP system failure, including degradation of navigation performance resulting in a loss of RNP containment integrity.

4.3.3 The ability of the aircraft to maintain the required FTE after a full or partial failure of the autopilot and/or flight director should be documented.

Note.- *If autopilot malfunction testing was performed for worst case failures, no further validation is required. In this case, the manufacturer is expected to provide a statement of confirmation.*

4.4 Functional requirements

4.4.1 An autopilot or flight director with at least "roll-steering" capability that is driven by the RNP system is required. The autopilot/flight director must operate with suitable accuracy to track the lateral and, as appropriate, vertical paths required by a specific RNP procedure.

4.4.2 An electronic map display depicting the RNP computed path of the selected procedure is required.

4.4.3 The flight management computer, the flight director system, and the autopilot must be capable of commanding and achieving a bank angle up to 25 degrees above 400 ft AGL.

4.4.4 The flight guidance mode should remain in lateral navigation while on an RF leg, when a procedure is abandoned or a missed approach/go-around is initiated [through activation of Take-off/go-around (TOGA) or other means] to enable display of deviation and display of positive course guidance during the RF leg. As an alternative means, crew procedures may be used that ensure that the aircraft adheres to the specified flight path throughout the RF leg segment.

4.5 Compliance demonstration

4.5.1 In seeking an airworthiness approval for a navigation system implementing the RF path terminator, the compliance demonstration supporting such an approval should be scoped to the airspace operational concept and the boundaries to which the RF leg is likely to be applied.

4.5.2 Consideration should be given to evaluation of the navigation system on a representative set of procedure designs under all foreseen operating conditions. The evaluation should address maximum assumed crosswind and maximum altitude with the aircraft operating in the range of

expected airspeeds for the manoeuvre and operating gross weights. Procedure design constraints should include sequencing multiple, consecutive RF leg segments of varying turn radii, including consecutive RF leg segments reversing the direction of turn (i.e. reversing from a left-hand RF turn to a right-hand RF turn). Within the demonstration, the applicant should be seeking to confirm the FTE commensurate with the identified RNP navigation accuracy and that the RF turn entry and exit criteria are satisfied. Any limitations identified during the compliance demonstration should be documented. Flight crew procedures should be assessed, including identification of any limitations which surround the use of pilot selectable or automatic bank angle limiting functions and confirmation of those related to go-around or missed approach from an RF leg segment.

5. OPERATIONAL REQUIREMENTS

5.1 Background

This section identifies the operational requirements associated with the use of RF legs as scoped in 1.1 of this appendix. It assumes that the airworthiness approval of the aircraft and systems has been completed. This means that the basis for the RF leg function and the system performance has already been established and approved based upon appropriate levels of analysis, testing and demonstration. As part of this activity, the normal procedures, as well as any limitations for the function, will have been documented, as appropriate, in the aircraft flight and operations manuals.

5.2 Approval process

The approval process will follow the procedures established in Appendix 3 of this AC.

5.3 Aircraft eligibility

5.3.1 Relevant documentation acceptable to the CAA must be available to establish that the aircraft is equipped with an RNP system with a demonstrated RF leg capability. Eligibility may be established in two steps: first, recognizing the qualities and qualifications of the aircraft and equipment; and second, determining the acceptability for operations. The determination of eligibility for existing systems should consider acceptance of manufacturer documentation of compliance, e.g. FAA ACs 90-105, 90-101A, 20-138B, EASA AMC 20-26.

Note.- *RNP systems demonstrated and qualified for RNP AR operations using RF leg functionality are considered qualified with recognition that the RNP operations are expected to be performed consistent with the operators RNP AR approval. No further examination of aircraft capability, operator training, maintenance, operating procedures, databases, etc. is necessary.*

5.3.2 *Eligibility airworthiness documents*. The flight manual or referenced document should contain the following information:

a) A statement indicating that the aircraft meets the requirements for RNP operations with RF legs and has demonstrated the established minimum capabilities for these operations. This documentation should include the phase of flight, mode of flight (e.g. FD on or off, and/or AP on or off, and applicable lateral and vertical modes), minimum demonstrated lateral navigation accuracy, and sensor limitations, if any;

b) Any conditions or constraints on path steering performance (e.g. AP engaged, FD with map display, including lateral and vertical modes, and/or CDI/map scaling requirements) should be identified. Use of manual control with CDI only is not allowed on RF legs; and

c) The criteria used for the demonstration of the system, acceptable normal and non-normal configurations and procedures, the demonstrated configurations and any constraints or limitations necessary for safe operation should be identified.

5.4 Operational approval

5.4.1 The operational approval will follow the steps described in Section 9 of this AC.

5.4.2 *Issuance of the approval to conduct A-RNP operations with RF legs*.- Once the operator has successfully completed the operational approval process, the CAA will grant to the operator the authorization to conduct A-RNP operations with RF legs.

a) LAR 121 and/or 135 operators.- For LAR 121 and/or LAR 135 operators, the CAA will issue the corresponding operations specifications (OpSpecs) that will reflect the A-RNP authorization with RF legs.

b) LAR 91 operators.- For LAR 91 operators, the CAA will issue a letter of authorization (LOA).

5.4.2 Training documentation.- Commercial operators must have a training programme addressing the operational practices, procedures and training related to RF legs in terminal operations (e.g. initial, upgrade or recurrent training for pilot, dispatchers or maintenance personnel). Private operators should be familiar with the practices and procedures identified in 5.6 - Pilot knowledge and training of this appendix.

Note.- *It is not required to establish a separate training programme or regime if RNAV and RF leg training is already an integrated element of a training programme. However, it should be possible to identify what aspects of RF leg use are covered within a training programme.*

5.4.4 OMs and checklists.- OMs and checklists for commercial operators must address information/guidance on the SOP detailed in 5.5 - Operating procedures. Private operators should operate using the practices and procedures identified in 5.6 - Pilot knowledge and training. These SOP and practices must clearly define any aircraft limitations associated with RF leg execution (e.g. if the aircraft is not capable of executing RF leg segments, then the instructions to pilots must prohibit an attempt to fly a procedure requiring RF leg capability).

5.5 Operating procedures

5.5.1 The pilot must use either a flight director or autopilot when flying an RF leg. The pilot should comply with any instructions or procedures identified by the manufacturer as necessary to comply with the performance requirements in this appendix.

5.5.2 Procedures with RF legs will be identified on the appropriate chart.

5.5.3 When the dispatch of a flight is predicated on flying an RNP procedure with an RF leg, the dispatcher/pilot must determine that the installed autopilot/flight director is operational.

5.5.4 The pilot is not authorized to fly a published RNP procedure unless it is retrievable by the procedure name from the aircraft navigation database and conforms to the charted procedure. The lateral path must not be modified, with the exception of complying with ATC clearances/instructions.

5.5.5 The aircraft must be established on the procedure prior to beginning the RF leg.

5.5.6 The pilot is expected to maintain the centre line of the desired path on RF legs. For normal operations, cross-track error/deviation (the difference between the displayed path and the displayed aircraft position relative to the displayed path (i.e. FTE) should be limited to half the navigation accuracy associated with the procedure (e.g. 0.5 NM for RNP 1).

5.5.7 Where published, the pilot must not exceed maximum airspeeds associated with the flyability (design) of the RF leg.

5.5.8 If an aircraft system failure results in the loss of capability to follow an RF turn, the pilot should maintain the current bank and roll out on the charted RF exit course. The pilot should advise ATC as soon as possible of the system failure.

5.6 Pilot knowledge and training

5.6.1 The training programme must include:

a) The information in this appendix;

b) The meaning and proper use of RF functionality in RNP systems;

c) Associated procedure characteristics as determined from the chart depiction and textual description;

d) Associated levels of automation, mode annunciations, changes, alerts, interactions, reversions, and degradation;

Note.- *Manually selecting aircraft bank limiting functions may reduce the aircraft's ability to maintain its desired track and are not permitted. The pilots should recognize that manually selectable aircraft bank-limiting functions may reduce their ability to satisfy ATC path expectations, especially when executing large angle turns.*

e) Monitoring track-keeping performance;

f) The effect of wind on aircraft performance during execution of RF legs and the need to remain within the RNP containment area. The training programme should address any operational wind limitations and aircraft configurations essential to safely complete the RF turn;

g) The effect of ground speed on compliance with RF paths and bank angle restrictions impacting the ability to remain on the course centre line;

h) Interpretation of electronic displays and symbols; and

i) Contingency procedures.

5.7 Navigation database

Aircraft operators will be required to manage their navigation data base load either through the packing or through flight crew procedure, where they have aircraft systems capable of supporting the RF functionality, but as an operator they do not have an approval for its use.

APPENDIX 5

FIXED RADIUS TRANSITION (FRT)

1. INTRODUCTION

1.1 Background

1.1.1 The FRT is intended to define transitions along airways in the case where separation between parallel routes is also required in the transition, and the fly-by transition is not compatible with the separation criteria.

1.1.2 Increasing demand on intense airspace use and the need to progress horizontal airspace availability in areas with high traffic density requires the design of new airspace structures with closer spaced routes. In a lot of instances, turns will be required in the route network, for example, to circumnavigate reserved airspace, transit from one airway structure to another or to connect en-route airspace to terminal airspace. Therefore, reduced route spacing will only be possible if similar route spacing can be maintained in the turns. Initial applications are expected to be based on the route designator conventions stipulated in Annex 11 to the Convention on International Civil Aviation.

1.2 Purpose

The purpose of this appendix is to define the FRT navigation functionality, which is an enabler for applying closer route spacing along turns in the en-route network. This appendix may be associated with en-route A-RNP specification.

2. IMPLEMENTATION CONSIDERATIONS

2.1 Turn geometry

The geometry of the FRT is defined by the track change, θ (difference between outbound and inbound track in degrees), and the radius, R (see Figure 5 -1). Those two parameters define the turn centre, the lead distance Y, which is the distance from turn initiation towards the transition waypoint, and the abeam distance X, which is the distance between the transition waypoint and the point where the aircraft crosses the bisector of the turn. The latter two values are determined by the following expressions:

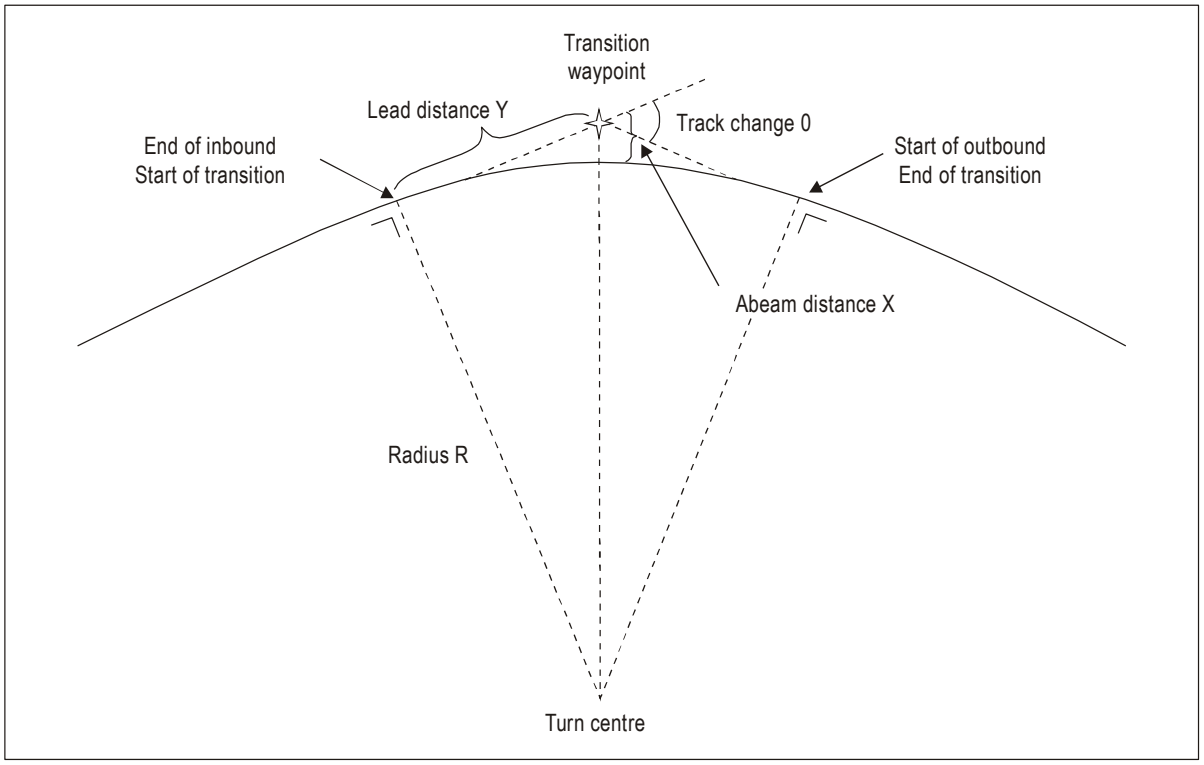
$$Y = R \tan(\theta/2)$$

$$X = R\left(\frac{1}{\cos(\theta/2)} - 1\right)$$

2.2 Aircraft bank angle

The FRT will result in a bank angle dependent upon ground speed. Therefore, during the turn, changes to airspeed and wind will result in varying bank angle. The turn radius must be selected to ensure that the bank angle remains within acceptable limits for cruise operations.

Figure 5-1 - Fixed radius transition



2.3 Application of FRT

2.3.1 The FRT should be used when there is a requirement for a specific fixed radius curved path en route. The radius is calculated, and the curved path is seamlessly joined with the associated route segments by the RNP system. RNP systems supporting this path transition provide the same ability to conform to the track-keeping accuracy during the turn as in the straight line segments. FRTs are expected to be applied where accurate repeatable and predictable navigation performance is required for what is, in effect, a constant radius fly-by turn.

2.3.2 The FRT may be associated as an optional requirement for routes defined using the A-RNP navigation specification:

2.4 Route design considerations and assumptions

2.4.1 The radius of turn should be either 22.5 NM to be used on upper routes (e.g. FL 200 and above) or 15 NM to be used on lower routes (e.g. FL190 and below). The selected radius should be published for the appropriate waypoint(s) in the AIP for the route. Other radius of turn values can be considered, but must be evaluated against the bounds of aircraft performance.

2.4.2 The inbound and outbound route segments will be tangential to the FRT as computed by the navigation system.

2.4.3 FRTs will not be constructed by the RNP system where the track change is greater than 90 degrees.

2.4.4 For FRTs where the next flight path segment requires a different navigation accuracy, the navigation accuracy applicable to the complete FRT must be the largest one. For example, when

a transition occurs from a path segment requiring an accuracy of 1.0 NM to a path segment requiring an accuracy of 2.0 NM, the navigation accuracy of 2.0 NM must apply throughout the FRT.

2.4.5 Where there is a transition from one airway to another airway, both requiring an FRT at the common transition waypoint, the larger of the two radii applicable to the common transition waypoint shall be selected.

3. AIRCRAFT REQUIREMENTS

3.1 Functional requirements

The system must be able to define transitions between flight path segments using a three-digit numeric value for the radius of turn (to 1 decimal place) in nautical miles, e.g. 15.0, 22.5.

3.2 On-board performance monitoring and alerting

3.2.1 The navigation system must have the capability to execute a flight path transition and maintain a track consistent with a fixed radius between two route segments. The lateral TSE must be within ±1 × RNP of the path defined by the published procedure for at least 95 per cent of the total flight time for each phase of flight and any manual, autopilot and/or flight director mode. For path transitions where the next route segment requires a different TSE and the path transition required is an FRT, the navigation system may retain the navigation accuracy value for the previous route segment throughout the entire FRT segment. For example, when a transition occurs from a route segment requiring an accuracy value of 2.0 to a route segment requiring an accuracy value of 1.0, the navigation system may use an accuracy value of 2.0 throughout the FRT.

Note.- *Default values for FTE can be found in RTCA DO-283A. FAA AC 120-29A, 5.19.2.2 and 5.19.3.1, also provides guidance on establishing FTE values.*

3.3 Display requirements

3.3.1 The aircraft system shall provide means for the flight crew to monitor the FTE during the FRT.

3.3.2 FTE monitoring shall be provided by means of displaying the curved path of the FRT on a moving map display (navigation display) with pilot selectable range and numerical indication of the cross-track value.

3.4 Navigation database

The navigation database will specify the radius associated with a particular fix, along an airway.

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APPENDIX 6

TIME OF ARRIVAL CONTROL (TOAC)

(To be developed)

A-RNP JOB AID

REQUEST TO CONDUCT A-RNP OPERATIONS

1. Introduction

This job aid was developed by the Latin American Regional Safety Oversight Cooperation System (SRVSOP) to provide States, operators, and inspectors with guidance on the process to be followed by an operator in order to obtain an A-RNP authorization.

