CIVIL AVIATION PUBLICATION

CAP 04

DESIGNATED AIRSPACE OPERATIONS

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LIST OF ABBREVIATIONS

ABAS	Aircraft-Based Augmentation System
ACAS	Aircraft Collision Avoidance System
ADS	Automatic Dependent Surveillance
ADS-B	Automatic Dependent Surveillance - Broadcast
ADS-C	Automatic Dependent Surveillance – Contract
AFM	Aircraft Flight Manual
ANP	Actual Navigation Performance
AOC	Air Operator Certificate (for Commercial Air Transport operators)
ATC	Air Traffic Control
ATM	Air Traffic Management
B-RNAV	Basic Area Navigation (European standard)
B-RNP 1	Basic Required Navigation Performance 1 nm (US standard)
CDI	Course Deviation Indicator
CDU	Control Display Unit
CPDLC	Controller-Pilot Data Link Communications
CSA	Channel of Standard Accuracy
DME	Distance Measuring Equipment
EASA	European Aviation Safety Agency
ECAC	European Civil Aviation Conference
(E)HIS	(Electronic) Horizontal Situation Indicator
EUR	European Region (ICAO)
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FDE	Fault Detection and Exclusion (GNSS)
FL	Flight Level
FMS	Flight Management System
FRT	Fixed Radius Transition
FT	Feet
FTE	Flight Technical Error
GBAS	Ground-Based Augmentation System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GRAS	Ground-based Regional Augmentation System
IAF	Initial Approach Fix
ICAO	International Civil Aviation Organisation
IF	Intermediate Fix
INS	Inertial Navigation System
IRS	Inertial Reference System
JAA	Joint Aviation Authorities
LNAV	Lateral Navigation mode (FMS)
LoA	Letter of Acceptance
LOFT	Line-Oriented Flight Training
LORAN	Long Range Navigation (Low frequency radio navigation network)
LRNS	Long Range Navigation System
M	metres
MAPt	Missed Approach Point
MEL	Minimum Equipment List

MHz	Megahertz
NAT HLA	North Atlantic High Level Airspace (previously MNPS)
NDB	Non-Directional Beacon
NM	Nautical miles
NOTAM	Notice(s) to Airmen
NSE	Navigation System Error
PAC	Pacific Region (ICAO)
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations (ICAO publication)
PBN	Performance Based Navigation
PDE	Path Definition Error
PEE	Positioning Estimation Error
PF	Pilot Flying
PM	Pilot Monitoring
P-RAIM	Predictive Receiver Autonomous Integrity Monitoring
P-RNAV	Precision Area Navigation (European Standard)
PSE	Path Steering Error
R/T	Radio Telephony
RAIM	Receiver Autonomous Integrity Monitoring
RF	Radius to Fix (Path Terminator)
RNAV	Area Navigation
RNP	Required Navigation Performance
SBAS	Satellite-based Augmentation System SID (Standard Instrument Departure)
SLOP	Strategic Lateral Offset Procedure
SPS	Standard Positioning Service (GPS)
SSR	Secondary Surveillance Radar (ATC Transponder)
STAR	Standard Arrival
STD	Synthetic Training Device
TMA	Terminal Area
TSE	Total System Error
UTC	Universal Coordinated Time
VOR	Very High Frequency Omni-directional Range
WGS-84	World Geodetic System – 1984

GLOSSARY OF TERMS

The following is an explanation of some of the terms used in RNAV procedures. Other definitions may be found in the ICAO Doc. 9613, Performance Based Navigation Manual, available from the CAA.

Aircraft-Based Augmentation System (ABAS). An augmentation system that augments and/or integrates the information obtained from GNSS elements with all the other information available on board the aircraft.

Approach procedure with vertical guidance (APV). An instrument procedure, which utilises lateral and vertical guidance, but does not meet the requirements established for precision approach and landing operations.

Area navigation (RNAV). A method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

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

B-RNAV. A European RNAV navigation specification with a required track keeping accuracy of ±5 NM for at least 95% of the flight time. B-RNAV or Basic RNAV capability can be achieved using inputs from VOR/DME, DME/DME or GNSS and/or INS.

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

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

Letter of Acceptance. An EASA Type 2 LoA is issued by EASA whereas the FAA issues a Type 2 LoA in accordance with AC 20153. Transport Canada (TCCA) issues an Acknowledgement Letter of an Aeronautical Data Process using the same basis. Both the FAA LoA and the TCCA Acknowledgement Letter are seen to be equivalent to the EASA LoA. EUROCAE/RTCA document ED76/ DO200A Standards for Processing Aeronautical Data contains guidance relating to the processes that the supplier may follow.

Localizer Performance with Vertical Guidance (LPV). A US term for an augmented GNSS approach utilising geometric vertical navigation with the following FAA definition. A type of approach with vertical guidance (APV) based on WAAS, published on RNAV (GPS) approach charts. This procedure takes

advantage of the more precise lateral guidance available from WAAS enabled GNSS receivers. The approach minimum is published as a decision altitude (DA).

***Navigation Specification*.** A navigation specification is a set of aircraft and flight crew requirements needed to support Performance Based Navigation operations within a defined airspace.

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

- ***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).

North Atlantic High Level Airspace (NAT HLA). NAT HLA vertical dimension airspace is that portion of the North Atlantic airspace between FL290 and FL410 inclusive. The lateral dimensions include the following Control Areas (CTAs): REYKJAVIK, SHANWICK, GANDER and SANTA MARIA OCEANIC plus the portion of NEW YORK OCEANIC which is North of 27N but excluding the area which is west of 60°W & south of 38°30'N. Boda Oceanic was recently added.

***Overlays*.** The use of RNAV systems to fly instrument flight procedures that are themselves based on conventional ground navigational aids and can be flown without the use of an RNAV system.

Performance Based Navigation. Performance Based Navigation specifies system performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in an airspace block. Performance requirements are defined in terms of the accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept.

***P-RNAV*.** A European RNAV navigation specification with a required track-keeping accuracy of ±1 NM for at least 95% of the flight time, together with advanced functionality and a high integrity navigation database. P-RNAV capability can be achieved using inputs from DME/DME or GNSS and/or INS. May also be referred to as RNP 1 or RNAV 1.

Radius to Fix (RF) Path Terminator. A specific fixed-radius curved path in a terminal and approach procedure intended to be applied where an accurate repeatable and predictable ground path is required. Also known as RF leg.

Receiver Autonomous Integrity Monitoring (RAIM) A technique whereby a GNSS receiver/processor determines the integrity of the GNSS navigation signals using only GPS signals or GPS signals augmented with altitude. This determination is achieved by a consistency check among redundant pseudorange measurements. At least one satellite in addition to those required for navigation should be in view for the receiver to perform the RAIM function.