2. Purpose of the job aid

2.1 To give operators and inspectors information on the main reference documents of A-RNP.
2.2 To provide tables showing the contents of the application, the associated reference paragraphs, the place in the application of the operator where A-RNP elements are mentioned and columns for inspector comments and follow-up on the status of various elements of A-RNP.

3. Actions recommended for the inspector and operator

Some recommendations for use of the job aid follow:

3.1 At the pre-application meeting with the operator, the inspector reviews the “basic events of the A-RNP approval process” described in Part 1 of this job aid, in order to provide an overview of the approval process events.
3.2 The inspector reviews this job aid with the operator in order to establish the form and content of the A-RNP approval application.
3.3 The operator uses this job aid as a guide to collect the documents/annexes of the A-RNP application.
3.4 The operator inserts in the job aid references showing in what part of its documents are the A-RNP programme elements located.
3.5 The operator submits the job aid and the application to the inspector (documents/annexes).
3.6 The inspector indicates in the job aid whether an item is in compliance or needs corrective action.
3.7 The inspector informs the operator as soon as possible when a corrective action by the operator is required.
3.8 The operator provides the inspector with the revised material when so requested.
3.9 The CAA provides the operator with the operational specifications (OpSpecs) or a letter of authorisation (LOA), as applicable, when the tasks and documents have been completed.

4. Structure of the job aid

5. Main sources of documents, information, and contacts

To access the A-RNP job aid, enter to the Web page of the ICAO/SAM Regional Office (www.lima.icao.int) under the SRVSOP link or directly to the following address: http://www1.lima.icao.int/srvsop/document

6. Main reference documents

Reference Document	Title
Annex 6	Operation of aircraft
ICAO Doc 9613	Performance based navigation (PBN) manual
AMC 20-5	Acceptable means of compliance for airworthiness approval and operational criteria for the use of the NAVSTAR Global positioning system (GPS)
AC 20-130A	Airworthiness approval of navigation or flight management systems integrating multiple navigation sensors
AC 20-138A	Airworthiness approval of global navigation satellite system (GNSS) equipment
TSO-C115b	Airborne area navigation equipment using multi-sensor inputs
TSO-C129a	Airborne supplemental navigation equipment using the global positioning system (GPS)
TSO-C145a	Airborne navigation sensors using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)
TSO-C146a	Stand-Alone airborne navigation equipment using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)

PART 1: GENERAL INFORMATION

Basic events in the A-RNP approval process

	Action by the operator	Action by the CAA
1	Establishes the need to obtain A-RNP authorization.	
2	Reviews the AFM, AFM supplement or Type certificate data sheet (TCDS), or other appropriate documents [*e.g.,* service bulletins (SB), service letters (SL), etc.] to determine the eligibility of the aircraft for A-RNP operations. The operator contacts the aircraft or avionics manufacturer, if necessary, to confirm A-RNP or higher eligibility of the aircraft.	
3	Contacts the CAA to schedule a pre-application meeting to discuss the operational approval requirements.	
4		During the pre-application meeting, establishes: • the form and contents of the application; • the documents that support A-RNP approval • the date in which the application will be submitted for evaluation • the need to conduct a validation flight observed by the CAA.
5	Submits the application at least 60 days before start-up of A-RNP operations.	
6		Reviews the request of the operator.
7	Once the amended manuals, programmes, and documents have been approved, provides training to flight crews, flight dispatchers, and maintenance personnel, and conducts a validation flight, if required by the CAA.	Only if required, participates in the validation flight.
8		Once the operational and airworthiness requirements have been met, issues the operational approval in the form of OpSpecs for LAR 121 or 135 operators or equivalent operators, or a LOA for LAR 91 operators or equivalent operators, as appropriate.

Notes related to the approval process

1. **Responsible authority**

   a. **Commercial air transport (LAR 121 and/or 135 regulations or equivalent).-** The **State of registry** determines that the aircraft meets the airworthiness requirements. The **State of the operator** issues the A-RNP approval (*e.g.,* OpSpecs).

   b. **General aviation (LAR 91 regulations or equivalent).-** The **State of registry** determines that the aircraft meets the airworthiness requirements and issues the operational approval (*e.g.,* a LOA).

2. The CAA does not need to issue a LOA or equivalent document for each individual area of operation in the case of LAR 91 operators.

3. LAR 121 and/or 135 operators with A-RNP approval must list this approval in the OpSpecs.

4. Related sections of the Latin American Aeronautical Regulations (LAR) or equivalent regulations

   a. LAR 91 Sections 91.1015 and 91.1640 or equivalents

   b. LAR 121 Section 121.995 (b) or equivalent

   c. LAR 135 Section 135.565 (c) or equivalent

5. Related ICAO Documents

   a. Annex 6 to the Convention on International Civil Aviation – Operation of Aircraft

   b. Annex 10 to the Convention on International Civil Aviation – Aeronautical telecommunications

   c. Annex 15 to the Convention on International Civil Aviation – Aeronautical information services

   d. ICAO Doc 9613 – Performance-based navigation (PBN) manual

   e. ICAO Doc 4444 – Procedures for air navigation services – Air traffic management

PART 2: INFORMATION ON THE IDENTIFICATION OF AIRCRAFT AND OPERATORS

NAME OF THE OPERATOR: _____

Aircraft manufacturer, model, and series	Registration numbers	Serial numbers	A-RNP system Number, manufacturer, and model	RNP specification

DATE OF PRE-APPLICATION MEETING _____

DATE ON WHICH THE APPLICATION WAS RECEIVED _____

DATE ON WHICH THE OPERATOR INTENDS TO BEGIN A-RNP OPERATIONS _____

IS THE CAA NOTIFICATION DATE APPROPRIATE? YES _____ NO _____

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PART 3 – OPERATOR APPLICATION (ANNEXES AND DOCUMENTS)

Annex	Title of Annex/Document	Indication of inclusion by the operator	Comments by the inspector
A	**Operator letter requesting A-RNP authorization**		
B	**Airworthiness documents showing aircraft eligibility for A-RNP.** AFM, AFM revision, AFM supplement, or Type certificate data sheet (TCDS) showing RNP system eligibility for A-RNP or less. Statement by the manufacturer.- Aircraft that have a statement by the manufacturer documenting compliance with SRVSOP CA 91-007 criteria or equivalent, meet the performance and functional requirements of said document.		
C	**Aircraft modified to meet A-RNP standards. Documentation on aircraft inspection and/or modification, if applicable.** Maintenance records documenting the installation or modification of aircraft systems (*e.g.,* FAA Form 337 – major repairs and alterations).		
D	**Maintenance programme** • For aircraft with established A-RNP system maintenance practices, the list of references of the document or programme. • For recently installed A-RNP systems, the maintenance practices for their review.		
E	**Minimum equipment list (MEL) (only for operators conducting operations based on a MEL):** MEL showing provisions for A-RNP systems.		
F	**Training** **1. LAR 91 operators or equivalent: Training method:** Training at home, LAR 142 training centres, or other training courses, course		

Annex	Title of Annex/Document	Indication of inclusion by the operator	Comments by the inspector
	completion records. **2. LAR 121 and/or 135 operators or equivalent:** Training programmes (training curricula) for flight crews, flight dispatchers, and maintenance personnel.		
G	**Operating policies and procedures** **1. LAR 91 operators or equivalent:** Operations manual (OM) or sections to be attached to the application, corresponding to A-RNP operating procedures and policies. **2. LAR 121 and/or 135 operators or equivalent:** Operations manual and checklists.		
H	**Navigation database** **Details of the navigation data validation programme.**		
I	**Withdrawal of A-RNP approval** Indication of the need to follow up on navigation error reports submitted and the possibility of withdrawal of A-RNP approval.		
J	**Validation flight plan:** Only if required by the CAA.		

CONTENTS OF THE APPLICATION TO BE SUBMITTED BY THE OPERATOR

____ **A-RNP COMPLIANCE DOCUMENTATION OF THE AIRCRAFT/NAVIGATION SYSTEMS**

____ **OPERATING PROCEDURES AND POLICIES**

____ **SECTIONS OF THE MAINTENANCE MANUAL RELATED TO THE A-RNP SYSTEM (if not previously reviewed)**

Note 1: Documents may be grouped in a single folder or may be sent as individual documents.

PART 4: CONTENTS OF THE OPERATOR APPLICATION FOR A-RNP OPERATIONS

#	Contents of the A-RNP application by the operator	Reference paragraphs CA 91-007	In what Annexes/Documents of the operator can the application contents be located (e.g. Annex A)	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	**Operator request letter** Statement of intent to obtain A-RNP authorization.				
2	**Description of aircraft equipment.**				
3	**Eligibility of A-RNP systems.** Airworthiness documents establishing the eligibility of the A-RNP navigation system, its approval status, and a list of the aircraft for which the approval is being requested.				
4	**Training programme** **1. LAR 121 or 135 operators or equivalent: Training programmes:** Operators will develop an initial and periodic training programme for flight crews, flight dispatchers, if applicable, and maintenance personnel. **2. LAR 91 operators or equivalent: Training methods:** The following methods are acceptable for these operators: Training at home, LAR 142 training centres, or other training courses.				

#	Contents of the A-RNP application by the operator	Reference paragraphs CA 91-007	In what Annexes/Documents of the operator can the application contents be located (e.g. Annex A)	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
5	**Operating procedures** **1. LAR 121 and/or 135 operators or equivalent:** Operations manual and checklists**.** **2. LAR 91 operators or equivalent:** Operations manual or section of the operator application documenting A-RNP policies and procedures.				
6	**Maintenance practices** • For aircraft with established maintenance practices for A-RNP navigation systems, the operator will provide document references. • For newly installed A-RNP systems, the operator will provide maintenance practices for their review.				
7	**Update of the minimum equipment list (MEL)** Applicable to operators conducting operations according to a MEL.				
8	**Navigation data validation programme**				
9	**Withdrawal of A-RNP approval** Indication of the need for follow-up on the navigation error reports and the possibility				

#	Contents of the A-RNP application by the operator	Reference paragraphs CA 91-007	In what Annexes/Documents of the operator can the application contents be located (e.g. Annex A)	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	of withdrawal of the A-RNP approval.				
10	**Validation flight plan, only if required** The validation flight plan will be presented only if required.				

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PART 5 – GUIDE TO DETERMINE THE ELIGIBILITY OF A-RNP AIRCRAFT

#	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	**Aircraft eligibility requirements for A-RNP operations** **General**				
1a	RNP 2 navigation specification requires GNSS as the primary navigation sensor, either as a stand-alone navigation system or as part of a multi-sensor system.				
2	**Navigation sensors**				
2a	**Global navigation satellite system (GNSS).-** The sensor must comply with the guidelines in FAA AC 20-138() or FAA AC 20-130A. For systems that comply with FAA AC 20-138(), the following sensor accuracies can be used in the total system accuracy analysis without additional substantiation: GNSS sensor accuracy is better than 36 meters (95 per cent), and augmented GNSS (GBAS or SBAS) sensor accuracy is better than 2 meters (95 per cent). In the event of a latent GNSS satellite failure and marginal GNSS satellite geometry, the probability the TSE remains within the procedure design obstacle clearance volume must be greater than 95 per cent.				

#	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	Note.- *GNSS-based sensors output a horizontal integrity limit (HIL), also known as a horizontal protection level (HPL) (see FAA AC 20-138() and RTCA/DO-229D for an explanation of these terms). The HIL is a measure of the position estimation error assuming a latent failure is present. In lieu of a detailed analysis of the effects of latent failures on the TSE, an acceptable means of compliance for GNSS-based systems is to ensure the HIL remains less than twice the navigation accuracy, minus the 95 per cent of FTE, during the RNP operation.*				
2b	**Inertial reference system (IRS).-** An IRS must satisfy the criteria of SRVSOP LAR 121 Appendix G or equivalent. While Appendix G defines the requirement for a 2 NM per hour drift rate (95 per cent) for flights up to 10 hours, this rate may not apply to an RNP system after loss of position updating. Systems that have demonstrated compliance with LAR 121, Appendix G, can be assumed to have an initial drift rate of 8 NM/hour for the first 30 minutes (95 minutes) without further substantiation. Aircraft manufacturers and applicants can demonstrate improved inertial performance in accordance with the methods described in Appendix 1 or 2 of FAA Order 8400.12A. ***Note.-*** *Integrated GPS/INS position solutions reduce the rate of degradation after loss of position updating. For "tightly coupled" GPS/IRUs, RTCA/DO-229C, Appendix R, provides additional guidance.*				
2c	**Distance measuring equipment (DME).-**				

#	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	For RNP procedures and routes, the RNP system may only use DME updating when authorized by the CAA. The manufacturer should identify any operating constraints (e.g. manual inhibit of DME) in order for a given aircraft to comply with this requirement. ***Note 1.-*** *This is in recognition of States where a DME infrastructure and capable equipped aircraft are available, those States may establish a basis for aircraft qualification and operational approval to enable use of DME. It is not intended to imply a requirement for implementation of DME infrastructure or the addition of RNP capability using DME for RNP operations.* ***Note 2.-*** *This does not imply an equipment capability must exist providing a direct means of inhibiting DME updating. A procedural means for the flight crew to inhibit DME updating or executing a missed approach if reverting to DME updating may meet this requirement.*				
2d	**VHF Omni-directional range station (VOR).-** For RNP procedures, the RNAV system must not use VOR updating. The manufacturer should identify any operating constraints (e.g. manual inhibit of VOR) in order for a given aircraft to comply with this requirement. ***Note.-*** *This does not imply an equipment capability must exist providing a direct means of inhibiting VOR updating. A procedural means for the flight crew to inhibit VOR updating or executing a missed approach if reverting to VOR updating may meet this requirement.*				

#	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
2e	**For multi-sensor systems**, there must be automatic reversion to an alternate RNAV sensor if the primary RNAV sensor fails. Automatic reversion from one multi-sensor system to another multi-sensor system is not required.				
2f	Carriage of a single RNP system is considered generally acceptable (e.g., in continental en-route airspace or approach). As conventional navigation may not be available, reversionary operation must be achieved by other means.				
2g	Where more stringent requirements (e.g. dual RNP system) exist (e.g. A-RNP operations in oceanic and remote airspace) these carriage requirements must be promulgated through the State AIP and/or in Doc 7030.				
3	**On-board performance monitoring and alerting requirements**				
3a	For A-RNP operations on-board performance monitoring and alerting is required				
3b	The aircraft navigation system, or aircraft navigation system and flight crew in combination, is required to monitor the TSE, and to provide an alert if the accuracy				

#	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	requirement is not met or if the probability that the TSE exceeds two times the accuracy value is larger than 10^{-5}. To the extent operational procedures are used to satisfy this requirement, the crew procedure, equipment characteristics, and installation should be evaluated for their effectiveness and equivalence. Examples of information provided to the flight crew for awareness of navigation system performance include “Estimated position uncertainty - EPU”, “ACTUAL”, “Actual navigation performance - ANP”, and “Estimated position error - EPE”. Examples of indications and alerts provided when the operational requirement is or can be determined as not being met include “UNABLE RNP”, “Nav Accur Downgrad”, GNSS alert, loss of GNSS integrity, TSE monitoring [real time monitoring of navigation sytem error (NSE) and flight technical error (FTE) combined], etc. The navigation system is not required to provide both performance and sensor-based alerts, e.g. if a TSE-based alert is provided, a GNSS alert may not be necessary.				
4	**System performance**				
4a	**Accuracy.-** During operations in airspace or on routes or procedures designated as				

#	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	RNP, the lateral TSE must be within the applicable accuracy (±0.3 NM to ±2.0 NM) for at least 95 per cent of the total flight time. The along-track error must also be within ± the applicable accuracy for at least 95 per cent of the total flight time. To satisfy the accuracy requirement, the 95 per cent FTE should not exceed one half of the applicable accuracy except for a navigation accuracy of 0.3 NM where the FTE is allocated to be 0.25. ***Note.-*** *The use of a deviation indicator is an acceptable means of compliance for satisfying the FTE part of the lateral TSE with the scaling commensurate with the navigation application*.				
4b	**Integrity.-** Malfunction of the aircraft navigation equipment is classified as a major failure condition under airworthiness guidance material (i.e. 1×10^{-5} per hour).				
4c	**Continuity.-** Loss of function is classified as a minor failure condition for applications predicated on this navigation specification. Where a State or application establishes a classification of major, the continuity requirement may be typically satisfied by carriage of dual independent navigation systems.				
4d	**Signal-in-space (SIS).-** For GNSS RNP system architectures, the aircraft navigation equipment shall provide an alert if the				