RNAV 1 SID/STAR (FAA Operations). Procedures requiring system performance currently met by GPS or DME/DME/IRU RNAV systems satisfying the criteria discussed in FAA AC 90-100A. RNAV 1 procedures may require the aircraft's track-keeping accuracy remain bounded by ±1 NM for 95% of the total flight time.

RNAV 2 SID/STAR (FAA Operations). RNAV terminal procedures requiring system performance currently met by GPS or DME/DME/IRU RNAV systems satisfying the criteria discussed in FAA AC 90-100A. RNAV 2 terminal procedures require the aircraft's track-keeping accuracy remain bounded by ±2 NM for 95% of the total flight time.

RNP AR APCH. RNP Approval Required Approaches represent the ICAO equivalent to FAA RNP Special Aircraft and Aircrew Approval Required (SAAAR) operations.

RNP Operations. Aircraft operations using an RNP System for RNP applications.

Satellite Based Augmentation System (SBAS). A wide area coverage augmentation system for satellite navigation systems (GPS, GLONASS, Galileo). An SBAS requires a network of ground stations across the area of augmentation and one or more geostationary satellites able to broadcast signals over this area. The ground stations continually monitor the signals from the satellite navigation system of interest, and from an analysis of the signals integrity information and accuracy corrections can be provided for the whole of the augmentation area. The correction signals are sent from a ground master station to the geostationary satellite and re-broadcast. Few aeronautical standard receivers are currently configured to receive SBAS signals. The United States SBAS is known by the acronym WAAS whilst the Europeans have EGNOS, with the Japanese developing MSAS (Multi-functional Satellite Augmentation System).

Vertical Navigation (VNAV). A method of navigation which permits aircraft operation on a vertical flight profile using altimetry sources, external flight path references, or a combination of these.

Wide-Area Augmentation System (WAAS). This is the term for the US satellite based augmentation system (SBAS) which augments the GPS Standard Positioning Service (SPS). It provides enhanced integrity, accuracy, availability and continuity to the SPS over the contiguous United States.

CHAPTER 1

INTRODUCTION

1.1 GENERAL

1.1.1 Purpose

The purpose of this CAP is to provide all San Marino operators with an overview on required aircraft equipment, generic training, procedures and operational approval requirements for operations in the following designated airspace.

(a) RNAV/RNP

(b) B-RNAV

(c) RNP 1, P-RNAV (RNAV 1) & RNAV 2

(d) RNP APCH

(e) RNP AR APCH

(f) NAT HLA

(g) RVSM

It is essential that all operators understand that operations in designated airspace may not be carried out unless a specific approval for that designation of airspace has been issued by the San Marino CAA for the individual aircraft. Airworthiness and operational criteria must be satisfied before such approval can be issued and the fact that the associated navigational equipment is fitted and certified is not sufficient.

1.1.2 Approval Criteria

An applicant from a General Aviation operator to operate in designated airspace must provide evidence of navigation/altimetry capability (as appropriate) and declare in a Declaration of Compliance (refer Form SM 04) that the aircraft has suitably approved equipment (is eligible), the navigation database is valid, the pilot is suitably qualified and current with respect to the equipment and adequate procedures and checklists are in place.

An applicant from a Commercial Air Transport operator to operate in designated airspace on a PBN route/procedure must provide documentary evidence on the aircraft equipment and capability, the navigation database, pilot training and qualifications and adequacy of procedures. (Refer Form SM 04A)

Note: Only one application is required for multiple approvals and can be submitted online. (e.g. RNAV 5 (B-RNAV) + RVSM could be submitted on one application form)

1.1.3 References

The information in this CAP is not intended to be the sole reference material to be reviewed prior to making an application. The following appropriate references below, as amended, should also be consulted.

(a) ICAO Doc. 9613, Performance Based Navigation Manual (http://www.icao.int/pbn)

(b) ICAO DOC 8168 Procedures for Air Navigation Services Aircraft Operations (Volume II) Construction of Visual and Instrument Flight Procedures.

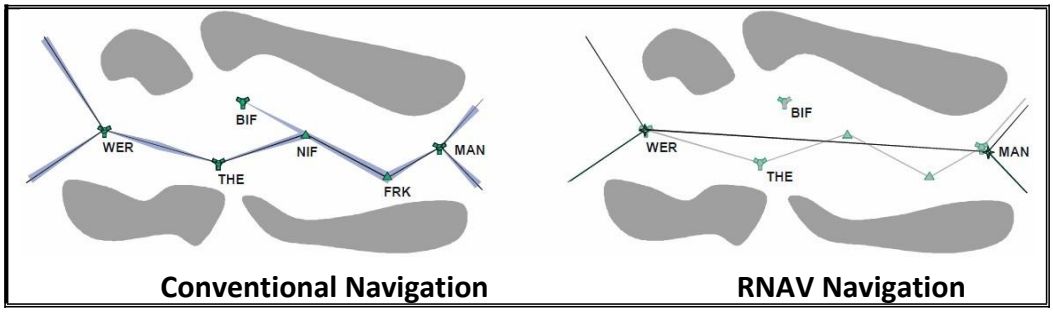
(c) JAA TGL 10 (P-RNAV)

Note: Please also refer to the Chapters on NAT HLA/RVSM for additional references.

1.2 AREA NAVIGATION (RNAV)

1.2.1 General

Area Navigation (RNAV) is a method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.



RNAV systems have evolved in a manner similar to conventional ground-based routes and procedures. Airspace and obstacle clearance criteria were developed based on the performance of available equipment; and specifications for requirements were based on available capabilities. To avoid such prescriptive specifications of requirements, an alternative method for defining equipage requirements by specifying the performance requirements has been developed by ICAO. This method is called Performance Based Navigation (PBN).

1.2.2 Performance Based Navigation (PBN)

Performance-Based navigation (PBN) defines performance requirements for aircraft navigating on an ATS route, terminal procedure or in a designated airspace. It is ICAO's effort and objective to redefine the regional differences of various Area Navigation (RNAV) and Required Navigation Performance (RNP) specifications into a globally harmonized set of PBN applications.

The PBN concept specifies that RNAV system performance requirements be defined in terms of the accuracy, integrity, availability, continuity and functionality which are needed for the proposed operations in the context of a particular airspace concept.

Performance requirements are identified in navigation specifications, which also identify the choice of navigation sensors and equipment that may be used to meet the performance requirements. PBN airspace specifications are not designed for a specific sensor, but according to a navigation specification (e.g. RNAV 1). The selection of the appropriate navigation specification is based on the airspace requirements, the available NAVAID infrastructure, and the equipage and operational capability of aircraft expected to use the route.

For example, where an airspace requirement is for RNAV 1 or RNAV 2, the available navigation infrastructure could be either basic GNSS or DME/DME to meet the specification, and aircraft could utilise either to conduct operations.

1.3 NAVIGATION SPECIFICATIONS

1.3.1 General

A Navigation Specification specifies what performance is required of the RNAV system in terms of accuracy, integrity, availability and continuity; which navigation functionalities the RNAV system is required to have in order to meet the required performance; which navigation sensors must be integrated into the RNAV system in order to achieve the required performance, and the flight crew operational requirements in order to achieve the required performance from the aircraft and the RNAV system.

1.3.2 Oceanic, Remote Continental, En-Route and Terminal Operations

Under the concept of Performance Based Navigation, there are two kinds of area navigation specification:

(a) **RNAV X**: A navigation specification designation that does not include a requirement for on-board performance monitoring and alerting;

(b) **RNP X**: A navigation specification designation that includes requirements for on-board performance monitoring and alerting.

Note: For both RNP X/RNAV X, the expression "X" refers to the lateral navigation accuracy in nautical miles that is expected to be achieved at least 95% of the flight time.

1.3.3 Approach Operations

For the Approach phase, navigation specifications cover all segments of the instrument approach. RNP specifications are designated using RNP as a prefix and an abbreviated textual suffix, e.g. RNP APCH (RNP Approach) or RNP AR APCH (RNP Approval Required - Approach).

1.3.4 North Atlantic High Level Airspace (NAT HLA)

Aircraft operating in North Atlantic airspace are required to meet NAT HLA requirements. (Refer to Chapter 8)

1.3.5 Understanding RNAV Designations

In cases where navigation accuracy is used as part of the designation of a navigation specification, it should be noted that navigation accuracy is only one of the many performance requirements included in a navigation specification.

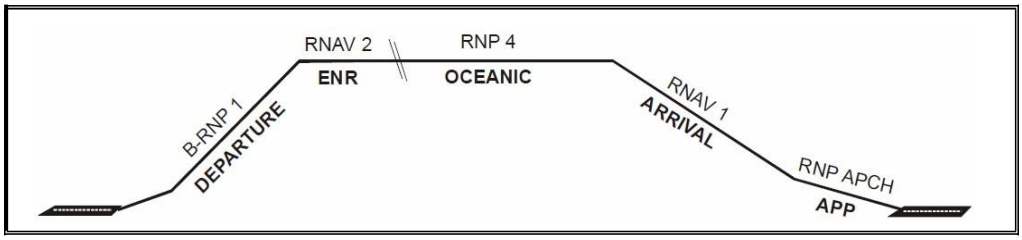
For example, an RNAV 1 designation refers to an RNAV specification which includes a requirement for 1 nm navigation accuracy among many other performance requirements. Although the designation RNAV 1 may suggest that 1 nm (lateral) navigation accuracy is the only performance criterion to be met, this is not the case. Like all navigation specifications, the RNAV 1 specification includes all flight crew and airborne navigation system requirements.

Because specific performance requirements are defined for each navigation specification, an aircraft approved for an RNP specification is not automatically approved for all RNAV specifications. Similarly, an aircraft approved for an RNP or RNAV specification having a stringent accuracy requirement (e.g. RNP 0.3 specification) is not automatically approved for a navigation specification having a less stringent accuracy requirement (e.g. RNP 4).

An aircraft approved to the more stringent accuracy requirements may not necessarily meet some of the functional requirements of the navigation specification having a less stringent accuracy requirement.

Note: The European applications of P-RNAV and B-RNAV will continue to be used by EU Member States and in the future these will change to the international navigation specifications of RNP 1, RNAV 1 and RNAV 5.

For any particular PBN operation, it is possible that a sequence of RNAV and RNP applications may be used. A flight may commence in an airspace using a Basic-RNP 1 SID, transit through en-route then oceanic airspace requiring RNAV 2 and RNP 4, respectively, and culminate with terminal and approach operations requiring RNP 1, RNAV 1 and RNP APCH.



1.3.6 Navigation Performance Errors

The three main errors in the context of on-board performance monitoring and alerting are;

(a) Path definition error (PDE).

PDE occurs when the path defined in the RNAV system does not correspond to the desired path; i.e. the path expected to be flown over the ground. Use of an RNAV system for navigation requires that a defined path representing the intended track is loaded into the navigation database.

A consistent, repeatable path cannot be defined for a turn that allows for a fly-by turn at a waypoint, requires a fly-over of a waypoint, or occurs when the aircraft reaches a target altitude. In these cases, the navigation database contains a point-to-point desired flight path, but cannot account for the RNAV system defining a fly-by or fly-over path and performing a manoeuvre. In practice, PDE is negligible.

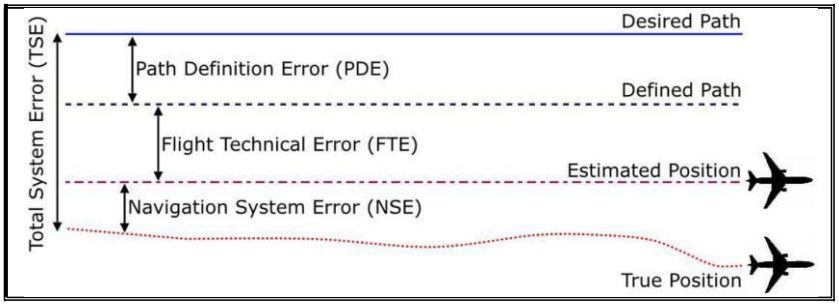
(b) Flight technical error (FTE).

FTE relates to the flight crew or autopilot's ability to follow the defined path or track, including any display system error. FTE can be monitored by the autopilot or flight crew procedures and the extent to which these procedures need to be supported by other means depends, for example, on the phase of flight and the type of operations. Such monitoring support could be provided by a map display.

(c) Navigation system error (NSE).

NSE refers to the difference between the aircraft's estimated and actual position.

(d) The above errors make up a Total System Error (TSE) or the system use error. Mathematically, TSE = √ (NSE)2 + (FTE)2.



Each aircraft operating in RNP airspace must have Total System Error components in the cross-track and along track directions that are less than the RNP value for 95% of the flying time.

1.3.7 Performance Monitoring and Alerting

On-board performance monitoring and alerting is the main element which determines whether the navigation system complies with the necessary safety level associated with an RNP application; it relates to both lateral and longitudinal navigation performance.

On-board performance monitoring and alerting allows the flight crew to detect that the navigation system is not achieving, or cannot guarantee, the navigation performance required for the operation. On-board performance monitoring and alerting capabilities fulfil two needs; one on board the aircraft and one within the airspace design.

The assurance of airborne system performance is implicit for RNAV operations. RNP systems, however, provide a means to minimize variability and assure reliable, repeatable and predictable flight operations.