#	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	probability of SIS errors causing a lateral position error greater than two times the applicable accuracy (2 × RNP) exceeds 1 × 10^{-7} per hour. ***Note 1.-*** *The lateral TSE includes positioning error, FTE, PDE and display error. For procedures extracted from the on-board navigation database, PDE is considered negligible due to the navigation database requirements (12), and pilot knowledge and training (11).* ***Note 2.-*** *For RNP systems where the architecture is an integrated, multi-sensor capability and where GNSS integrity is incorporated into a 2 × RNP integrity alert consistent with RTCA/EUROCAE DO-236/ED-75 when performance cannot be met, a separate GNSS integrity alert is not required.*				
5	**Aircraft eligibility requirements for A-RNP operations.**				
	The aircraft eligibility has to be determined through demonstration of compliance against the relevant airworthiness criteria and the requirements of 8.2. The aircraft original equipment manufacturer (OEM) or the holder of installation approval for the aircraft, e.g. Supplemental type certificate (STC) holder, will demonstrate compliance to the CAA and the approval can be documented in manufacturer documentation (e.g. service letters). Aircraft flight manual (AFM) entries are not required provided the CAA accepts				

#	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	manufacturer documentation.				
	The aircraft OEM or the holder of installation approval for the aircraft should document demonstration of compliance with the A-RNP capability and highlight any limitations of functionality and performance. ***Note-*** *Requests for approval to use optional functionality (e.g. FRT) should address the aircraft and operational requirements as described in the corresponding paragraps, appendixes and AC included in Table 2 of this AC.*				
5	**Functional requirements – See Appendix 1 of AC 91-007**				
6	**Maintenance requirements – See Paragraph 8.4 of AC 91-007**				
7	**Navigation database** Details of the navigation data validation programme				

PART 6 - BASIC PILOT PROCEDURES FOR A-RNP OPERATIONS

	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
Operating procedures					
1	**Pre-flight planning**				
	Operators and pilots intending to conduct RNP operations requiring A-RNP capability should indicate the appropriate application in the flight plan.				
	The on-board navigation data must be current and appropriate to the route being flown and for potential diversions. Navigation databases are expected to be current for the duration of the flight. If the AIRAC cycle is due to change during flight, operators and pilots should establish procedures to ensure the accuracy of navigation data, including suitability of navigation facilities used to define the routes and procedures for flight.				
	Operators using GNSS equipment should confirm the availability of RAIM by using RAIM availability prediction software taking account of the latest GNSS NOTAMs. Operators using SBAS augmentation should also check the relevant SBAS NOTAMs to determine the availability of SBAS. Notwithstanding preflight analysis results, because of unplanned failure of some GNSS or DME elements (or local interference), pilots must realize that integrity availability (or GNSS/DME				

	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	navigation altogether) may be lost while airborne which may require reversion to an alternate means of navigation. Therefore, pilots should assess their capability to navigate in case of failure of the primary sensor or the RNP system.				
2	**General operating procedures**				
	Operators and pilots should not request or file RNP routes, SIDs, STARs or approaches unless they satisfy all the criteria in the relevant State documents. The pilot should comply with any instructions or procedures identified by the manufacturer, as necessary, to comply with the performance requirements in this chapter. ***Note.-*** *Pilots are expected to adhere to any AFM limitations or operating procedures required to maintain the RNP for the operation.*				
	At system initialization, pilots must confirm the navigation database is current and verify that the aircraft position has been entered correctly. Pilots must not fly an RNP route, SID, STAR or approach unless it is retrievable by name from the on-board navigation database and conforms to the chart. An RNP route, SID, STAR or approach should not be used if doubt exists as to the validity of the procedure in the navigation database. ***Note.-*** *Flight crew may notice a slight difference between the navigation information portrayed on the chart and their primary navigation display. Differences of 3 degrees or less may result from equipment manufacturer's application of magnetic variation*				

	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	and are operationally acceptable.				
	Cross-checking with conventional NAVAIDs is not required as the absence of integrity alert is considered sufficient to meet the integrity requirements. However, monitoring of navigation reasonableness is suggested, and any loss of RNP capability shall be reported to ATC. While operating on RNP Routes, SIDs, STARs or approaches, pilots are encouraged to use flight director and/or autopilot in lateral navigation mode, if available. Flight crew should be aware of possible lateral deviations when using raw path steering data or navigation map displays for lateral guidance in lieu of flight director. When the dispatch of a flight into RNP operations is predicated on use of the autopilot/flight director at the destination and/or alternate, the dispatcher/flight crew must determine that the autopilot/flight director is installed and operational.				
	Manual entry of RNP				
	If the navigation system does not automatically retrieve and set the navigation accuracy from the on-board navigation database for each leg segment of a route or procedure, the flight crew's operating procedures should ensure the smallest navigation accuracy for the route or procedure is manually entered into the RNP system.				

	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	SID specific requirements				
	Prior to flight, pilots must verify their aircraft navigation system is operating correctly and the correct runway and departure procedure (including any applicable en-route transition) are entered and properly depicted. Pilots who are assigned an RNP departure procedure and subsequently receive a change of runway, procedure or transition must verify the appropriate changes are entered and available for navigation prior to take-off. A final check of proper runway entry and correct route depiction, shortly before take-off, is recommended.				
	Engagement altitude.- The pilot must be able to use RNP equipment to follow flight guidance for lateral navigation no later than 153 m (500 ft) above the airport elevation. The altitude at which guidance begins on a given route may be higher (e.g. climb to 304 m (1 000 ft) then direct to …).				
	Pilots must use an authorized method (lateral deviation indicator/navigation map display/flight director/autopilot) to achieve an appropriate level of performance.				
	GNSS aircraft.- When using GNSS, the signal must be acquired before the take-off roll commences. For aircraft using FAA Technical standard order (TSO)-C129a equipment, the departure airport must be loaded into the flight plan				

	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	in order to achieve the appropriate navigation system monitoring and sensitivity. For aircraft using FAA TSO-C145a/C146a equipment, if the departure begins at a runway waypoint, then the departure airport does not need to be in the flight plan to obtain appropriate monitoring and sensitivity.				
	STAR specific requirements				
	Prior to the arrival phase, the flight crew should verify that the correct terminal route has been loaded. The active flight plan should be checked by comparing the charts with the map display (if applicable) and the multifunction control and display unit (MCDU). This includes confirmation of the waypoint sequence, reasonableness of tracks and distances, any altitude or speed constraints, and, where possible, which waypoints are fly-by and which are fly-over. If required by a route, a check will need to be made to confirm that updating will exclude a particular NAVAID. A route must not be used if doubt exists as to the validity of the route in the navigation database. ***Note.-*** *As a minimum, the arrival checks could be a simple inspection of a suitable map display that achieves the objectives of this paragraph.*				
	The creation of new waypoints by manual entry into the RNP system by the flight crew would invalidate the route and is not permitted.				

	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	Where the contingency procedure requires reversion to a conventional arrival route, necessary preparations must be completed before commencing the RNP route.				
	Route modifications in the terminal area may take the form of headings or “direct to” clearances and the flight crew must be capable of reacting in a timely fashion. This may include the insertion of tactical waypoints loaded from the database. Manual entry or modification by the flight crew of the loaded route, using temporary waypoints or fixes not provided in the database, is not permitted.				
	Pilots must verify their aircraft navigation system is operating correctly, and the correct arrival procedure and runway (including any applicable transition) are entered and properly depicted.				
	Although a particular method is not mandated, any published altitude and speed constraints must be observed. Approaches using temporary waypoints or fixes not provided in the navigation database are not permitted.				
	Contingency procedures				
	The pilot must notify ATC of any loss of the RNP capability (integrity alerts or loss of navigation), together with the proposed course of action. If unable to comply with the requirements of an RNP				

	Topics	Reference paragraphs CA 91-007	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	SID or STAR, pilots must advise ATS as soon as possible. The loss of RNP capability includes any failure or event causing the aircraft to no longer satisfy the A-RNP requirements of the route.				
	In the event of communications failure, the flight crew should continue with the A-RNP SID or STAR in accordance with the published lost communications procedure.				

SRVSOP contacts:

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Job aid: A-RNP
Version: 1
Date: 25/04/2014

ADVISORY CIRCULAR

CA : 91-012
DATE : 25/04/14
REVISION : Original
ISSUED BY : SRVSOP

SUBJECT: AIRCRAFT AND OPERATOR APPROVAL FOR RNP 0.3 OPERATIONS

1. PURPOSE

This advisory circular (AC) establishes criteria on aircraft and operators approval for RNP 0.3 operations.

An operator may use alternate means of compliance, provided those means are acceptable to the Civil Aviation Administration (CAA).

The future tense of the verb or the term “shall” apply to operators who choose to meet the criteria set forth in this AC.

2. RELEVANT SECTIONS OF THE LATIN AMERICAN AERONAUTICAL REGULATIONS (LAR) OR EQUIVALENT

LAR 91: Sections 91.1015 and 91.1640 or equivalents

LAR 121: Section 121.995 (b) or equivalent

LAR 135: Section 135.565 (c) or equivalent

3. RELATED DOCUMENTS

Annex 6	Operation of aircraft
	Part I – International commercial air transport – Aeroplanes
	Part II – International general aviation – Aeroplanes
	Part III – International operations - Helicopters
Annex 10	Aeronautical communications
	Volume I: Radio navigation aids
Annex 15	Aeronautical information services
ICAO Doc 9613	Performance based navigation (PBN) manual
ICAO Doc 4444	Procedures for air navigation services – Air traffic management (PANS-ATM)
ICAO Doc 8168	Procedures for air navigation services - Aircraft operations
	Volume I: Flight procedures
	Volume II: Construction of visual and instrument flight procedures

4. DEFINITIONS AND ABBREVIATIONS

4.1 Definitions

a) **Aircraft-based augmentation system (ABAS).-** A system which 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 the receiver autonomous integrity monitoring (RAIM).

b) **Area navigation (RNAV)**.- A navigation method that allows aircraft to operate on any desired flight path within the coverage of ground or space-based navigation aids, or within the limits of the capability of self-contained aids, or a combination of both methods.

Note.- *Area navigation includes performance-based navigation as well as other RNAV operations that do not meet the definition of performance-based navigation.*

c) **Flight technical error (FTE)**.- The FTE is the accuracy with which an aircraft is controlled, as measured by the indicated aircraft position with respect to the indicated command or desired position. It does not include procedural blunder errors.

d) **Global navigation satellite system (GNSS)**.- A generic term used by the International Civil Aviation Organization (ICAO) to define any global position, speed, and time determination system that includes one or more main satellite constellations, such as GPS and the global navigation satellite system (GLONASS), aircraft receivers and several integrity monitoring systems, including aircraft-based augmentation systems (ABAS), satellite-based augmentation systems (SBAS), such as the wide area augmentation systems (WAAS), and ground-based augmentation systems (GBAS), such as the local area augmentation system (LAAS).

Distance information will be provided, at least in the immediate future, by GPS and GLONASS.

e) **Global positioning system (GPS)**.- The global positioning system (GNSS) of the United States is a satellite-based radio navigation system that uses precise distance measurements to determine the position, speed, and time in any part of the world. The GPS is made up by three elements: the spatial, the control, and the user elements. The GPS spatial segment nominally consists of, at least, 24 satellites in 6 orbital planes. The control element consists of 5 monitoring stations, 3 ground antennas, and one main control station. The user element consists of antennas and receivers that provide the user with position, speed, and precise time.

f) **Navigation specifications**.- Set of aircraft and flight crew requirements needed to support performance-based navigation operations within a defined airspace. There are two kinds of navigation specifications:

Required Navigation Performance (RNP) Specification.- A navigation specification based on area navigation that includes the requirement for on-board performance monitoring and alerting, designated by the prefix RNP; *e.g.,* RNP 4, RNP APCH, RNP AR APCH.

Area Navigation (RNAV) Specification.- A navigation specification based on area navigation that does not include the requirement for on-board performance monitoring and alerting, designated by the prefix RNAV; *e.g.*, RNAV 5, RNAV 2, RNAV 1.

Note 1.- *The Manual on Performance-based Navigation (PBN) (Doc 9613), Volume II, contains detailed guidelines on navigation specifications.*

Note 2.- *The term RNP, formerly defined as "a statement of the navigation performance necessary for operation within a defined airspace", has been deleted from the Annexes to the Convention on International Civil Aviation because the RNP concept has been replaced by the PBN concept. In said Annexes, the term RNP is now only used within the context of the navigation specifications that require on-board performance control and alerting; e.g., RNP 4 refers to the aircraft and the operational requirements, including a lateral performance of 4 nautical miles (NM), with the requirement for on-board performance control and alerting as described in the PBN Manual of the International Civil Aviation Organization (ICAO) (Doc 9613).*

g) **Navigation system error (NSE).-** The difference between the true position and the estimated position.

h) **Path definition error (PDE).-** The difference between the defined path and the desired path at a given place and time.

i) **Performance-based navigation (PBN)**.- Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure, or in a designated airspace.

Note.- *Performance requirements are expressed in navigation specifications (RNAV and RNP specifications) in terms of accuracy, integrity, continuity, availability, and functionality needed for the proposed operation in the context of a particular airspace concept.*

j) **Receiver autonomous integrity monitoring (RAIM)**.- A technique used in a GPS receiver/processor to determine the integrity of its navigation signals, using only GPS signals or GPS signals enhanced with barometric altitude data. This determination is achieved by a consistency check among redundant pseudo-range measurements. At least one additional available satellite is required with respect to the number of satellites that are needed for the navigation solution.

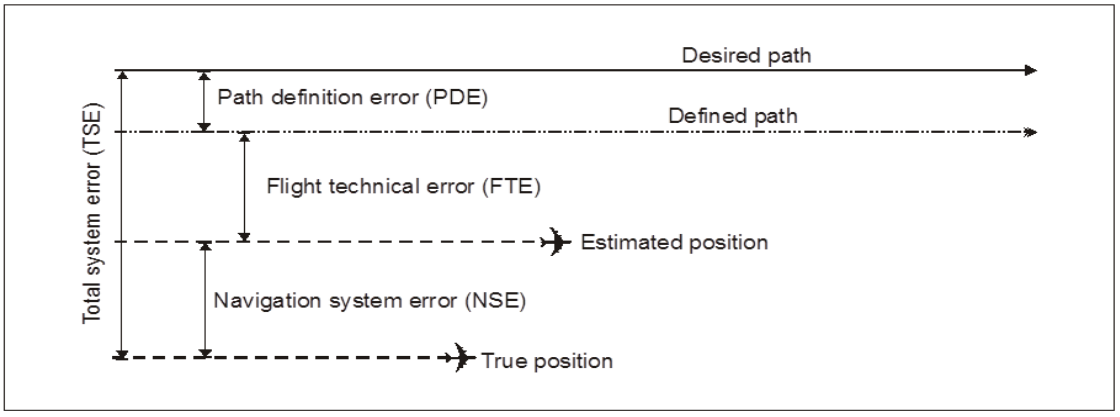
k) **RNP operations**.- Aircraft operations that use an RNP system for RNP navigation applications.

l) **RNP system**.- An area navigation system that supports on-board performance monitoring and alerting.

m) **Total system error (TSE).-** The difference between the true position and the desired position. This error is equal to the vector sum of the path definition error (PDE), flight technical error (FTE), and navigation system error (NSE).

Note.- *On occasions, the FTE is known as path steering error (PSE), and the NSE as position estimation error (PEE).*

Total system error (TSE)



n) **Waypoint (WPT).** A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Waypoints area identified as either:

Fly-by waypoint. - A waypoint which requires turn anticipation to allow tangential interception of the next segment of a route or procedure.

Fly over waypoint. - A waypoint at which a turn is initiated in order to join the next segment of a route or procedure.