1.3.8 Accuracy and Track Guidance

Aircraft RNAV/RNP systems are certified as multi-sensor systems. The FMS position is usually based on a combination of the outputs from one, two or three Inertial Reference Systems (IRS), refined by inputs from other navigation sensors. Preference for use is given to the navigation sensor capable of providing the most accurate position. Before using a navigation sensor, the FMS performs a reasonableness check on the data. Certification accuracy limits (FMS position) are:

UPDATING SOURCE	POSITION ACCURACY
GPS	100 metres
DME/DME	0.3 nm (depending on station geometry)
VOR/DME	1.0 nm (depending on distance from station)
IRS (multiple)	2.0 nm/hr drift after alignment

Track guidance is normally provided by the RNAV system directly to the autopilot or to the pilot via the flight director/course deviation indicator. Where the aircraft is to be flown with the autopilot uncoupled to the RNAV system, the display of imminent changes in speed, heading or height is expected to be provided in sufficient time for the pilot to respond in a manner which will keep the aircraft within similar flight technical tolerances to that achieved with the autopilot coupled.

1.3.9 Aircraft Equipment - General

The required aircraft equipment differs depending on the designated airspace requirements. Aircraft RNAV equipment operates by automatically determining aircraft position from one or a combination of the following sensors, and the equipment has the means to establish and follow a desired path:

(a) VOR/DME;

(b) DME/DME;

(c) INS or IRS;

(d) LORAN C;

(e) GNSS (GPS)

Both RNAV and RNP specifications include requirements for certain navigation functionalities. At the basic level, these functional requirements may include:

(a) Continuous indication of aircraft position relative to track to be displayed to the pilot flying (PF) on a navigation display situated in his primary field of view;

(b) Display of distance and bearing to the active (To) waypoint;

(c) Display of ground speed or time to the active (To) waypoint;

(d) Navigation data storage function;

(e) Appropriate failure indication of the RNAV system, including the sensors. More sophisticated navigation specifications include the requirement for navigation databases and the capability to execute database procedures.

1.3.10 Navigation Database

The RNAV system is expected to access a navigation database, if available. The navigation database contains pre-stored information on NAVAID locations, waypoints, ATS routes and terminal procedures and related information. The RNAV system will use such information and may also conduct cross-checks between sensor information and the database.

Any navigation database which supports an airborne navigation application as a primary means of navigation must be provided by a database supplier who holds a Type 2 Letter of Acceptance (LoA) or equivalent. If the supplier does not hold a Type 2 LoA or equivalent, the navigation database must meet equivalent standards of integrity as approved by the San Marino CAA. Procedures must be in place that ensures the timely distribution and insertion of current and unaltered electronic navigation data to all aircraft that require it, so that only current and up to date data is used.

Operators must assure that appropriate digital communications software updates are incorporated when necessary and that both air and ground systems are able to identify and properly respond to the installed level of digital communication capability. There must be a documented mechanism for software update procedures.

All applicants of private or commercial aircraft need to have documented procedures for the management of navigation databases where these are utilized for PBN. These procedures will define the data validation procedures for navigation databases and the installation of new databases into aircraft so that they remain current with the AIRAC cycle. These procedures must be documented in their Operations Manual.

Note 1:Navigation databases are expected to be current for the duration of the flight. If the AIRAC cycle is due to change during flight, the electronic data must be verified against paper products that are current for the required time frame.

Note 2:For RNP AR APCH application refer to additional requirements in Chapter 7.

1.4 GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)

1.4.1 General

Global Navigation Satellite Systems (GNSS) is the standard generic term for satellite navigation systems that provide autonomous geo-spatial positioning with global coverage. This system translates into extreme accuracy and reliability. GNSS allows small electronic receivers to determine their location (longitude, latitude and altitude) to within a few metres using time signals transmitted along a line-of-sight by radio from satellites.

Receivers calculate the precise time as well as position.

The United States NAVSTAR Global Positioning System (GPS), Russian GLONASS and the European Union's Galileo positioning system are GNSS. GNSS navigation services (i.e. position and time data) may be obtained using various combinations of the following elements installed on the ground, on satellites and/or on board aircraft:

The position information provided by GNSS is expressed in terms of the World Geodetic System – 1984 (WGS-84), which utilises a standard geodetic reference datum. The time data provided by the GNSS to the user is expressed in a time scale that takes Universal Time Co-ordinated (UTC) as its reference.

1.4.2 Receiver Autonomous Integrity Monitoring (RAIM)

Receiver Autonomous Integrity Monitoring (RAIM) is a technique whereby the on-board GNSS receiver / processor determines the integrity of the GNSS navigation signals using only GNSS or GNSS signals augmented with barometric altitude.

This determination is achieved by a consistency check among redundant measurements (pseudo-ranges). At least one satellite in addition to those required for navigation must be in view for the receiver to perform RAIM. Four satellites are required for navigation.

It is a requirement of RNP APCH and RNP AR APCH final approach operations, and for information regarding likely performance for other GNSS-based RNAV operations that, prior to dispatch, a prediction of the number of satellites available within the constellation must be carried out. This is to ensure availability of navigational and integrity monitoring capability during the planned approach period. Predicted periods when fewer than five satellites will be visible are termed "RAIM Holes".

A web site called www.augur.ecacnav.com is available for this pre-flight planning function. Whilst it has primarily European region coverage, other destinations may be added on request.

Note: RAIM predictions are included in briefing material as GNSS NOTAMs.

1.5 RNAV ROUTE STRUCTURES

1.5.1 General

Traditional airways and other routes were defined by tracks between geographic positions defined by radio navigation beacons. In RNAV operations, the aircraft flies between geodetic waypoints or fixes that may, or may not, be co-located with radio navigation beacons but which are not defined by them.

1.5.2 Oceanic and Remote Continental Routes

Oceanic and remote continental airspace concepts are served by two navigation applications, RNAV 10 and RNP 4. Both these navigation applications rely primarily on GNSS to support the navigation element of the airspace concept.

In the case of the RNAV 10 application, no form of ATS surveillance service is required.

In the case of the RNP 4 application, ADS contract (ADS-C) is used.

AREA	NAVIGATION APPLICATION	NAVIGATION SPECIFICATION	NAVAID INFRASTRUCTURE	COMMS	SURVEILLANCE
Oceanic	En-route ATS routes	RNP 10	GNSS	Voice	Procedural
Oceanic	En-route ATS routes	RNP 4	GNSS	Voice Datalink (ADS-C & CPDLC)	Procedural
Oceanic	En-route ATS routes	RNP 10	IRS	Voice Datalink (ADS-C & CPDLC)	Procedural
Remote Continental	En-route ATS routes	RNP 10	GNSS	Voice	Procedural
Remote Continental	En-route ATS routes	RNP 4	GNSS	Voice Datalink (ADS-C & CPDLC)	Procedural
Remote Continental	En-route ATS routes	RNP 10	IRS	Voice Datalink (ADS-C & CPDLC)	Procedural

1.5.3 Continental Routes

Continental en-route airspace concepts are supported by RNAV applications. RNAV 5 is used in the Middle East (MID) and European (EUR) Regions. It is designated as B-RNAV (Basic RNAV) in Europe and RNAV 5 in the Middle East. In the United States, an RNAV 2 application supports an en-route continental airspace concept. Continental RNAV applications support airspace concepts which include radar surveillance and direct controller to pilot communication (voice).

AREA	NAVIGATION APPLICATION	NAVIGATION SPECIFICATION	NAVAID INFRASTRUCTURE	COMMS	SURVEILLANCE
Continental En-Route	En-route ATS routes	RNAV 5	GNSS VOR/DME DME/DME	Voice	ATS Surveillance
Continental En-Route	En-route ATS routes	RNP 1	GNSS DME/DME	Voice	Procedural
Continental En-Route	En-route ATS routes	RNAV 2 no IRS RNAV 1 with IRS RNAV 1 no IRS But with adequate DME	GNSS DME/DME	Voice	Procedural
Continental En-Route	En-route ATS routes	RNP 10	GNSS DME/DME	Voice	Procedural

1.5.4 Terminal Arrival and Departure Routes

Existing terminal airspace concepts, which include arrival and departure routes, are supported by RNAV applications. These are currently used in the European (EUR) Region and the United States. The European terminal airspace RNAV application is known as Precision RNAV (P-RNAV).

Although the P-RNAV specification shares a common navigation accuracy with RNAV 1, this regional navigation specification does not satisfy the full requirements of the ICAO RNAV 1 specification.

The United States terminal airspace application formerly known as US RNAV Type B has been aligned with the PBN concept and is now called RNAV 1. Basic-RNP 1 has been developed primarily for application in non-radar, low-density terminal airspace.

AREA	NAVIGATION APPLICATION	NAVIGATION SPECIFICATION	NAVAID INFRASTRUCTURE	COMMS	SURVEILLANCE
Terminal	SIDs, STARs Transitions	RNAV 2 without IRS RNAV 1 with IRS RNAV 1 without IRS but with adequate DME	GNSS DME/DME	Voice	ATS Surveillance
Terminal	SIDs, STARs Transitions	Basic - RNP 1	GNSS	Voice	Procedural
Terminal	SIDs, STARs Transitions	Basic - RNP 1 RNAV 1 with GPS only	GNSS DME/DME	Voice	ATS Surveillance

1.5.5 Approach

Approach concepts cover all segments of an instrument approach, i.e. initial, intermediate, final and missed approach. They call for RNP specifications requiring a navigation accuracy of 0.3 nm to 0.1 nm or lower. Typically, there are three sorts of RNP applications:

(a) New procedures to runways never served by an instrument procedure;

(b) Procedures either replacing or serving as backup to existing instrument procedures based on different technologies;

(c) Procedures developed to enhance aerodrome access in demanding environments.

The relevant RNP specifications are RNP APCH and RNP AR APCH.

AREA	NAVIGATION APPLICATION	NAVIGATION SPECIFICATION	NAVAID INFRASTRUCTURE	COMMS	SURVEILLANCE
Approach	Approach	RNP APCH	GNSS	Voice	ATS Surveillance
Approach	Approach	RNP APCH	GNSS	Voice	Procedural
Approach	Approach	RNP AR APCH	GNSS	Voice	Procedural
Approach	Approach	RNP AR APCH	GNSS	Voice	ATS Surveillance

1.6 CONTINUING SURVEILLANCE

1.6.1 Operator Responsibility

As part of their Safety Management System, all operators should conduct their own continuing surveillance on the following areas,

(a) Checking the Occurrence Reports for abnormalities.

(b) Checking Voyage Reports for RNP anomalies.

(c) Continuation training evaluation.

(d) Cross-checking to ensure that operations are in accordance with the appropriate ICAO Regional Supplementary Procedures and/or Aeronautical Information Publication for that airspace.

(e) Electronic navigation data integrity and management procedures.

1.6.2 Reporting Action

Unsafe conditions or performance related to RNP or RVSM operations such as a navigation error or altimetry events, which potentially could affect continued safe operations, must be reported to the ATS of the FIR controlling State within 24 hours.

It is incumbent upon each operator to take immediate action to rectify the conditions that cause an operational error. In addition to reporting events to the ATS above, the operator should also report the event to the CAA within 72 hours, by submission of a CAA Occurrence Report with initial analysis of causal factors and measures taken to prevent further events.

The operator shall advise the CAA of any rectification work or modifications, which may affect PBN or RVSM capability.

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CHAPTER 2

RNAV/RNP 10 AIRSPACE

2.1 GENERAL

RNAV/RNP 10 is an oceanic or remote area specification requiring the aircraft to maintain a track- keeping accuracy of +/- 10 nm without regular updates from ground-based navigation aids. RNP 10 approval can be based on IRS performance alone (with a time limit of up to 6.2 hours), and there is no requirement for an RNP alerting function in the FMS.

The existing RNP 10 designation is, therefore, inconsistent with PBN RNP and RNAV specifications. Since RNP 10 does not include requirements for on-board performance monitoring and alerting, technically, RNP 10 is an RNAV navigation specification. However, renaming current RNP 10 routes, operational approvals, etc. to an RNAV 10 designation would be an extensive and expensive task, which is not cost-effective. Consequently, any existing or new operational approvals will continue to be designated RNP 10, and any charting annotations will be depicted as RNP 10. The use of RNP 10 or RNAV 10 or RNAV/RNP 10 is acceptable.

RNP 10 airspace supports 50 nm lateral and longitudinal distance-based separation minima, and examples of RNP 10 airspace exist over the NAT, Indian Ocean and in the AFI, SAM and PAC regions.

2.2 AIRCRAFT EQUIPMENT REQUIREMENTS

RNP 10 requires that aircraft operating in oceanic and remote areas are equipped with at least two independent and serviceable LRNSs comprising an INS, an IRS FMS or a GNSS, with integrity such that the navigation system does not provide an unacceptable probability of misleading information.

2.3 OPERATIONAL PROCEDURES

2.3.1 Before Flight Phase

In the before flight phase, the flight crew should:

(a) Identify which portions of the flight are to be conducted in RNP 10 airspace and verify the entry and exit points;

(b) Ensure that the letter “R” is annotated in item 10 of the ATC Flight Plan. Additional information should be displayed in the Remarks section indicating the accuracy capability, such as RNP 4 versus RNP 10;

(c) For IRS-only operations, ensure that the RNP 10 time limit has been accounted for (normally 6.2 hours);

(d) Check the Technical Log to ensure that there is no defect in navigational equipment that would preclude RNP 10 operations;

Note: The MEL would normally identify those alleviations that are not suitable for RNAV/RNP 10 operations.