4.2 Abbreviations

a)	ABAS	Aircraft-based augmentation system
b)	AC	Advisory circular
c)	AFM	Aircraft flight manual
d)	AIP	Aeronautical information publication
e)	AIRAC	Aeronautical information regulation and control
f)	ANP	Actual navigation performance
g)	ANSP	Air navigation service providers
h)	AP	Automatic pilot

i)	APV	Approach procedure with vertical guidance
j)	APV/baro-VNAV	Approach procedure with vertical guidance/Barometric vertical navigation
k)	ATC	Air traffic control
l)	ATM	Air traffic management
m)	ATN	Aeronautical telecommunication network
n)	ATS	Air traffic service
o)	baro-VNAV	Barometric vertical navigation
p)	CA	Advisory circular (SRVSOP)
q)	CA	Course to an altitude
r)	CAA	Civil Aviation Administration/Civil Aviation Authority
s)	CDI	Course deviation indicator
t)	CDU	Control and display unit
u)	CF	Course to a fix
v)	Doc	Document
w)	DF	Direct to a fix
x)	DME	Distance-measuring equipment
y)	DV	Flight dispatcher (SRVSOP)
z)	EASA	European Aviation Safety Agency
aa)	EHSI	Electronic horizontal situation indicator
bb)	EPE	Estimated position error
cc)	EPU	Estimated position uncertainty
dd)	FA	Course from a fix to an altitude
ee)	FAA	Federal Aviation Administration (United States)
ff)	FAF	Final approach fix
gg)	FAP	Final approach point
hh)	FAS	Final approach segment
ii)	FD	Flight director
jj)	FGS	Flight guidance system
kk)	FM	Course from a fix to manual termination
ll)	Fly-by WPT	Fly-by way-point
mm)	Flyover WPT	Flyover way-point
nn)	FMS	Flight management system
oo)	FRT	Fixed radius transition
pp)	FTE	Flight technical error
qq)	GA	General aviation
rr)	GBAS	Ground-based augmentation system

ss)	GNSS	Global navigation satellite system
tt)	GLONASS	Global navigation satellite system
uu)	GPS	Global positioning system
vv)	GS	Ground speed
ww)	HEMS	Helicopter emergency service
xx)	HSI	Horizontal situation indicator
yy)	IF	Initial fix
zz)	IFP	Instrument flight procedure
aaa)	IFR	Instrument flight rules
bbb)	IMC	Instrument meteorological conditions
ccc)	IPC	Illustrated parts catalogs
ddd)	LAAS	Local area augmentation system
eee)	LAR	Latin American Aeronautical Regulations
fff)	LNAV	Lateral navigation
ggg)	LOA	Letter of authorisation/letter of acceptance
hhh)	LOI	Loss of integrity
iii)	MCDU	Multifunction control and display unit
jjj)	MCM	Maintenance control manual
kkk)	MEL	Minimum equipment list
lll)	MIO	Operations inspector manual (SRVSOP)
mmm)	NM	Nautical mile
nnn)	NAA	National airworthiness authority
ooo)	NAVAID	Navigation aid
ppp)	NDB	Non-directional radio beacon
qqq)	NOTAM	Notice to airmen
rrr)	NPA	Non-precision approach
sss)	NSE	Navigation system error
ttt)	LNAV	Lateral navigation
uuu)	OACI	International Civil Aviation Organization
vvv)	OM	Operations manual
www)	OEM	Original equipment manufacturer
xxx)	OpSpecs	Operations specifications
yyy)	PA	Precision approach
zzz)	PANS-ATM	Procedures for air navigation services - Air traffic management
aaaa)	PANS-OPS	Procedures for air navigation services - Aircraft operations
bbbb)	PBN	Performance-based navigation
cccc)	PDE	Path definition error

dddd)	PEE	Position estimation error
eeee)	PF	Pilot flying
ffff)	PINS	Point in Space
gggg)	PNF	Pilot not flying
hhhh)	POH	Pilot operating handbook
iiii)	P-RNAV	Precision area navigation
jjjj)	PSE	Path steering error
kkkk)	RAIM	Receiver autonomous integrity monitoring
llll)	RF	Constant radius arc to a fix / Radius to fix
mmmm)	RFM	Rotorcraft flight manual
nnnn)	RNAV	Area navigation
oooo)	RNP	Required navigation performance
pppp)	RNP APCH	Required navigation performance approach
qqqq)	RNP AR APCH	Required navigation performance authorisation required approach
rrrr)	RTCA	Radio Technical Commission for Aviation
ssss)	R/T	Radio/Transmitter
tttt)	SBAS	Satellite-based augmentation system
uuuu)	SID	Standard instrument departure
vvvv)	SIS	Signal-in-space
wwww)	SRVSOP	Regional Safety Oversight Cooperation System
xxxx)	STAR	Standard instrument arrival
yyyy)	STC	Supplemental type certificate
zzzz)	TF	Track to a fix
aaaaa)	TOGA	Take-off/go-around
bbbbb)	TSE	Total system error
ccccc)	TSO	Technical standard order
ddddd)	VA	Heading to an altitude
eeeee)	VI	Heading to an intercept
fffff)	VM	Heading to a manual termination
ggggg)	VMC	Visual meteorological conditions
hhhhh)	VNAV	Vertical navigation
iiiii)	VOR	Very high frequency omnidirectional radio range
jjjjj)	WAAS	Wide area augmentation system
kkkkk)	WGS	World geodetic system
lllll)	WPT	Waypoint

5. INTRODUCTION

5.1 This navigation specification is intended for aircraft/helicopter RNP 0.3 operations en route and in the terminal airspace of airports as well as operations to and from heliports and for servicing offshore rigs. RNP 0.3 accuracy may also be used en route to support operations at low level in mountainous remote areas and, for airspace capacity reasons, in high density airspace.

5.2 The RNP 0.3 navigation specification is applicable to departure, en route, arrival (including the initial and intermediate approach segments), and to the final phase of the missed approach. This navigation specification addresses continental, remote continental and offshore operations and may be applied in ATM environments both with and without ATS surveillance. Route length restrictions may be applicable for en-route operations meeting RNP 0.3.

5.3 The large majorities of IFR helicopters are already equipped with TSO C145/146 systems and moving map displays, and require autopilot including stability augmentation for IFR certification.

5.4 While this specification has been defined primarily for helicopter applications, this does not exclude the application to fixed wing operations where demonstrated performance is sufficient to meet the functional and accuracy requirements of this specification for all phases of flight.

5.5 Fulfilling the accuracy requirements of this specification may be achieved by applying operational limitations, which could include but are not necessarily limited to the maximum permitted airspeed and requirements for autopilot coupling. The latter requirement does not impact the helicopter eligibility since an autopilot is needed as part of the IFR helicopter certification.

5.6 A number of navigation systems using GNSS for positioning will be capable of being approved for RNP 0.3 operations if suitably integrated into the flight guidance system (FGS)/flight display system. However, this specification takes advantage of known functionality and the on-board performance monitoring and alerting capability of many TSO-C145/C146 GPS systems which are installed in a wide range of IFR helicopters.

5.7 This specification enables a significant part of the IFR helicopter fleet to obtain benefit from PBN. Specifically, in the following operations:

- ✓ reduced protected areas, potentially enabling separation from fixed wing traffic to allow simultaneous non-interfering operations in dense terminal airspace;
- ✓ low-level routes in obstacle-rich environments reducing exposure to icing environments;
- ✓ seamless transition from en route to terminal route;
- ✓ more efficient terminal routing in an obstacle-rich or noise-sensitive terminal environment, specifically in consideration of helicopter emergency service IFR operations between hospitals; and
- ✓ transitions to helicopter point-in-space approaches and for helicopter departures.

5.8 Helicopter en-route operations are limited by range and speed and can often equate to the dimensions of terminal fixed wing operations.

5.9 This AC does not address all the requirements that may be specified for particular operation. These requirements are established in other documents, such as the aeronautical information publication (AIP) and ICAO Doc 7030 – Regional Supplementary Procedures.

5.10 While operational approval primarily relates to the navigation requirements of the airspace, the operators and pilots must consider all operational documents relating to the airspace, which are required by the CAA, before conducting flights into RNP 0.3 airspace.

5.11 The material described in this CA has been developed based on the following document:

- ✓ ICAO Doc 9613, Volume II, Part C, Chapter 7 – Implementing RNP 0.3.

6. GENERAL CONSIDERATIONS

6.1 Navigation aid infrastructure

a) The RNP 0.3 specification is based upon GNSS; its implementation is not dependent on the availability of SBAS.

b) DME/DME based RNAV systems will not be capable of consistently providing RNP 0.3 performance, therefore it should not be planned the implementation of RNP 0.3 operations through application of DME/DME-based navigation.

c) Operators must not use RNP 0.3 in areas of known navigation signal (GNSS) interference.

d) Operators relying on GNSS are required to have the means to predict the availability of GNSS fault detection (e.g. ABAS RAIM) to support operations along the RNP 0.3 ATS route.

e) The on-board RNP system, GNSS avionics, the ANSP or other entities may provide a prediction capability.

f) The AIP should clearly indicate when prediction capability is required and acceptable means to satisfy that requirement. This prediction will not be required where the navigation equipment can make use of SBAS augmentation and the planned operation will be contained within the service volume of the SBAS signal.

Note.- *When the operator of an SBAS-equipped aircraft is permitted to disregard the requirement for a RAIM prediction in an SBAS service area, the operator shall check SBAS NOTAMS prior to the flight to ensure the availability of the SBAS signal-in-space (SIS).*

6.2 Communications and ATS surveillance

a) The application of this navigation specification is not dependent upon the availability of ATS surveillance or communications.

6.3 Obstacle clearance, route spacing and horizontal separation

a) Guidance on obstacle clearance is provided in PANS-OPS (Doc 8168, Volume II); the general criteria in Parts I and III apply, and assume normal operations.

b) The route spacing supported by this AC will be determined by a safety study for the intended operations which will depend on the route configuration, air traffic density and intervention capability, etc. Horizontal separation standards are published in PANS-ATM (Doc 4444).

6.4 Publications

a) The departure and arrival procedure design should comply with normal climb and descent profiles for the operation considered and identify minimum segment altitude requirements.

b) The navigation data published in the State AIP for the procedures and supporting NAVAIDS must meet the requirements of Annex 15 - *Aeronautical Information Services*.

c) All procedures must be based upon WGS-84 coordinates.

d) The AIP should clearly indicate whether the navigation application is RNP 0.3.

e) The available navigation infrastructure shall be clearly designated in all the appropriate charts (*e.g.*, GNSS).

f) The required navigation standard (*e.g.*, RNP 0.3) for all RNP 0.3 operations shall be clearly designated in all the appropriate charts.

6.5 Additional considerations

a) Additional flight crew operational procedures and operational limitations may be required to ensure that FTE is bounded and appropriate alerting is available to meet the requirements of the RNP 0.3 specification for all phases of flight. Therefore, this performance should only be demanded where it is operationally needed (e.g. RNP 0.3 ATS routes should not be implemented where RNP 2 routes would be sufficient to enable the operation).

7. AIRWORTHINESS AND OPERATIONAL APPROVAL

7.1 For a commercial air transport operator to be granted a RNP 0.3 approval, it must comply with two types of approvals:

a) the airworthiness approval, issued by the State of registry; and

b) the operational approval, issued by the State of the operator.

7.2 For general aviation operators, the State of registry will determine whether or not the aircraft meets the applicable RNP 0.3 requirements and will issue the operational approval (*e.g.*, letter of authorisation – LOA).

7.3 Before filing the application, operators shall review all aircraft qualification requirements. Compliance with airworthiness requirements or equipment installation alone does not constitute operational approval.

8. AIRWORTHINESS APPROVAL

8.1 Aircraft requirements

8.1.1 Systems

a) The following systems meet the accuracy, integrity and continuity requirements of these criteria:

1) Aircraft with E/TSO-C145a and the requirements of E/TSO-C115B FMS, installed for IFR use in accordance with FAA AC 20-130A;

2) Aircraft with E/TSO-C146a equipment installed for IFR use in accordance with FAA AC 20-138 or AC 20-138A; and

3) Aircraft with RNP 0.3 capability certified or approved to equivalent standards (e.g. TSO-C193).

8.1.2 General

a) For RNP 0.3 operations on-board performance monitoring and alerting is required. This section provides the criteria for a TSE form of performance monitoring and alerting that will ensure a consistent evaluation and assessment of compliance for RNP 0.3 applications.

b) The aircraft navigation system, or aircraft navigation system and the pilot in combination, is required to monitor the TSE, and to provide an alert if the accuracy requirement is not met or if the probability that the lateral TSE exceeds two times the accuracy value is larger than 10^{-5}. To the extent operational procedures are used to satisfy this requirement, the crew procedure, equipment characteristics, and installation should be evaluated for their effectiveness and equivalence. Examples of information provided to the pilot for awareness of navigation system performance include “EPU”, “ACTUAL”, “ANP” and “EPE”. Examples of indications and alerts provided when the operational requirement is or can be determined as not being met include “UNABLE RNP”, “Nav Accur Downgrad”, GNSS alert limit, loss of GNSS integrity, TSE monitoring (real time monitoring of NSE and FTE combined), etc. The navigation system is not required to provide both performance and sensor-based alerts, e.g. if a TSE based alert is provided, a GNSS alert may not be necessary.

8.1.3 On-board performance, monitoring and alerting

a) **Accuracy.-** During operations in airspace or on ATS routes designated as RNP 0.3, the lateral TSE must be within ±0.3 NM for at least 95 per cent of the total flight time. The along-track error must also be within ±0.3 NM for at least 95 per cent of the total flight time. To meet this performance requirement, an FTE of 0.25 NM (95 per cent) may be assumed.

Note.- *For all RNP 0.3 operations, the use of a coupled FGS is an acceptable means of complying with this FTE assumption (see RTCA DO-208, Appendix E, Table 1). Any alternative means of FTE bounding, other than coupled FGS, may require FTE substantiation through an airworthiness demonstration.*

b) **Integrity.-** *Malfunction of the aircraft navigation equipment is classified as a major failure condition under* airworthiness regulations (i.e. 1×10^{-5} per hour).

c) **Continuity.-** For the purpose of this specification, loss of function is a major failure condition for remote continental and offshore operations. The carriage of dual independent long-range navigation systems may satisfy the continuity requirement. Loss of function is classified as a minor failure condition for other RNP 0.3 operations if the operator can revert to a different available navigation system and proceed to a suitable airport.

d) **Signal-in-space (SIS).-** The aircraft navigation equipment shall provide an alert if the probability of SIS errors causing a lateral position error greater than 0.6 NM exceeds 1×10^{-7} per hour.

8.1.4 **Bounding FTE for equipment not monitoring TSE performance**

a) RNP 0.3 operations require coupled FGS to meet the allowable FTE bound unless the manufacturer demonstrates and obtains airworthiness approval for an alternate means of meeting the FTE bound. The following may be considered as one operational means to monitor the FGS FTE:

1) FTE should remain within half-scale deflection (unless there is other substantiated FTE data);

2) Pilots must manually set systems without automatic CDI scaling to not greater than 0.3 NM full-scale prior to commencing RNP 0.3 operations; and

3) Aircraft with electronic map display, or another alternate means of flight path deviation display, must select appropriate scaling for monitoring FTE.

b) Automatic monitoring of FTE is not required if the necessary monitoring can be achieved by the pilot using available displays without excessive workload in all phases of flight. To the extent that compliance with this specification is achieved through operational procedures to monitor FTE, an evaluation of the pilot procedures, equipment characteristics, and installation must ensure their effectiveness and equivalence, as described in the functional requirements and operating procedures.

c) PDE is considered negligible if the quality assurance process is applied at the navigation database level (Section 12) and if operating procedures (Section 10) are applied.

8.2 **Aircraft eligibility requirements for RNP 0.3 operations**

a) The aircraft eligibility must be determined through demonstration of compliance against the relevant airworthiness criteria and the requirements of 8.1.

b) The original equipment manufacturer (OEM) or the holder of installation approval for the aircraft, e.g. STC holder, will demonstrate compliance to their CAA, and the approval can be documented in manufacturer documentation (e.g. service letters).

c) AFM entries are not required provided the State accepts manufacturer documentation.

Note.- *Requests for approval to use optional functionality (e.g. RF legs) should address the aircraft and operational requirements as described in Appendix 4.*

8.3 **Functional requirements**

Appendix 1 contains the functional requirements that meet the criteria of this AC.

8.4 **Continued airworthiness**

a) The operators of aircraft approved to perform RNP 0.3 operations, must ensure the continuity of the technical capacity of them, in order to meet technical requirements established in this AC.

b) Each operator who applies for RNP 0.3 operational approval shall submit to the CAA of State of registry, a maintenance and inspection program that includes all those requirements of maintenance necessary to ensure that navigation systems continue fulfilling the RNP 0.3 approval criteria.

c) The following maintenance documents must be revised, as appropriate, to incorporate RNP 0.3 aspects:

1) Maintenance control manual (MCM);

2) Illustrated parts catalogs (IPC); and

3) Maintenance program.

d) The approved maintenance program for the affected aircrafts should include maintenance practices listed in maintenance manuals of the aircraft manufacturer and its components, and must consider:

1) that equipment involved in the RNP 0.3 operation should be maintained according to directions given by manufacturer's components;

2) that any amendment or change of navigation system affecting in any way RNP 0.3 initial approval, must be forwarded and reviewed by the CAA for its acceptance or approval of such changes prior to its implementation; and

3) that any repair that is not included in the approved/accepted maintenance documentation, and that could affect the integrity of navigation performance, should be forwarded to the CAA for acceptance or approval thereof.

e) Within the RNP 0.3 maintenance documentation must be presented the training program of maintenance personnel, which inter alia, should include:

1) PBN concept;

2) RNP 0.3 application;

3) equipment involved in an RNP 0.3 operation; and

4) MEL use.

9. OPERATIONAL APPROVAL

Airworthiness approval alone does not authorise an applicant or operator to conduct RNP 0.3 operations. In addition to the airworthiness approval, the applicant or operator must obtain an operational approval to confirm the suitability of normal and contingency procedures in connection to the installation of a given piece of equipment.

Concerning commercial air transport, the assessment of an application for RNP 0.3 operational approval is done by the State of the operator, in accordance with standing operating rules [*e.g.*, LAR 121.995 (b) and LAR 135.565 (c)] or equivalents supported by the criteria described in this AC.

For general aviation, the assessment of an application for RNP 0.3 operational approval is carried out by the State of registry, in accordance with standing operating rules (*e.g.*, LAR 91.1015 and LAR 91.1640 or equivalents) supported by the criteria established in this AC.

9.1 Requirements to obtain operational approval

9.1.1 In order to obtain RNP 0.3 approval, the applicant or operator will take the following steps, taking into account the criteria established in this paragraph and in Sections 10, 11, 12, and 13:

a) *Airworthiness approval*.- Aircraft shall have the corresponding airworthiness approvals, pursuant to Paragraph 8 of this CA.

b) *Application*.- The operator shall submit the following documentation to the CAA:

1) *RNP 0.3 operational approval application;*

2) *Description of aircraft equipment*.- The operator shall provide a configuration list with details of the relevant components and the equipment to be used for RNP 0.3 operations. The list shall include each manufacturer, model, and equipment version of GNSS equipment and software of the installed FMS.

3) *Airworthiness documents related to aircraft eligibility*.- The operator shall submit relevant documentation, acceptable to the CAA, showing that the aircraft is equipped with RNP systems that meet the RNP 0.3 requirements, as described in Paragraph 8 of this AC. For example, the operator will submit the parts of the AFM or AFM supplement that contain the airworthiness statement.

4) *Training programme for flight crews and flight dispatchers (DV)*

(a) Commercial operators (*e.g.*, LAR 121 and LAR 135 operators) will present to the CAA the RNP 0.3 training curriculums to show that the operational procedures and practices and the training aspects described in Paragraph 11 have been included in the initial, upgrade or recurrent training curriculums for flight crews and DV.

Note.- *It is not necessary to establish a separate training programme if the RNP 0.3 training identified in Paragraph 11 has already been included in the training programme of the operator. However, it must be possible to identify what aspects of RNP 0.3 are covered in the training programme.*

(b) Private operators (*e.g.*, LAR 91 operators) shall be familiar with and demonstrate that they will perform their operations based on the practices and procedures described in Paragraph 11.

5) *Operations manual and checklists*

(a) Commercial operators (*e.g.*, LAR 121 and 135 operators) must review the operations manual (OM) and the checklists in order to include information and guidance on the operating procedures detailed in Paragraph 10 of this AC. The appropriate manuals must contain the operating instructions for navigation equipment and contingency procedures. The manuals and checklists must be submitted for review along with the formal application in Phase 2 of the approval process.

(b) Private operators (*e.g.*, LAR 91 operators) must operate their aircraft based on the practices and procedures identified in Paragraph 10 of this AC.

6) *Minimum Equipment List (MEL)*.- The operator will send to the CAA for approval any revision to the MEL that is necessary to conduct RNP 0.3 operations. If a RNP 0.3 operational approval is granted based on a specific operational procedure, operators must modify the MEL and specify the required dispatch conditions.

7) *Maintenance*.- The operator will submit for approval a maintenance programme to conduct RNP 0.3 operations.

8) *Training programme for maintenance personnel*.- Operators will submit the training curriculums that correspond to maintenance personnel in accordance with Paragraph 8.4 e).

9) *Navigation data validation programme*.- The operator will present the details about the navigation data validation programme as described in Appendix 2 to this AC.

c) *Training*.- Once the amendments to manuals, programmes, and documents submitted have been accepted or approved, the operator will provide the required training to its personnel.

d) *Validation flight*.- The CAA may deem it advisable to perform a validation flight before granting the operational approval. Such validation can be performed on commercial flights. The validation flight will be carried out according to Chapter 12, Volume II, Part II of the operations inspector manual (MIO) of the Regional Safety Oversight Cooperation System (SRVSOP).

e) *Issuance of the approval to conduct RNP 0.3 operations*.- Once the operator has successfully completed the operational approval process, the CAA will grant the operator the authorization to conduct RNP 0.3 operations.

1) LAR 121 and/or 135 operators.- For LAR 121 and/or LAR 135 operators, the CAA will issue the corresponding operations specifications (OpSpecs) that will reflect the RNP 0.3 approval.

2) *LAR 91 operators*.- For LAR 91 operators, the CAA will issue a letter of authorization (LOA).

10. OPERATING PROCEDURES

10.1 The operator and flight crews will become familiar with the following operating and contingency procedures associated with RNP 0.3 operations.

a) **Pre-flight planning**

1) Operators and pilots intending to conduct operations on RNP 0.3 ATS routes, including SIDs and STARs, initial and intermediate approach, must file the appropriate flight plan suffixes.

2) The on-board navigation data must be current and include appropriate procedures. Navigation databases are expected to be current for the duration of the flight. If the AIRAC cycle is due to change during flight, operators and pilots should establish procedures to ensure the accuracy of the navigation data, including the suitability of navigation facilities defining the routes and procedures for flight.

b) **RNP 0.3 availability prediction**

1) RAIM prediction is not required where the equipment uses SBAS augmentation and the planned operations are within the service volume of the SBAS system.

2) In areas and regions where SBAS is not usable or available, RAIM availability for the intended route should be checked prior to flight.

3) Operators can verify the availability of RAIM to support RNP 0.3 operations via NOTAMs (where available) or through GNSS prediction services.

4) The CAA may provide specific guidance on how to comply with RAIM prediction.

5) Operators should be familiar with the prediction information available for the intended ATS route.

6) RAIM availability prediction should take into account the latest GNSS constellation NOTAMs and avionics model (when available). The ANSP, avionics manufacturer, or the RNP system may provide this service.

7) In the event of a predicted, continuous loss of RNP 0.3 of more than 5 minutes for any part of the RNP 0.3 operation, the flight planning should be revised (e.g. delaying the departure or planning a different ATS route). If the prediction service is temporarily unavailable, ANSPs may still allow RNP 0.3 operations to be conducted.

8) RAIM availability prediction software does not guarantee the availability of GNSS. Rather, prediction tools simply assess the expected capability to meet the RNP. Because of potential unplanned failures of some GNSS elements, pilots/ANSPs must consider the loss of RAIM (or GNSS navigation altogether) while airborne may require reversion to an alternative means of navigation. Therefore, pilots should assess their capability to navigate in case of failure of GNSS navigation and consider the actions necessary to successfully divert to an alternate destination.

c) **General operating procedures**

1) The pilot must comply with any instructions or procedures the manufacturer identifies necessary to comply with the performance requirements in this chapter.

Note.- *Pilots are expected to adhere to all AFM/RFM limitations or operating procedures required to maintain RNP 0.3 performance for the ATS route. This shall include any speed restrictions needed to ensure maintenance of RNP 0.3 navigation accuracy.*

2) Operators and pilots should not request or file RNP 0.3 procedures unless they satisfy all the criteria in the relevant State documents. If an aircraft not meeting these criteria receives

a clearance from ATC to conduct an RNP 0.3 operation, the pilot must advise ATC that he/she is unable to accept the clearance and must request alternate instructions.

3) The operator must confirm the availability of GNSS for the period of intended operations along the intended ATS route using all available information and the availability of NAVAID infrastructure required for any (non-RNAV) contingencies.

4) At system initialization, the pilot must confirm the navigation database is current and verify that initial position of the aircraft is entered correctly. The pilot must also verify proper entry of their desired ATS route and any ATC changes to that ATS route upon initial clearance and any subsequent change of ATS route. The pilot must ensure the waypoints sequence depicted by their navigation system matches the ATS route depicted on the appropriate chart(s) and their assigned ATS route.

Note.- *The pilot may notice a slight difference between the navigation information portrayed on the chart and their primary navigation display. Differences of 3 degrees or less may result from the equipment manufacturer's application of magnetic variation and are operationally acceptable.*

5) The pilot must not attempt to fly an RNP 0.3 instrument flight procedure (IFP) unless it is retrievable by name from the on-board navigation database and conforms to the charted procedure. However, the pilot may subsequently modify a procedure by inserting or deleting specific waypoints in response to ATC clearances. The pilot may select the ATS route to be flown for the en-route section of the flight from the database or may construct the ATS route by means of selection of individual en-route waypoints from the database. The manual entry or creation of new waypoints, by manual entry of latitude and longitude or rho/theta values is not permitted. Additionally, pilots must not change any SID or STAR database waypoint type from a fly-by to a fly-over or vice versa.

6) The pilot should cross-check the flight plan clearance by comparing charts or other applicable resources with the navigation system textual display and the aircraft/rotorcraft map display, if applicable. If required, the pilot should also confirm exclusion of specific NAVAIDs in compliance with NOTAMs or other pilot procedures.

7) There is no pilot requirement to cross-check the navigation system's performance with conventional NAVAIDs as the absence of an integrity alert is considered sufficient to meet the integrity requirements. However, the pilot should monitor the reasonableness of the navigation solution and report any loss of RNP 0.3 capability to ATC. In addition, the pilot must continuously monitor the lateral deviation indicator (or equivalent navigation map display) during all RNP 0.3 operations.

8) The pilot is expected to maintain centre line, as depicted by on-board lateral deviation indicators, during all RNP operations unless authorized to deviate by ATC or under emergency conditions. For normal operations on straight segments or FRTs, cross-track error/deviation (the difference between the RNP system computed path and the aircraft position relative to the path) should be limited to ±½ the navigation accuracy associated with the procedure (0.15 NM). Brief deviations from this standard (e.g. overshoots or undershoots) during track changes (fly-by and fly-over turns), up to a maximum of one times the navigation accuracy (i.e. 0.3 NM for RNP 0.3), are allowable.

Note.- *Some systems do not display or compute a path during track changes (fly-by and fly-over turns). As such, the pilots of these aircraft may not be able to adhere to the lateral navigation accuracy requirement (e.g. 0.15 NM) during these turns. However, the pilot is expected to satisfy the operational requirement during intercepts following turns and on straight segments.*

9) If ATC issues a heading assignment taking the aircraft/rotorcraft off an ATS route, the pilot should not modify the flight plan in the RNAV system until receiving a new ATC clearance to rejoin the ATS route or the controller confirms a new ATS route clearance. When the aircraft is following an ATC heading assignment, the specified accuracy requirement does not apply.

10) Manually selecting aircraft bank limiting functions may reduce the aircraft's ability to maintain its desired track and is not recommended. The pilot should recognize manually

selectable aircraft bank-limiting functions might reduce their ability to satisfy path requirements of the procedure, especially when executing large angle turns. This should not be construed as a requirement to deviate from flight manual procedures; rather, pilots should be encouraged to avoid the selection of such functions except where needed for flight safety reasons.

d) **Aircraft/rotorcraft with RNP selection capability**

The pilot of an aircraft/rotorcraft with a manual RNP input selection capability should select RNP 0.3 for all RNP 0.3 ATS routes.

e) **RNP 0.3 SID specific requirements**

1) Prior to commencing take-off, the pilot must verify the aircraft RNP system is available, operating correctly, and the correct airport/heliport and departure data are loaded and properly depicted (including the aircraft's initial position). A pilot assigned an RNP 0.3 departure procedure and subsequently issued a change to the procedure or a transition from the procedure must verify that the appropriate changes are entered and available for navigation prior to take-off. A final check of proper departure entry and correct route depiction, shortly before take-off, is recommended.

2) The GNSS signal must be available and acquired by the aircraft's GNSS avionics before the take-off.

3) *Engagement of system after take-off.-* When required, the pilot must be able to engage (i.e. couple) the FGS prior to reaching the first waypoint defining a procedure requiring RNP 0.3 in accordance with this specification.

f) **RNP 0.3 STAR specific requirements**

1) Prior to the arrival phase, the pilot should verify loading of the correct terminal route. The active flight plan should be checked by comparing the charts (paper or electronic) with the map display (if applicable) and the MCDU. This includes confirmation of the waypoint sequence, reasonableness of track angles and distances, any altitude or speed constraints, and, where possible, identification of which waypoints are fly-by and which are fly-over or which represent the beginning or end of a radius-to-fix leg segment. An ATS route must not be used if the pilot has any reason to doubt the validity of the ATS route in the navigation database.

Note.- *As a minimum, the arrival checks can be a simple inspection of a suitable map display that achieves the objectives of this paragraph.*

2) The creation of new waypoints by manual entry into the RNP 0.3 system by the pilot would not create a valid ATS route and is unacceptable at all times.

3) Where contingency procedures require reversion to a conventional IFP, the pilot must complete all necessary preparation for such reversion (e.g. manual selection of NAVAID) before commencing any portion of the IFP.

4) Procedure modifications in the terminal area may take the form of ATC-assigned radar headings or "direct to" clearances, and the pilot must be capable of reacting in a timely fashion. This may include a requirement for the pilot to insert tactical waypoints loaded from the on-board navigation database. The pilot must not make manual entries or modify and create temporary waypoints or fixes that are not provided in the on-board navigation database.

5) The pilot must verify their aircraft navigation system is operating correctly, and the correct arrival procedure (including any applicable transition) is entered and properly depicted. Although a particular method is not mandated, the pilot must adhere to any published altitude and speed constraints associated with an RNP 0.3 operation.

g) **Contingency procedures**

1) The pilot must notify ATC of any loss of the RNP 0.3 capability (integrity alerts or loss of

navigation) together with the proposed course of action. If unable to comply with the requirements of an RNP 0.3 ATS route for any reason, the pilot must advise ATC as soon as possible. The loss of RNP 0.3 capability includes any failure or event causing the aircraft to no longer satisfy the RNP 0.3 requirements of the desired ATS route.

2) In the event of communications failure, the pilot should continue with the published lost communications procedure.

11. TRAINING PROGRAMMES

11.1 The training programme for flight crews and flight dispatchers (DV) shall provide sufficient training (*e.g*. using flight training devices, flight simulators or aircraft) on the aircraft´s RNP system to the extent necessary. The training programme will include the following topics:

a) The information in this AC;

b) The meaning and proper use of aircraft/helicopter equipment/navigation suffixes;

c) Procedure characteristics as determined from chart depiction and textual description;

d) Depiction of waypoint types (fly-over and fly-by) and path terminators (provided in Section 1.4.3.4 AIRINC 424 path terminators and any other types used by the operator) as well as associated aircraft/helicopter flight paths;

e) Required navigation equipment and MEL for operation on RNP 0.3 ATS routes;

f) RNP system-specific information:

1) Levels of automation, mode annunciations, changes, alerts, interactions, reversions, and degradation;

2) Functional integration with other aircraft systems;

3) The meaning and appropriateness of route discontinuities as well as related flight crew procedures;

4) Pilot procedures consistent with the operation (e.g. monitor PROG or LEGS page);

5) Types of navigation sensors utilized by the RNP system and associated system prioritization/weighting/logic/limitations;

6) Turn anticipation with consideration for airspeed and altitude effects;

7) Interpretation of electronic displays and symbols used to conduct an RNP 0.3 operation; and

8) Understanding of the aircraft configuration and operational conditions required to support RNP 0.3 operations (i.e. appropriate selection of CDI scaling/lateral deviation display scaling);

g) RNP equipment operating procedures, as applicable, including how to perform the following actions:

1) Verifying currency and integrity of aircraft navigation data;

2) Verifying successful completion of RNP system self-tests;

3) Entry of and update to the aircraft navigation system initial position;

4) Retrieving and flying an IFP with appropriate transition;

5) Adhering to speed and/or altitude constraints associated with an RNP 0.3 IFP;

6) Impact of pilot selectable bank limitations on aircraft/rotorcraft ability to achieve the required accuracy on the planned route;

7) Selecting the appropriate STAR or SID for the active runway in use and be familiar with

flight crew procedures required to deal with a runway change;

8) Verifying waypoint and flight plan programming;

9) Flying direct to a waypoint;

10) Flying a course/track to a waypoint;

11) Intercepting a course/track;

12) Following vectors and rejoining an RNP ATS route from “heading” mode;

13) Determining cross-track error/deviation. More specifically, the maximum deviations allowed to support RNP 0.3 must be understood and respected;

14) Inserting and deleting route discontinuities;

15) Removing and reselecting navigation sensor inputs;

16) When required, confirming exclusion of a specific NAVAID or NAVAID type;

17) Changing the arrival airport/heliport and the alternate airport;

18) Performing a parallel offset function, if the capability exists. The pilot should know how to apply offsets within the functionality of their particular RNP system and the need to advise ATC if this functionality is not available; and

19) Performing a conventional holding pattern;

h) Operator-recommended levels of automation for phase of flight and workload, including methods to minimize cross-track error to maintain route centre line;

i) R/T phraseology for RNAV/RNP applications; and

j) Contingency procedures for RNAV/RNP failures.