(e) Check and brief the contingency procedures for the area in which RNP 10 operations are to be conducted.

2.3.2 En-Route Phase

During en-route operations, and before entering RNAV/RNP 10 airspace, flight crew should:

(a) Verify that the aircraft technical status allows RNAV/RNP 10 operations;

(b) Find an alternative non-RNAV/RNP 10 route or divert if the equipment requirements cannot be met;

(c) After entering RNAV/RNP 10 airspace, flight crew should:

(1) cross-check to identify navigation errors in sufficient time to prevent the aircraft from an inadvertent deviation from ATC cleared routes;

(2) advise ATC of any deterioration or failure of the navigation equipment below the navigation performance requirements, or of any deviations required for a contingency procedure.

(d) For aircraft with automatic offset programming capability only, determine if the use of the Strategic Lateral Offset Procedure may be employed at the discretion of the flight crew. This procedure may be used for both wake vortex encounters and to mitigate the heightened risk of collision when non-normal events such as operational altitude deviation errors and turbulence-induced altitude deviations occur.

2.3.3 Contingency Procedures

In oceanic and remote areas, continuous direct controller-pilot communication may not always be possible, so a range of contingencies have been considered which allow independent action by flight crews. These procedures provide for the more frequent cases such as:

(a) Inability to maintain assigned flight level due to meteorological conditions, aircraft performance or pressurization failure;

(b) En-route diversion across the prevailing traffic flow;

(c) Loss of, or significant reduction in, the required navigation capability when operating in airspace where the navigation performance accuracy is a prerequisite to the safe conduct of flight operations.

In general, they permit crews, in exceptional circumstances, to deviate from assigned clearances by selecting flight levels and/or tracks where other aircraft are least likely to be encountered.

During such deviations, crews are required to make maximum use of the aircraft lighting and to transmit relevant information on all appropriate frequencies, including the distress and emergency frequency.

Once contact with ATC has been re-established, the crew will be assisted and issued with new clearances as required. Offset track procedures are permitted if an encounter with turbulence is considered to be due to a wake vortex encounter.

Note: Details of specific contingency procedures for each area or route can be found in the Route Guide (e.g. Jeppesen Manual).

2.4 TRAINING REQUIREMENTS

2.4.1 Basic RNAV Concept Training

Basic RNAV Concept Training must be conducted prior to RNP 10 airspace training. Basic RNAV Concept Training will include the following topics:

(a) Theory of RNAV including differences between RNAV and RNP operations;

(b) The meaning of RNP / ANP;

(c) Limitations of RNAV;

(d) GPS concepts and limitations (if applicable);

(e) Charting, database and avionics issues including:

(1) Waypoint naming and depiction concepts;

(2) Fly-by and Fly-over waypoints.

(f) Use of RNAV equipment including, where appropriate:

(1) Verification and sensor management;

(2) Tactically modifying the flight plan;

(3) Addressing discontinuities;

(4) Entering associated data such as:

(i) Wind;

(ii) Altitude/Speed constraints;

(iii) Vertical profile/Vertical speed.

(g) R/T phraseology for RNAV;

(h) The implications for RNAV operations of systems malfunctions which are not RNAV-related (e.g. hydraulic failure or engine failure).

2.4.2 Additional RNP 10 Training

Additional training for RNP 10 operations must include the following topics:

(a) Basic RNAV Concept training;

(b) Airspace where RNP 10 compliance is required;

(c) Flight planning requirements;

(d) Pre-flight procedures;

(e) En-route procedures;

(f) Contingency procedures.

There are no requirements for STD training or checking in relation to RNP 10 but these operations should be introduced into training scenarios (where suitable). Recency for RNP 10 operations is satisfied by normal licensing recency requirements.

2.5 APPLICATION FOR RNP 10

2.5.1 Process

All operators must submit evidence of navigation performance capability with their application.

The application (refer Form SM 04 or Form SM 04A) must address all of the sections on equipment, operational requirements, including documentation and training. General Aviation operators shall sign the "Declaration of Compliance" indicating all equipment, operational requirements, documentation and training meet the requirements for RNP 10 approval.

Commercial Air Transport operators shall submit documentary evidence of the required information in the application form.

2.5.2 Airworthiness Issues

The components of a RNP 10 capable aircraft are usually installed at manufacture of a new generation aircraft and the manufacturer includes statements as to navigation performance capability in the Aircraft Flight Manual, an AFM Supplement or STC.

Where an aircraft has been modified for RNP capability, the Commercial Air Transport operator must provide the CAA with all the aircraft navigation details for each aircraft registration and include the applicable software versions.

Unless the approved MEL already addresses the required navigation equipment, an amendment to the MEL should be submitted to the CAA for approval.

It is up to the operator to determine that the maintenance organisation used is capable of providing maintenance support of navigation equipment and software. That support must be provided by trained maintenance personnel capable of implementing digital communications related maintenance programmes. The support includes, but is not limited to;

(a) addressing installation,

(b) modification,

(c) correction of reported system discrepancies,

(d) use of test equipment,

(e) procedures,

(f) MEL relief, and

(g) return to service authorisations.

2.5.3 Equipment

As RNP 10 is an oceanic or remote area specification, acceptable aircraft navigation equipment must be;

(a) Two fully serviceable Long Range Navigation Systems (LRNs), which consist of either;

(1) Two Inertial Navigation Systems, or

(2) Two Flight Management Systems (FMS) with two Inertial Reference Systems (IRS), or

(3) Two approved Global Positioning Systems (GPS), or

(4) One INS and one FMS/IRS, or

(5) One INS and one approved GPS, or

(6) One FMS/IRS and one approved GPS.

(b) Capable of providing a continuous indication to the flight crew of the aircraft position relative to track, and

(c) Should be coupled to the automatic pilot.

2.5.4 Operational Requirements

To be eligible for a RNP 10 approval from the CAA, the following operational issues need to be addressed and documented by the operator.

Commercial Air Transport operators must submit the supporting documentation whilst General Aviation operators need not submit this supporting documentation but must have them available upon request:

(a) Operating procedures (SOPs including Contingency Procedures);

(b) FCOM & Quick Reference Handbook changes (if applicable);

(c) Training programmes;

(d) Provision of flight planning information for designated area (e.g. NOTAMs, AIP etc.); and

(e) Data base and software integrity.