12. NAVIGATION DATABASE

a) Navigation data management is addressed in Annex 6, Part 1, Chapter 7. In support of this, the operator must obtain the navigation database from a supplier complying with RTCA DO 200A/EUROCAE document ED 76, Standards for Processing Aeronautical Data, and the database must be compatible with the intended function of the equipment. The CAA recognizes compliance to the referenced standard using an LOA or other equivalent document.

b) The operator must report any navigation database discrepancies that invalidate a SID, STAR or initial/intermediate approach procedure to the navigation database supplier, and the operator must prohibit their pilots from attempting an affected SID or STAR.

c) Aircraft operators should consider the need to conduct ongoing checks of the operational navigation databases in order to meet existing quality system requirements.

13. OVERSIGHT, INVESTIGATION OF NAVIGATION ERRORS, AND WITHDRAWAL OF RNP 0.3 APPROVAL

a) The operator will establish a process to receive, analyse, and follow up on navigation errors reports in order to determine appropriate corrective action.

b) Information indicating the potential for repeated errors may require modification of an operator´s training programme.

c) Information attributing multiple errors to particular pilots may necessitate remedial training or license review.

d) Repeated navigation error occurrences attributed to specific navigation equipment should result

in cancellation of the operational approval permitting use of that equipment during RNP 0.3 operations.

APPENDIX 1

FUNCTIONAL REQUIREMENTS

The following navigation displays and functions (installed per AC 20-130A and AC 20-138A or equivalent airworthiness installation advisory material) are required.

Paragraph	*Functional requirement*	*Explanation*
a)	Navigation data, including a failure indicator, must be displayed on a lateral deviation display (CDI, EHSI) and/or a navigation map display. These must be used as primary flight instruments for the navigation of the aircraft, for manoeuvre anticipation and for failure/status/integrity indication.	Non-numeric lateral deviation display (e.g. CDI, EHSI), with a to/from indication and a failure annunciation, for use as primary flight instruments for navigation of the aircraft, for manoeuvre anticipation, and for failure/status/integrity indication, with the following five attributes: 1) The capability to continuously display to the pilot flying, on the primary flight instruments for navigation of the aircraft (primary navigation display), the computed path and aircraft position relative to the path. For operations where the required minimum flight crew is two pilots, the means for the pilot not flying to verify the desired path and the aircraft position relative to the path must also be provided. 2) Each display must be visible to the pilot and located in the primary field of view (±15° from the pilot's normal line of sight) when looking forward along the flight path. 3) The lateral deviation display scaling should agree with any implemented alerting and annunciation limits. 4) The lateral deviation display must also have a full-scale deflection suitable for the current phase of flight and must be based on the required track-keeping accuracy. 5) The display scaling may be set automatically by default logic: automatically to a value obtained from a navigation database, or manually by pilot procedures. The full-scale deflection value must be known or must be available for display to the pilot commensurate with the required track-keeping accuracy. 6) The lateral deviation display must be automatically slaved to the computed path.

		The course selector of the deviation display should be automatically slewed to the computed path. As an alternate means of compliance, a navigation map display can provide equivalent functionality to a lateral deviation display as described in 1 to 6 above, with appropriate map scales and giving equivalent functionality to a lateral deviation display. The map scale should be set manually to a value appropriate for the RNP 0.3 operation.
b)	The following system functions are required as a minimum within any RNP 0.3 equipment.	1) The capability to continuously display to the pilot flying, on the primary flight instruments for navigation of the aircraft (primary navigation display), the computed path and aircraft position relative to the path. For operations where the required minimum flight crew is two pilots, the means for the pilot not flying to verify the desired path and the aircraft position relative to the path must also be provided. 2) A navigation database, containing current navigation data officially promulgated for civil aviation, which can be updated in accordance with the AIRAC cycle and from which IFR procedures and ATS routes or waypoint data corresponding to the coordinates of significant points on ATS routes, can be retrieved and loaded into the RNP system. The stored resolution of the data must be sufficient to achieve negligible PDE. The database must be protected against pilot modification of the stored data. 3) The means to display the validity period of the navigation data to the pilot. 4) The means to retrieve and display data stored in the navigation database relating to individual waypoints and NAVAIDs, to enable the pilot to verify the ATS route to be flown. 5) Capacity to load from the database into the RNP system the entire Instrument flight procedure (IFP) and the ATS route to be flown.
c)	The means to display the following items, either in the pilot's primary field of view, or on a readily accessible display page.	1) The active navigation sensor type. 2) The identification of the active (To) waypoint.

		3) The ground speed or time to the active (To) waypoint. 4) The distance and bearing to the active (To) waypoint.
d)	The capability to execute a “Direct to” function.	
e)	The capability for automatic leg sequencing with the display of sequencing to the pilot.	
f)	The capability to execute RNP 0.3 terminal procedures extracted from the on-board navigation database, including the capability to execute fly-over and fly-by turns.	
g)	The capability to automatically execute leg transitions and maintain tracks consistent with the following ARINC 424 path terminators, or their equivalent. – Initial fix (IF) – Course to a fix (CF) – Course to an altitude (CA) – Direct to a fix (DF) – Track to a fix (TF)	***Note.-*** *Path terminators are defined in ARINC 424, and their application is described in more detail in RTCA documents DO-236B and DO-201A.*
h)	The capability to automatically execute leg transitions consistent with Heading to an altitude (VA), Heading to a manual termination (VM) and Heading to an intercept (VI) ARINC 424 path terminators, or must be able to be manually flown on a heading to intercept a course or to go direct to another fix after reaching a procedure-specified altitude.	
i)	The capability to automatically execute leg transitions consistent with Course to an altitude (CA) and Course from a fix to manual termination (FM) ARINC 424 path terminators, or the RNAV system must permit the pilot to readily	

	designate a waypoint and select a desired course to or from a designated waypoint.	
j)	The capability to load an ATS route from the database, by name.	
k)	The capability to display an indication of the RNP 0.3 system failure, in the pilot's primary field of view.	
l)	The system shall be capable of loading numeric values for courses and tracks from the on-board navigation database.	

APPENDIX 2

NAVIGATION DATA VALIDATION PROGRAMME

1. INTRODUCTION

The information stored in the navigation database defines the lateral and longitudinal guidance of the aircraft for RNP 0.3. Navigation database updates are carried out every 28 days. The navigation data used in each update are critical to the integrity of every RNP 0.3 route. This appendix provides guidance on operator procedures to validate the navigation data associated with the RNP 0.3 operations.

2. DATA PROCESSING

a) The operator will identify in its procedures the person responsible for the navigation data updating process.

b) The operator must document a process for accepting, verifying, and loading navigation data into the aircraft.

c) The operator must place its documented data process under configuration control.

3. INITIAL DATA VALIDATION

3.1 The operator must validate every RNP 0.3 route to ensure compatibility with the aircraft and to ensure that the resulting paths are consistent with the published routes. As a minimum, the operator must:

a) compare the navigation data of RNP 0.3 routes to be loaded into the FMS with valid charts and maps containing the published routes; and

b) once the RNP 0.3 routes are validated, a copy of the validated navigation data shall be kept and maintained in order to compare them with subsequent data updates.

4. DATA UPDATING

Upon receiving a navigation data update and before using such data on the aircraft, the operator must compare the update with the validated routes. This comparison must identify and resolve any discrepancy in the navigation data. If there are significant changes (any change affecting the path or the performance of the route) in any part of the route, and if those changes are verified through the initial data, the operator must validate the amended route in accordance with the initial validation data.

5. NAVEGATION DATA SUPPLIERS

Navigation data suppliers must have a letter of acceptance (LOA) in order to process these data (*e.g.*, FAA AC 20-153 or the document on the conditions for the issuance of letters of acceptance to navigation data suppliers by the European Aviation Safety Agency – EASA (EASA IR 21 Subpart G) or equivalent documents). A LOA recognises the data supplier as one whose data quality, integrity and quality management practices are consistent with the criteria of DO-200A/ED-76. The database supplier of an operator must have a Type 2 LOA and its respective suppliers must have a Type 1 or 2 LOA. The CAA may accept a LOA issued to navigation data suppliers or issue its own LOA.

6. AIRCRAFT MODIFICATIONS (DATABASE UPDATE)

If an aircraft system necessary for RNP 0.3 operations is modified (*e.g.*, change of software), the operator is responsible for validating the RNP 0.3 routes with the navigation database and the modified system. This can be done without any direct assessment if the manufacturer confirms that the modification has no effect on the navigation database or on path calculation. If there is no such confirmation by the manufacturer, the operator must perform an initial validation of the navigation data with the modified system.

APPENDIX 3

RNP 0.3 APPROVAL PROCESS

a) The RNP 0.3 approval process consists of two types of approvals, airworthiness and operational. Although the two have different requirements, they must be considered in one single process.

b) This process is an orderly method used by the CAA to make sure that the applicants meet the established requirements.

c) The approval process is made up by the following phases:

1) Phase one: Pre-application

2) Phase two: Formal application

3) Phase three: Documentation evaluation

4) Phase four: Inspection and demonstration

5) Phase five: Approval

d) In *Phase one - Pre-application*, the CAA calls the applicant or operator to a pre-application meeting. At this meeting, the CAA informs the applicant or operator of all the operational and airworthiness requirements that it must meet during the approval process, including the following:

1) the contents of the formal application;

2) the review and evaluation of the application by the CAA;

3) the limitations (if any) applicable to the approval; and

4) conditions under which the RNP 0.3 approval could be cancelled.

e) In *Phase two – Formal Application*, the applicant or operator submits the formal application along with all the relevant documentation, as established in Paragraph 9.1.1 b) of this AC.

f) In Phase three – *Documentation evaluation*, the CAA evaluates all the documentation and the navigation system to determine their eligibility and the approval method to be followed in connection with the aircraft. As a result of this analysis and evaluation, the CAA may accept or reject the formal application along with the documentation.

g) In *Phase four – Inspection and demonstration*, the operator will provide training to its personnel and will carry out the validation flight, if required.

h) In *Phase five* - Approval, the CAA issues the RNP 0.3 approval once the operator has met the airworthiness and operational requirements. For LAR 121 and 135 operators, the CAA will issue the OpSpecs, and for LAR 91 operators, a LOA.

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APPENDIX 4

RADIUS TO FIX (RF) PATH TERMINATOR

1. INTRODUCTION

1.1 Background

This appendix addresses ARINC 424 RF path terminator functionality when used in association with RNP 0.3 navigation specification. RF legs are a required capability for use with RNP 0.3 rather than a minimum requirement. This functionality can be used in the initial and intermediate approach segments, the final phase of the missed approach, SIDs and STARs. The application of this appendix in the final approach or the initial or intermediate phases of the missed approach is prohibited. Such procedure segments wishing to apply RF would have to use the RNP AR specification.

1.2 Purpose

1.2.1 This appendix provides guidance to CAAs implementing instrument flight procedures (IFPs) where RF legs are incorporated into terminal procedures.

1.2.2 For the ANSP, it provides a consistent CAA recommendation on how to implement RF legs. For the operator, it provides training requirements. This appendix is intended to facilitate operational approval for existing RNP systems that have a demonstrated RF leg capability. An operational approval based upon this standard allows an operator to conduct operations on procedures containing RF legs globally.

1.2.3 This appendix also provides airworthiness and operational criteria for the approval of an RNP system incorporating an RF leg capability. Although the ARINC 424 RF leg functionality in this appendix is identical to that found in the RNP AR specification, the approval requirements when applied in association with RNP 0.3 are not as constraining as those applied to RNP AR. This is taken into account in the related obstacle protection and route spacing criteria. ICAO Doc 9905 provides a continuous lateral protection of 2 × RNP for RNP AR applications, on the basis that the certification and approval process provides assurance that the integrity and continuity of the navigation solution will meet 10^{-7}. The demanding integrity and continuity requirements for RNP AR do not apply to the RF functionality described here as ICAO Doc 8168 provides additional buffers in the RF design criteria.

2. IMPLEMENTATION CONSIDERATIONS

2.1 Application of RF legs

2.1.1 The RF leg should be used when there is a requirement for a specific fixed radius curved path in a terminal procedure. The RF leg is defined by the arc centre fix, the arc initial fix, the arc ending fix and the turn direction. The radius is calculated by the navigation computer as the distance from the arc centre fix to the arc ending fix. RNP systems supporting this leg type provide the same ability to conform to the track-keeping accuracy during the turn as in the straight line segments. RF legs are intended to be applied where accurate repeatable and predictable navigation performance is required in a constant radius turn.

2.1.3 RF legs may be used on any segment of a terminal procedure except the FAS, the Initial missed approach phase or the intermediate missed approach phase. The criteria for designing procedures with RF legs are detailed in PANS-OPS (ICAO Doc 8168).

Note.- *Although the RF leg is designed to be applied within the extent of terminal procedures, during higher flight level/altitude segments aircraft may become bank angle limited. When designing terminal procedures with curved path segments, consideration should be given to the interface between the terminal procedure (SID or STAR) and the ATS route structure and whether it is more appropriate to implement the curved path segment through use of the FRT. The FRT design feature within an ATS route structure is provided for any such curved path requirements as part of the A-RNP specification.*

2.2 Instrument flight procedure (IFP) design considerations and assumptions

2.2.1 The radius of turn depends upon the ground speed of the aircraft and the applied bank angle. From an IFP design perspective, the maximum ground speed of the aircraft is determined by the maximum allowable IAS, the turn altitude and the maximum tail wind. IFP design criteria for maximum IAS, turn altitude, bank angle and maximum tailwind are described in detail in PANS-OPS (ICAO Doc 8168).

2.2.2 When speed restrictions are required for departures they will be placed on the RF leg exit waypoint or a subsequent waypoint as required. For arrivals, the speed restriction should be applied to the waypoint associated with the beginning of the RF leg (path terminator of preceding leg).

2.2.3 The inbound and outbound legs will be tangential to the RF leg.

2.2.4 The requirements of an RF leg may be continued through to a sequential RF leg when implementing wrap-around instrument procedures, e.g. departures.

2.2.5 The procedure will be subjected to comprehensive validation checks prior to publication in order to assure flyability by the intended aircraft types.

3. GENERAL CONSIDERATIONS FOR USE OF RF LEGS

3.1 Benefits

RF legs provide a predictable and repeatable ground track during a turn and prevent the dispersion of tracks experienced in other types of turn construction due to varying aircraft speeds, turn anticipation, bank, roll rate, etc. Therefore, RF legs can be employed where a specified path must be flown during a turn. Additionally, because an RF leg traverses a specified distance it can be used to maintain aircraft longitudinal spacing between aircraft having the same speed. This is not necessarily true with other turn constructions such as fly-by transitions, because of the varying turn paths aircraft execute.

3.2 Publication considerations

Guidance for charting RF legs is provided in PANS-OPS (ICAO Doc 8168). The requirement for RF functionality must be clearly marked on the chart.

3.3 ATC coordination

3.1.1 It is expected that ATC will be familiar with RF leg benefits and their limitations, e.g. speed. ATC shall not allocate a speed that exceeds a constraint associated with the (design) flyability of an RF leg.

3.1.2 Aircraft must be established on the inbound track to the RF leg prior to it being sequenced by the navigation system. ATC must therefore not issue a Direct To clearance to a waypoint beginning an RF leg or a vector to intercept an RF leg.

4. AIRCRAFT REQUIREMENTS

4.1 RNP system-specific information

4.1.1 The navigation system should not permit the pilot to select a procedure that is not supported by the equipment, either manually or automatically (e.g. a procedure is not supported if it incorporates an RF leg and the equipment does not provide RF leg capability).

4.1.2 The navigation system should also prohibit pilot access to procedures requiring RF leg capability if the system can select the procedure, but the aircraft is not otherwise equipped (e.g. the aircraft does not have the required roll steering autopilot or flight director installed).

Note 1.- *One acceptable means to meet these requirements is to screen the aircraft's on-board navigation database and remove any routes or procedures the aircraft is not eligible to execute. For example, if the aircraft is not eligible to complete RF leg segments, then the database screening could remove all procedures containing RF leg segments from the navigation database.*

Note 2.- *Another acceptable means of compliance may be pilot training to identify and prohibit the use of procedures containing RF legs.*

4.2 On-board performance monitoring and alerting

The navigation system must have the capability to execute leg transitions and maintain a track consistent with an RF leg between two fixes. The lateral TSE must be within ±1 × RNP of the path defined by the published procedure for at least 95 per cent of the total flight time for each phase of flight and each autopilot and/or flight director mode requested.

Note 1.- *Industry standards for RF defined paths can be found in RTCA DO-236B/EUROCAE ED-75B (Sections 3.2.5.4.1 and 3.2.5.4.2).*

Note 2.- *Default values for FTE can be found in RTCA DO-283A. FAA AC 120-29A, 5.19.2.2 and 5.19.3.1, also provides guidance on establishing FTE values.*

4.3 System failure modes/annunciations

4.3.1 The RNP system shall provide a visible alert within the pilot's primary field of view when loss of navigation capability and/or loss of integrity (LOI) are experienced.

4.3.2 Any failure modes that have the potential to affect the RF leg capability should be identified. Failure modes may include loss of electrical power, loss of signal reception, RNP system failure, including degradation of navigation performance resulting in a loss of RNP containment integrity.

4.3.3 The ability of the aircraft to maintain the required FTE after a full or partial failure of the autopilot and/or flight director should be documented.

Note.- *If autopilot malfunction testing was performed for worst case failures, no further validation is required. In this case, the manufacturer is expected to provide a statement of confirmation.*

4.4 Functional requirements

4.4.1 An autopilot or flight director with at least "roll-steering" capability that is driven by the RNP system is required. The autopilot/flight director must operate with suitable accuracy to track the lateral and, as appropriate, vertical paths required by a specific RNP procedure.

4.4.2 An electronic map display depicting the RNP computed path of the selected procedure is required.

4.4.3 The flight management computer, the flight director system, and the autopilot must be capable of commanding and achieving a bank angle up to 25 degrees above 400 ft AGL.

4.4.4 The flight guidance mode should remain in lateral navigation while on an RF leg, when a procedure is abandoned or a missed approach/go-around is initiated [through activation of Take-off/go-around (TOGA) or other means] to enable display of deviation and display of positive course guidance during the RF leg. As an alternative means, crew procedures may be used that ensure that the aircraft adheres to the specified flight path throughout the RF leg segment.

4.5 Compliance demonstration

4.5.1 In seeking an airworthiness approval for a navigation system implementing the RF path terminator, the compliance demonstration supporting such an approval should be scoped to the airspace operational concept and the boundaries to which the RF leg is likely to be applied.

4.5.2 Consideration should be given to evaluation of the navigation system on a representative set of procedure designs under all foreseen operating conditions. The evaluation should address maximum assumed crosswind and maximum altitude with the aircraft operating in the range of

expected airspeeds for the manoeuvre and operating gross weights. Procedure design constraints should include sequencing multiple, consecutive RF leg segments of varying turn radii, including consecutive RF leg segments reversing the direction of turn (i.e. reversing from a left-hand RF turn to a right-hand RF turn). Within the demonstration, the applicant should be seeking to confirm the FTE commensurate with the identified RNP navigation accuracy and that the RF turn entry and exit criteria are satisfied. Any limitations identified during the compliance demonstration should be documented. Flight crew procedures should be assessed, including identification of any limitations which surround the use of pilot selectable or automatic bank angle limiting functions and confirmation of those related to go-around or missed approach from an RF leg segment.

5. OPERATIONAL REQUIREMENTS

5.1 Background

This section identifies the operational requirements associated with the use of RF legs as scoped in 1.1 of this appendix. It assumes that the airworthiness approval of the aircraft and systems has been completed. This means that the basis for the RF leg function and the system performance has already been established and approved based upon appropriate levels of analysis, testing and demonstration. As part of this activity, the normal procedures, as well as any limitations for the function, will have been documented, as appropriate, in the aircraft flight and operations manuals.

5.2 Approval process

The approval process will follow the procedures established in Appendix 3 of this AC.

5.3 Aircraft eligibility

5.3.1 Relevant documentation acceptable to the CAA must be available to establish that the aircraft is equipped with an RNP system with a demonstrated RF leg capability. Eligibility may be established in two steps: first, recognizing the qualities and qualifications of the aircraft and equipment; and second, determining the acceptability for operations. The determination of eligibility for existing systems should consider acceptance of manufacturer documentation of compliance, e.g. FAA ACs 90-105, 90-101A, 20-138B, EASA AMC 20-26.

Note.- *RNP systems demonstrated and qualified for RNP AR operations using RF leg functionality are considered qualified with recognition that the RNP operations are expected to be performed consistent with the operators RNP 0.3 approval. No further examination of aircraft capability, operator training, maintenance, operating procedures, databases, etc. is necessary.*

5.3.2 *Eligibility airworthiness documents*. The flight manual or referenced document should contain the following information:

a) A statement indicating that the aircraft meets the requirements for RNP operations with RF legs and has demonstrated the established minimum capabilities for these operations. This documentation should include the phase of flight, mode of flight (e.g. FD on or off, and/or AP on or off, and applicable lateral and vertical modes), minimum demonstrated lateral navigation accuracy, and sensor limitations, if any;

b) Any conditions or constraints on path steering performance (e.g. AP engaged, FD with map display, including lateral and vertical modes, and/or CDI/map scaling requirements) should be identified. Use of manual control with CDI only is not allowed on RF legs; and

c) The criteria used for the demonstration of the system, acceptable normal and non-normal configurations and procedures, the demonstrated configurations and any constraints or limitations necessary for safe operation should be identified.

5.4 Operational approval

5.4.1 The operational approval will follow the steps described in Section 9 of this AC.

5.4.2 *Issuance of the approval to conduct RNP 0.3 operations with RF legs*.- Once the operator has successfully completed the operational approval process, the CAA will grant to the operator the authorization to conduct RNP 0.3 operations with RF legs.

a) LAR 121 and/or 135 operators.- For LAR 121 and/or LAR 135 operators, the CAA will issue the corresponding operations specifications (OpSpecs) that will reflect the RNP 0.3 authorization with RF legs.

b) LAR 91 operators.- For LAR 91 operators, the CAA will issue a letter of authorization (LOA).

5.4.2 Training documentation.- Commercial operators must have a training programme addressing the operational practices, procedures and training related to RF legs in terminal operations (e.g. initial, upgrade or recurrent training for pilot, dispatchers or maintenance personnel). Private operators should be familiar with the practices and procedures identified in 5.6 - Pilot knowledge and training of this appendix.

Note.- *It is not required to establish a separate training programme or regime if RNAV and RF leg training is already an integrated element of a training programme. However, it should be possible to identify what aspects of RF leg use are covered within a training programme.*

5.4.4 OMs and checklists.- OMs and checklists for commercial operators must address information/guidance on the SOP detailed in 5.5 - Operating procedures. Private operators should operate using the practices and procedures identified in 5.6 - Pilot knowledge and training. These SOP and practices must clearly define any aircraft limitations associated with RF leg execution (e.g. if the aircraft is not capable of executing RF leg segments, then the instructions to pilots must prohibit an attempt to fly a procedure requiring RF leg capability).

5.5 Operating procedures

5.5.1 The pilot must use either a flight director or autopilot when flying an RF leg. The pilot should comply with any instructions or procedures identified by the manufacturer as necessary to comply with the performance requirements in this appendix.

5.5.2 Procedures with RF legs will be identified on the appropriate chart.

5.5.3 When the dispatch of a flight is predicated on flying an RNP procedure with an RF leg, the dispatcher/pilot must determine that the installed autopilot/flight director is operational.

5.5.4 The pilot is not authorized to fly a published RNP procedure unless it is retrievable by the procedure name from the aircraft navigation database and conforms to the charted procedure. The lateral path must not be modified, with the exception of complying with ATC clearances/instructions.

5.5.5 The aircraft must be established on the procedure prior to beginning the RF leg.

5.5.6 The pilot is expected to maintain the centre line of the desired path on RF legs. For normal operations, cross-track error/deviation (the difference between the displayed path and the displayed aircraft position relative to the displayed path (i.e. FTE) should be limited to half the navigation accuracy associated with the procedure (e.g. 0.15 NM for RNP 0.3).

5.5.7 Where published, the pilot must not exceed maximum airspeeds associated with the flyability (design) of the RF leg.

5.5.8 If an aircraft system failure results in the loss of capability to follow an RF turn, the pilot should maintain the current bank and roll out on the charted RF exit course. The pilot should advise ATC as soon as possible of the system failure.

5.6 Pilot knowledge and training

5.6.1 The training programme must include:

a) The information in this appendix;

b) The meaning and proper use of RF functionality in RNP systems;

c) Associated procedure characteristics as determined from the chart depiction and textual description;

d) Associated levels of automation, mode annunciations, changes, alerts, interactions, reversions, and degradation;

Note.- *Manually selecting aircraft bank limiting functions may reduce the aircraft's ability to maintain its desired track and are not permitted. The pilots should recognize that manually selectable aircraft bank-limiting functions may reduce their ability to satisfy ATC path expectations, especially when executing large angle turns.*

e) Monitoring track-keeping performance;

f) The effect of wind on aircraft performance during execution of RF legs and the need to remain within the RNP containment area. The training programme should address any operational wind limitations and aircraft configurations essential to safely complete the RF turn;

g) The effect of ground speed on compliance with RF paths and bank angle restrictions impacting the ability to remain on the course centre line;

h) Interpretation of electronic displays and symbols; and

i) Contingency procedures.

5.7 Navigation database

Aircraft operators will be required to manage their navigation data base load either through the packing or through flight crew procedure, where they have aircraft systems capable of supporting the RF functionality, but as an operator they do not have an approval for its use.

RNP 0.3 JOB AID

REQUEST TO CONDUCT RNP 0.3 OPERATIONS

1. Introduction

This job aid was developed by the Latin American Regional Safety Oversight Cooperation System (SRVSOP) to provide States, operators, and inspectors with guidance on the process to be followed by an operator in order to obtain a RNP 0.3 authorization.

2. Purpose of the job aid

2.1 To give operators and inspectors information on the main reference documents of RNP 0.3.
2.2 To provide tables showing the contents of the application, the associated reference paragraphs, the place in the application of the operator where RNP 0.3 elements are mentioned and columns for inspector comments and follow-up on the status of various elements of RNP 0.3.

3. Actions recommended for the inspector and operator

Some recommendations for use of the job aid follow:

3.1 At the pre-application meeting with the operator, the inspector reviews the “basic events of the RNP 0.3 approval process” described in Part 1 of this job aid, in order to provide an overview of the approval process events.
3.2 The inspector reviews this job aid with the operator in order to establish the form and content of the RNP 0.3 approval application.
3.3 The operator uses this job aid as a guide to collect the documents/annexes of the RNP 0.3 application.
3.4 The operator inserts in the job aid references showing in what part of its documents are the RNP 0.3 programme elements located.
3.5 The operator submits the job aid and the application to the inspector (documents/annexes).
3.6 The inspector indicates in the job aid whether an item is in compliance or needs corrective action.
3.7 The inspector informs the operator as soon as possible when a corrective action by the operator is required.
3.8 The operator provides the inspector with the revised material when so requested.
3.9 The CAA provides the operator with the operational specifications (OpSpecs) or a letter of authorisation (LOA), as applicable, when the tasks and documents have been completed.

4. Structure of the job aid

5. Main sources of documents, information, and contacts

To access the RNP 0.3 job aid, enter to the Web page of the ICAO/SAM Regional Office (www.lima.icao.int) under the SRVSOP link or directly to the following address: http://www1.lima.icao.int/srvsop/document

6. Main reference documents

Reference Document	Title
Annex 6	Operation of aircraft
ICAO Doc 9613	Performance based navigation (PBN) manual
AMC 20-5	Acceptable means of compliance for airworthiness approval and operational criteria for the use of the NAVSTAR Global positioning system (GPS)
AC 20-130A	Airworthiness approval of navigation or flight management systems integrating multiple navigation sensors
AC 20-138A	Airworthiness approval of global navigation satellite system (GNSS) equipment
TSO-C115b	Airborne area navigation equipment using multi-sensor inputs
TSO-C129a	Airborne supplemental navigation equipment using the global positioning system (GPS)
TSO-C145a	Airborne navigation sensors using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)
TSO-C146a	Stand-Alone airborne navigation equipment using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)

PART 1: GENERAL INFORMATION

Basic events in the RNP 0.3 approval process

	Action by the operator	Action by the CAA
1	Establishes the need to obtain RNP 0.3 authorization.	
2	Reviews the AFM, AFM supplement or Type certificate data sheet (TCDS), or other appropriate documents [*e.g.,* service bulletins (SB), service letters (SL), etc.] to determine the eligibility of the aircraft for RNP 0.3 operations. The operator contacts the aircraft or avionics manufacturer, if necessary, to confirm RNP 0.3 or higher eligibility of the aircraft.	
3	Contacts the CAA to schedule a pre-application meeting to discuss the operational approval requirements.	
4		During the pre-application meeting, establishes: • the form and contents of the application; • the documents that support RNP 0.3 approval • the date in which the application will be submitted for evaluation • the need to conduct a validation flight observed by the CAA.
5	Submits the application at least 60 days before start-up of RNP 0.3 operations.	
6		Reviews the request of the operator.
7	Once the amended manuals, programmes, and documents have been approved, provides training to flight crews, flight dispatchers, and maintenance personnel, and conducts a validation flight, if required by the CAA.	Only if required, participates in the validation flight.
8		Once the operational and airworthiness requirements have been met, issues the operational approval in the form of OpSpecs for LAR 121 or 135 operators or equivalent operators, or an LOA for LAR 91 operators or equivalent operators, as appropriate.

Notes related to the approval process

1. **Responsible authority**

   a. **Commercial air transport (LAR 121 and/or 135 regulations or equivalent).-** The **State of registry** determines that the aircraft meets the airworthiness requirements. The **State of the operator** issues the RNP 0.3 approval (*e.g.,* OpSpecs).

   b. **General aviation (LAR 91 regulations or equivalent).-** The **State of registry** determines that the aircraft meets the airworthiness requirements and issues the operational approval (*e.g.,* an LOA).

2. The CAA does not need to issue a LOA or equivalent document for each individual area of operation in the case of LAR 91 operators.

3. LAR 121 and/or 135 operators with RNP 0.3 approval must list this approval in the OpSpecs.

4. Related sections of the Latin American Aeronautical Regulations (LAR) or equivalent regulations

   a. LAR 91 Sections 91.1015 and 91.1640 or equivalents

   b. LAR 121 Section 121.995 (b) or equivalent

   c. LAR 135 Section 135.565 (c) or equivalent

5. Related ICAO Documents

   a. Annex 6 to the Convention on International Civil Aviation – Operation of Aircraft

   b. Annex 10 to the Convention on International Civil Aviation – Aeronautical telecommunications

   c. Annex 15 to the Convention on International Civil Aviation – Aeronautical information services

   d. ICAO Doc 9613 – Performance-based navigation (PBN) manual

   e. ICAO Doc 4444 – Procedures for air navigation services – Air traffic management

PART 2: INFORMATION ON THE IDENTIFICATION OF AIRCRAFT AND OPERATORS

NAME OF THE OPERATOR: _____

Aircraft manufacturer, model, and series	Registration numbers	Serial numbers	RNP 0.3 system Number, manufacturer, and model	RNP specification

DATE OF PRE-APPLICATION MEETING _____

DATE ON WHICH THE APPLICATION WAS RECEIVED _____

DATE ON WHICH THE OPERATOR INTENDS TO BEGIN RNP 0.3 OPERATIONS _____

IS THE CAA NOTIFICATION DATE APPROPRIATE? YES _____ NO _____

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PART 3 – OPERATOR APPLICATION (ANNEXES AND DOCUMENTS)

Annex	Title of Annex/Document	Indication of inclusion by the operator	Comments by the Inspector
A	**Operator letter requesting RNP 0.3 authorization**		
B	**Airworthiness documents showing aircraft eligibility for RNP 0.3.** AFM, AFM revision, AFM supplement, or Type certificate data sheet (TCDS) showing RNP system eligibility for RNP 0.3 or less. Statement by the manufacturer.- Aircraft that have a statement by the manufacturer documenting compliance with SRVSOP CA 91-012 criteria or equivalent, meet the performance and functional requirements of said document.		
C	**Aircraft modified to meet RNP 0.3 standards. Documentation on aircraft inspection and/or modification, if applicable.** Maintenance records documenting the installation or modification of aircraft systems (*e.g.,* FAA Form 337 – major repairs and alterations).		
D	**Maintenance programme** • For aircraft with established RNP 0.3 system maintenance practices, the list of references of the document or programme. • For recently installed RNP 0.3 systems, the maintenance practices for their review.		
E	**Minimum equipment list (MEL) (only for operators conducting operations based on a MEL):** MEL showing provisions for RNP 0.3 systems.		
F	**Training** **1. LAR 91 operators or equivalent: Training method:** Training at home, LAR 142 training centres, or other training courses, course		

Annex	Title of Annex/Document	Indication of inclusion by the operator	Comments by the Inspector
	completion records. **2. LAR 121 and/or 135 operators or equivalent:** Training programmes (training curricula) for flight crews, flight dispatchers, and maintenance personnel.		
G	**Operating policies and procedures** **1. LAR 91 operators or equivalent:** Operations manual (OM) or sections to be attached to the application, corresponding to RNP 0.3 operating procedures and policies. **2. LAR 121 and/or 135 operators or equivalent:** Operations manual and checklists.		
H	**Navigation database** **Details of the navigation data validation programme.**		
I	**Withdrawal of RNP 0.3 approval** Indication of the need to follow up on navigation error reports submitted and the possibility of withdrawal of RNP 0.3 approval.		
J	**Validation flight plan:** Only if required by the CAA.		