2.5.5 Approval

The RNAV/RNP 10 approval will be issued on a Specific Approval Certificate for General Aviation operators, a copy of which must be carried in the aircraft for all flights expected to be conducted in that airspace.

The RNAV/RNP 10 approval will be granted by inclusion in the Operations Specifications of the AOC holder.

CHAPTER 3

RNAV 5 (B-RNAV) AIRSPACE

3.1 GENERAL

B-RNAV is an en-route navigation specification that is mandated above FL 95 throughout Europe and the Middle East (where it may be called RNAV 5).

For operations in RNAV 5/B-RNAV airspace, aircraft require a track-keeping accuracy of +/-5 nm for 95% of the flight time. RNAV 5/B-RNAV does not require a navigation database, it only requires the flight management system to store four waypoints, and it does not require waypoint fly-by functionality.

RNAV 5/B-RNAV track keeping is based on the air navigation service provides assessment of the available navigation aids against the minimum equipment standard and area navigation equipment updating from ground-based navigation aids is assumed. There is no requirement for an RNP alerting function, and crew navigation accuracy crosschecks over and above normal SOPs are not required.

3.2 AIRCRAFT EQUIPMENT REQUIREMENTS

RNAV 5/B-RNAV operations are based on the use of RNAV equipment which automatically determines the aircraft position using input from one or a combination of the following types of position sensors, together with the means to establish and follow a desired path:

(a) VOR/DME;

(b) DME/DME;

(c) INS or IRS;

(d) GNSS.

Navigation data must be available for display either on a display forming part of the RNAV equipment or on a lateral deviation display (e.g. CDI, (E)HSI, 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. They should meet the following requirements:

(a) The displays must be visible to the pilot when looking forward along the flight path;

(b) The lateral deviation display scaling should be compatible with any alerting and annunciation limits, where implemented;

(c) The lateral deviation display must have a scaling and full-scale deflection suitable for the RNAV 5 operation;

(d) The navigation database must be current and appropriate for the region of intended operation and must include the navigation aids and waypoints required for the route.

3.3 OPERATIONAL PROCEDURES

3.3.1 Before Flight Phase

In the before flight phase, flight crew should:

(a) Ensure that the letter "R" is annotated in item 10 of the ATC Flight Plan;

(b) If stand-alone GNSS equipment is used to satisfy the RNAV requirement, the availability of RAIM should be checked against the latest GPS NOTAMs;

(c) Check the Technical Log to ensure that there is no defect to navigational equipment that would preclude RNAV 5 (B-RNAV) operations;

Note: The MEL identifies those alleviations that are not suitable for RNAV 5 (B-RNAV) operations.

(d) Confirm that the navigation database is current;

(e) Crosscheck the cleared flight plan by comparing charts or other applicable resources with the FMS and the aircraft map display. If required, the exclusion of specific navigation aids should be confirmed.

3.3.2 En-Route Phase

During en-route RNAV 5/B-RNAV operations, flight crew should:

(a) Monitor flight progress for navigational reasonableness by cross-checks with conventional navigation aids using the primary displays in conjunction with the FMS;

(b) While operating on RNAV segments, flight crew should use the flight director and/or autopilot in lateral navigation mode (LNAV).

If ATC issues a heading assignment taking the aircraft off a route / procedure, flight crew should not modify the flight plan in the RNAV system until a clearance is received to rejoin the procedure or the controller confirms a new route clearance. When the aircraft is not on the published procedure, the specified accuracy requirement does not apply.

3.3.3 Contingency Procedures

ATC must be advised if the RNAV performance ceases to meet the requirements for RNAV 5/B-RNAV together with the proposed course of action (e.g. reversion to non-RNAV procedures or a request for radar headings).

In the event of communications failure, the flight crew should continue with the flight plan in accordance with the published communications failure procedure.

Where stand-alone GNSS equipment is used, in the event of a loss of the RAIM detection function, the GNSS position may continue to be used for navigation. The flight crew should attempt to cross-check the aircraft's position using other sources of position information (e.g. VOR, DME and NDB).

Note: Details of specific contingency procedures for each area or route can be found in the Route Guide (e.g. Jeppesen Manual).

3.4 TRAINING REQUIREMENTS

Training for RNAV 5/B-RNAV operations must include the following topics:

(a) Basic RNAV Concept training (refer to Section 2.4.1);

(b) Airspace where RNAV 5/B-RNAV compliance is required;

(c) Changes to charting and documents to reflect RNAV 5/B-RNAV;

(d) Navigational equipment required to be operational for flight in designated RNAV 5/B-RNAV airspace, and the limitations associated with such RNAV equipment;

(e) Use of lateral navigation mode and associated lateral control techniques;

(f) Flight planning requirements;

(g) Contingency procedures.

There are no requirements for STD training or checking in relation to RNAV 5/B-RNAV operations, but these operations should be introduced into training scenarios (where suitable). Recency for RNAV 5/B-RNAV operations is satisfied by normal licensing recency requirements.

3.5 APPLICATION FOR RNAV 5/B-RNAV

3.5.1 Process

All operators must submit evidence of navigation performance capability with their application.

The application (refer Form SM 04 or Form SM 04A, as applicable) must address all of the sections on equipment, operational requirements, including documentation and training. General Aviation operators shall sign the "Declaration of Compliance" indicating all equipment, operational requirements, documentation and training meet the requirements for RNAV 5/B-RNAV approval.

Commercial Air Transport operators shall submit documentary evidence of the required information in the application form.

3.5.2 Airworthiness Issues

The components of a RNAV5/B-RNAV capable aircraft are usually installed at manufacture of a new generation aircraft and the manufacturer includes statements as to navigation performance

capability in the Aircraft Flight Manual, an AFM Supplement or STC.

Where an aircraft has been modified for RNP capability, the Commercial Air Transport operator must provide the CAA with all the aircraft navigation details for each aircraft registration and include the applicable software versions.

Unless the approved MEL already addresses the required navigation equipment, an amendment to the MEL should be submitted to the CAA for approval.

It is up to the operator to determine that the maintenance organisation used is capable of providing maintenance support of navigation equipment and software. That support must be provided by trained maintenance personnel capable of implementing digital communications related maintenance programmes. The support includes, but is not limited to;

(a) addressing installation,

(b) modification,

(c) correction of reported system discrepancies,

(d) use of test equipment,

(e) procedures,

(f) MEL relief, and

(g) return to service authorisations.

3.5.3 Equipment

One or a combination of the following types of position sensors, together with the means to establish and follow a desired path:

(a) VOR/DME;

(b) DME/DME;

(c) INS or IRS;

(d) GNSS.

Navigation data must be available for display either on a display forming part of the RNAV equipment or on a lateral deviation display (e.g. CDI, (E)HSI, or a navigation map display).