CONTENTS OF THE APPLICATION TO BE SUBMITTED BY THE OPERATOR

____ **RNP 0.3 COMPLIANCE DOCUMENTATION OF THE AIRCRAFT/NAVIGATION SYSTEMS**

____ **OPERATING PROCEDURES AND POLICIES**

____ **SECTIONS OF THE MAINTENANCE MANUAL RELATED TO THE RNP 0.3 SYSTEM (if not previously reviewed)**

Note 1: Documents may be grouped in a single folder or may be sent as individual documents.

PART 4: CONTENTS OF THE OPERATOR APPLICATION FOR RNP 0.3 OPERATIONS

#	Contents of the RNP 0.3 application by the operator	Reference paragraphs CA 91-012	In what Annexes/Documents of the operator can the application contents be located (e.g. Annex A)	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	**Operator request letter** Statement of intent to obtain RNP 0.3 authorization.				
2	**Description of aircraft equipment.**				
3	**Eligibility of RNP 0.3 systems.** Airworthiness documents establishing the eligibility of the RNP 0.3 navigation system, its approval status, and a list of the aircraft for which the approval is being requested.				
4	**Training programme** **1. LAR 121 or 135 operators or equivalent: Training programmes:** Operators will develop an initial and periodic training programme for flight crews, flight dispatchers, if applicable, and maintenance personnel. **2. LAR 91 operators or equivalent: Training methods:** The following methods are acceptable for these operators: Training at home, LAR 142 training centres, or other				

#	Contents of the RNP 0.3 application by the operator	Reference paragraphs CA 91-012	In what Annexes/Documents of the operator can the application contents be located (e.g. Annex A)	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	training courses.				
5	**Operating procedures** **1. LAR 121 and/or 135 operators or equivalent:** Operations manual and checklists**.** **2. LAR 91 operators or equivalent:** Operations manual or section of the operator application documenting RNP 0.3 policies and procedures.				
6	**Maintenance practices** • For aircraft with established maintenance practices for RNP 0.3 navigation systems, the operator will provide document references. • For newly installed RNP 0.3 systems, the operator will provide maintenance practices for their review.				
7	**Update of the minimum equipment list (MEL)** Applicable to operators conducting operations according to a MEL.				
8	**Navigation data validation programme**				

#	Contents of the RNP 0.3 application by the operator	Reference paragraphs CA 91-012	In what Annexes/Documents of the operator can the application contents be located (e.g. Annex A)	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
9	**Withdrawal of RNP 0.3 approval** Indication of the need for follow-up on the navigation error reports and the possibility of withdrawal of the RNP 0.3 approval.				
10	**Validation flight plan, only if required** The validation flight plan will be presented only if required.				

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PART 5 – GUIDE TO DETERMINE THE ELIGIBILITY OF RNP 0.3 AIRCRAFT

#	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	**Aircraft eligibility requirements for RNP 0.3 operations**				
1a	RNP 0.3 navigation specification requires GNSS as the primary navigation sensor, either as a stand-alone navigation system or as part of a multi-sensor system.				
2	**Systems** The following systems meet the accuracy, integrity and continuity requirements of AC 91-012 criteria:				
2a	Aircraft with E/TSO-C145a and the requirements of E/TSO-C115B FMS, installed for IFR use in accordance with FAA AC 20-130A				
2b	Aircraft with E/TSO-C146a equipment installed for IFR use in accordance with FAA AC 20-138 or AC 20-138A				
2c	Aircraft with RNP 0.3 capability certified or approved to equivalent standards (e.g. TSO-C193)				
3	**On-board performance monitoring and alerting requirements**				

#	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
3a	For RNP 0.3 operations on-board performance monitoring and alerting is required				
3b	The aircraft navigation system, or aircraft navigation system and the pilot in combination, is required to monitor the TSE, and to provide an alert if the accuracy requirement is not met or if the probability that the lateral TSE exceeds two times the accuracy value is larger than 10^{-5}. To the extent operational procedures are used to satisfy this requirement, the crew procedure, equipment characteristics, and installation should be evaluated for their effectiveness and equivalence. Examples of information provided to the pilot for awareness of navigation system performance include “EPU”, “ACTUAL”, “ANP” and “EPE”. Examples of indications and alerts provided when the operational requirement is or can be determined as not being met include “UNABLE RNP”, “Nav Accur Downgrad”, GNSS alert limit, loss of GNSS integrity, TSE monitoring (real time monitoring of NSE and FTE combined), etc. The navigation system is not required to provide both performance and sensor-based alerts, e.g. if a TSE based alert is provided, a GNSS alert may not be necessary.				
4	**Bounding FTE for equipment not monitoring TSE performance**				

#	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
4a	RNP 0.3 operations require coupled FGS to meet the allowable FTE bound unless the manufacturer demonstrates and obtains airworthiness approval for an alternate means of meeting the FTE bound. The following may be considered as one operational means to monitor the FGS FTE: 1) FTE should remain within half-scale deflection (unless there is other substantiated FTE data); 2) Pilots must manually set systems without automatic CDI scaling to not greater than 0.3 NM full-scale prior to commencing RNP 0.3 operations; and 3) Aircraft with electronic map display, or another alternate means of flight path deviation display, must select appropriate scaling for monitoring FTE.				
4b	Automatic monitoring of FTE is not required if the necessary monitoring can be achieved by the pilot using available displays without excessive workload in all phases of flight. To the extent that compliance with this specification is achieved through operational procedures to monitor FTE, an evaluation of the pilot procedures, equipment characteristics, and installation must ensure their effectiveness and equivalence, as described in the functional requirements and operating procedures.				

#	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
4c	PDE is considered negligible if the quality assurance process is applied at the navigation database level (Section 12) and if operating procedures (Section 10) are applied.				
5	**Aircraft eligibility requirements for RNP 0.3 operations.**				
5a	The aircraft eligibility must be determined through demonstration of compliance against the relevant airworthiness criteria and the requirements of 8.1.				
5b	The original equipment manufacturer (OEM) or the holder of installation approval for the aircraft, e.g. STC holder, will demonstrate compliance to their CAA, and the approval can be documented in manufacturer documentation (e.g. service letters).				
5c	AFM entries are not required provided the State accepts manufacturer documentation				
5d	***Note.-*** *Requests for approval to use optional functionality (e.g. RF legs) should address the aircraft and operational requirements as described in Appendix 4.*				
6	**Functional requirements – See Appendix 1 of AC 91-012** Functional requirements must meet the criteria described in Appendix 1 of AC 91-012				

#	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
7	**Navigation database** Details of the navigation data validation programme				

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PART 6 - BASIC PILOT PROCEDURES FOR RNP 0.3 OPERATIONS

	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	Operating procedures				
1	**Pre-flight planning**				
	Operators and pilots intending to conduct operations on RNP 0.3 ATS routes, including SIDs and STARs, initial and intermediate approach, must file the appropriate flight plan suffixes.				
	The on-board navigation data must be current and include appropriate procedures. Navigation databases are expected to be current for the duration of the flight. If the AIRAC cycle is due to change during flight, operators and pilots should establish procedures to ensure the accuracy of the navigation data, including the suitability of navigation facilities defining the routes and procedures for flight.				
2	**RNP 0.3 availability prediction**				
	RAIM prediction is not required where the equipment uses SBAS augmentation and the planned operations are within the service volume of the SBAS system.				
	In areas and regions where SBAS is not usable or available, RAIM availability for the intended route				

	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	should be checked prior to flight				
	Operators can verify the availability of RAIM to support RNP 0.3 operations via NOTAMs (where available) or through GNSS prediction services.				
	The CAA may provide specific guidance on how to comply with RAIM prediction.				
	Operators should be familiar with the prediction information available for the intended ATS route.				
	RAIM availability prediction should take into account the latest GNSS constellation NOTAMs and avionics model (when available). The ANSP, avionics manufacturer, or the RNP system may provide this service.				
	In the event of a predicted, continuous loss of RNP 0.3 of more than 5 minutes for any part of the RNP 0.3 operation, the flight planning should be revised (e.g. delaying the departure or planning a different ATS route). If the prediction service is temporarily unavailable, ANSPs may still allow RNP 0.3 operations to be conducted.				
	RAIM availability prediction software does not guarantee the availability of GNSS. Rather, prediction tools simply assess the expected capability to meet the RNP. Because of potential unplanned failures of some GNSS elements,				

	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	pilots/ANSPs must consider the loss of RAIM (or GNSS navigation altogether) while airborne may require reversion to an alternative means of navigation. Therefore, pilots should assess their capability to navigate in case of failure of GNSS navigation and consider the actions necessary to successfully divert to an alternate destination.				
3	**General operating procedures**				
	The pilot must comply with any instructions or procedures the manufacturer identifies necessary to comply with the performance requirements in this chapter. ***Note.-*** *Pilots are expected to adhere to all AFM/RFM limitations or operating procedures required to maintain RNP 0.3 performance for the ATS route. This shall include any speed restrictions needed to ensure maintenance of RNP 0.3 navigation accuracy.*				
	Operators and pilots should not request or file RNP 0.3 procedures unless they satisfy all the criteria in the relevant State documents. If an aircraft not meeting these criteria receives a clearance from ATC to conduct an RNP 0.3 operation, the pilot must advise ATC that he/she is unable to accept the clearance and must request alternate instructions.				
	The operator must confirm the availability of GNSS for the period of intended operations along the intended ATS route using all available information				

	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	and the availability of NAVAID infrastructure required for any (non-RNAV) contingencies.				
	At system initialization, the pilot must confirm the navigation database is current and verify that initial position of the aircraft is entered correctly. The pilot must also verify proper entry of their desired ATS route and any ATC changes to that ATS route upon initial clearance and any subsequent change of ATS route. The pilot must ensure the waypoints sequence depicted by their navigation system matches the ATS route depicted on the appropriate chart(s) and their assigned ATS route. ***Note.-*** *The pilot may notice a slight difference between the navigation information portrayed on the chart and their primary navigation display. Differences of 3 degrees or less may result from the equipment manufacturer's application of magnetic variation and are operationally acceptable.*				
	The pilot must not attempt to fly an RNP 0.3 instrument flight procedure (IFP) unless it is retrievable by name from the on-board navigation database and conforms to the charted procedure. However, the pilot may subsequently modify a procedure by inserting or deleting specific waypoints in response to ATC clearances. The pilot may select the ATS route to be flown for the en-route section of the flight from the database or may construct the ATS route by means of selection of individual en-route waypoints from the database. The manual entry or creation of new waypoints, by manual entry of latitude and longitude or rho/theta				

	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	values is not permitted. Additionally, pilots must not change any SID or STAR database waypoint type from a fly-by to a fly-over or vice versa.				
	The pilot should cross-check the flight plan clearance by comparing charts or other applicable resources with the navigation system textual display and the aircraft/rotorcraft map display, if applicable. If required, the pilot should also confirm exclusion of specific NAVAIDs in compliance with NOTAMs or other pilot procedures.				
	There is no pilot requirement to cross-check the navigation system's performance with conventional NAVAIDs as the absence of an integrity alert is considered sufficient to meet the integrity requirements. However, the pilot should monitor the reasonableness of the navigation solution and report any loss of RNP 0.3 capability to ATC. In addition, the pilot must continuously monitor the lateral deviation indicator (or equivalent navigation map display) during all RNP 0.3 operations.				
	The pilot is expected to maintain centre line, as depicted by on-board lateral deviation indicators, during all RNP operations unless authorized to deviate by ATC or under emergency conditions. For normal operations on straight segments or FRTs, cross-track error/deviation (the difference between the RNP system computed path and the aircraft position relative to the path) should be limited to ±½ the navigation accuracy associated				

	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	with the procedure (0.15 NM). Brief deviations from this standard (e.g. overshoots or undershoots) during track changes (fly-by and fly-over turns), up to a maximum of one times the navigation accuracy (i.e. 0.3 NM for RNP 0.3), are allowable. ***Note.-*** *Some systems do not display or compute a path during track changes (fly-by and fly-over turns). As such, the pilots of these aircraft may not be able to adhere to the lateral navigation accuracy requirement (e.g. 0.15 NM) during these turns. However, the pilot is expected to satisfy the operational requirement during intercepts following turns and on straight segments.*				
	If ATC issues a heading assignment taking the aircraft/rotorcraft off an ATS route, the pilot should not modify the flight plan in the RNAV system until receiving a new ATC clearance to rejoin the ATS route or the controller confirms a new ATS route clearance. When the aircraft is following an ATC heading assignment, the specified accuracy requirement does not apply.				
	Manually selecting aircraft bank limiting functions may reduce the aircraft's ability to maintain its desired track and is not recommended. The pilot should recognize manually selectable aircraft bank-limiting functions might reduce their ability to satisfy path requirements of the procedure, especially when executing large angle turns. This should not be construed as a requirement to deviate from flight manual procedures; rather, pilots should be encouraged to avoid the selection of such functions				

	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	except where needed for flight safety reasons.				
4	**Aircraft/rotorcraft with RNP selection capability**				
	The pilot of an aircraft/rotorcraft with a manual RNP input selection capability should select RNP 0.3 for all RNP 0.3 ATS routes.				
5	**RNP 0.3 SID specific requirements**				
	Prior to commencing take-off, the pilot must verify the aircraft RNP system is available, operating correctly, and the correct airport/heliport and departure data are loaded and properly depicted (including the aircraft's initial position). A pilot assigned an RNP 0.3 departure procedure and subsequently issued a change to the procedure or a transition from the procedure must verify that the appropriate changes are entered and available for navigation prior to take-off. A final check of proper departure entry and correct route depiction, shortly before take-off, is recommended.				
	The GNSS signal must be available and acquired by the aircraft's GNSS avionics before the take-off.				
	Engagement of system after take-off.- When required, the pilot must be able to engage (i.e. couple) the FGS prior to reaching the first waypoint defining a procedure requiring RNP 0.3 in				

	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	accordance with this specification.				
6	**RNP 0.3 STAR specific requirements**				
	Prior to the arrival phase, the pilot should verify loading of the correct terminal route. The active flight plan should be checked by comparing the charts (paper or electronic) with the map display (if applicable) and the MCDU. This includes confirmation of the waypoint sequence, reasonableness of track angles and distances, any altitude or speed constraints, and, where possible, identification of which waypoints are fly-by and which are fly-over or which represent the beginning or end of a radius-to-fix leg segment. An ATS route must not be used if the pilot has any reason to doubt the validity of the ATS route in the navigation database. ***Note.-*** *As a minimum, the arrival checks can be a simple inspection of a suitable map display that achieves the objectives of this paragraph.*				
	The creation of new waypoints by manual entry into the RNP 0.3 system by the pilot would not create a valid ATS route and is unacceptable at all times.				
	Where contingency procedures require reversion to a conventional IFP, the pilot must complete all necessary preparation for such reversion (e.g. manual selection of NAVAID) before commencing				

	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	any portion of the IFP.				
	Procedure modifications in the terminal area may take the form of ATC-assigned radar headings or “direct to” clearances, and the pilot must be capable of reacting in a timely fashion. This may include a requirement for the pilot to insert tactical waypoints loaded from the on-board navigation database. The pilot must not make manual entries or modify and create temporary waypoints or fixes that are not provided in the on-board navigation database.				
	The pilot must verify their aircraft navigation system is operating correctly, and the correct arrival procedure (including any applicable transition) is entered and properly depicted. Although a particular method is not mandated, the pilot must adhere to any published altitude and speed constraints associated with an RNP 0.3 operation.				
7	**Contingency procedures**				
	The pilot must notify ATC of any loss of the RNP 0.3 capability (integrity alerts or loss of navigation) together with the proposed course of action. If unable to comply with the requirements of an RNP 0.3 ATS route for any reason, the pilot must advise ATC as soon as possible. The loss of RNP 0.3 capability includes any failure or event causing the aircraft to no longer satisfy the RNP 0.3				

	Topics	Reference paragraphs CA 91-012	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	requirements of the desired ATS route.				
	In the event of communications failure, the pilot should continue with the published lost communications procedure.				

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