3.5.4 Operational Requirements

To be eligible for a RNAV 5 (B-RNAV) approval from the CAA, the following operational issues need to be addressed by the operator. General Aviation operators need not submit this supporting documentation but must have them available upon request:

(a) Operating procedures (SOPs including Contingency Procedures);

(b) FCOM & Quick Reference Handbook changes (if applicable);

(c) Training programmes;

(d) Provision of flight planning information for designated area (e.g. NOTAMs, AIP etc.);

(e) Data base and software integrity.

3.5.5 Approval

The RNAV 5/B-RNAV approval will be issued on a Specific Approval Certificate for General Aviation operators, a copy of which must be carried in the aircraft for all flights expected to be conducted in that airspace.

The RNAV 5/B-RNAV approval will be granted by inclusion in the Operations Specifications of the AOC holder.

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CHAPTER 4

RNP 4 AIRSPACE

4.1 GENERAL

RNP 4 is an oceanic or remote area specification requiring the aircraft to maintain a track-keeping accuracy of ± 4 nm for at least 95% of the total flight time. The along-track error must also be within ± 4 nm for at least 95% of the total flight time. GNSS is the primary navigation sensor to support RNP 4, either as a stand-alone navigation system or as part of a multi-sensor system. Within RNP 4 airspace, all routes are based upon WGS-84 co-ordinates.

RNP 4 airspace supports 30 nm lateral and longitudinal distance-based separation minima, and examples of RNP 4 airspace exist in the PAC region and NAT HLA.

4.2 AIRCRAFT EQUIPMENT REQUIREMENTS

4.2.1 Navigation Equipment

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

The on-board navigation system must have the following functionalities:

(a) Display of navigation data;

(b) Track to fix (TF);

(c) Direct to fix (DF);

(d) “Direct To” function;

(e) Course to fix (CF);

(f) Parallel offset;

(g) Fly-by transition criteria;

(h) User interface displays;

(i) Flight planning path selection;

(j) Flight planning fix sequencing;

(k) User-defined course to fix;

(l) Path steering;

(m) Alerting capability;

(n) Navigation database access;

(o) WGS-84 geodetic reference system;

(p) Automatic radio position updating.

The system must have the capability to fly parallel tracks at a selected offset distance. When executing a parallel offset, the navigation accuracy and all performance requirements of the original route in the active flight plan must be applicable to the offset route. The system must provide for entry of offset distances in increments of 1 nm, left or right of course, and the system must be capable of offsets of at least 20 nm. The on-board navigation data must be current and include appropriate procedures.

4.2.2 Additional Communications Equipment

In RNP 4 airspace, controller-pilot data link communications (CPDLC) and automatic dependent surveillance (contract) (ADS-C) systems may also be required when the separation standard is 30 nm lateral and/or longitudinal. (depending on airspace requirements)

Note: Use of CPDLC procedures requires a separate operational approval from the CAA.

4.3 OPERATIONAL PROCEDURES

4.3.1 Before Flight Phase

In the before flight phase, flight crew should:

(a) Identify which portions of the flight are to be conducted in RNP 4 airspace and verify the entry and exit points;

(b) Ensure that the letter “R” is annotated in item 10 of the ATC Flight Plan. Additional information should be displayed in the Remarks section indicating the accuracy capability, such as RNP 4 versus RNP 10;

(c) Ensure that adequate navigation capability is available en-route to enable the aircraft to navigate to RNP 4;

(d) Check the Technical Log to ensure that there is no defect in navigational equipment that would preclude RNP 4 operations;

Note: The MEL identifies those alleviations that are not suitable for RNP 4 operations.

(e) Confirm that the navigation database is current and remain so for the duration of the flight;

(f) Check and brief the contingency procedures for the area in which RNP 4 operations are to be conducted.

4.3.2 En-Route Phase

During en-route operations, and before entering RNP 4 airspace, flight crew should:

(a) Verify that the aircraft technical status allows RNP 4 operations;

(b) Conduct a CPDLC and ADS-C log on to the appropriate authority; if applicable;

(c) After entering RNP 4 airspace, flight crew should:

(1) Use a lateral deviation indicator, flight director, or autopilot in lateral navigation mode;

(2) Maintain route centrelines, as depicted by on-board lateral deviation indicators and/or flight guidance unless authorised to deviate by ATC or under emergency conditions. For normal operations, cross-track error / deviation (the difference between the RNAV system computed path and the aircraft position relative to the path) should be limited to ±½ the navigation accuracy associated with the route (i.e. 2 nm). Brief deviations from this standard (e.g. overshoots or undershoots) during and immediately after route turns, up to a maximum of 100% of the required navigation accuracy (i.e. 4 nm), are allowable;

(3) Cross-check to identify navigation errors in sufficient time to prevent the aircraft from an inadvertent deviation from ATC cleared routes;

(4) Advise ATC of any deterioration or failure of the navigation equipment below the navigation performance requirements or of any deviations required for a contingency procedure.

(d) For aircraft with automatic offset programming capability only, determine if the use of the Strategic Lateral Offset Procedure may be employed at the discretion of the flight crew. This procedure may be used for both wake vortex encounters and to mitigate the heightened risk of collision when non-normal events such as operational altitude deviation errors and turbulence-induced altitude deviations occur.

4.3.3 Contingency Procedures

If the equipment requirements cannot be met an alternative non-RNP 4 route or diversion must be considered. In oceanic and remote areas, continuous direct controller-pilot communication may not always be possible, so a range of contingencies have been considered which allow independent action by flight crews. These procedures provide for the more frequent cases such as:

(a) Inability to maintain assigned flight level due to meteorological conditions, aircraft performance or pressurization failure;

(b) En-route diversion across the prevailing traffic flow;

(c) Loss of, or significant reduction in, the required navigation capability when operating in airspace where the navigation performance accuracy is a prerequisite to the safe conduct of flight operations.

In general, they permit crews, in exceptional circumstances, to deviate from assigned clearances by selecting flight levels and/or tracks where other aircraft are least likely to be encountered. During such deviations, crews are required to make maximum use of the aircraft lighting and to transmit relevant information on all appropriate frequencies, including the distress and emergency frequency.

Once contact with ATC has been re-established, the crew will be assisted and issued with new clearances as required. Offset track procedures are permitted if an encounter with turbulence is considered to be due to a wake vortex encounter.

Note: Details of specific contingency procedures for each area or route can be found in the Route Guide (e.g. Jeppesen Manual).

4.4 TRAINING REQUIREMENTS

Training for RNP 4 operations must include the following topics:

(a) Basic RNAV Concept training (See Section 2.4.1);

(b) Training for RNP 4 operations;

(c) Airspace where RNP 4 compliance is required;

(d) Changes to charting and documents to reflect RNP 4;

(e) ADS-B/C and CPDLC procedures:

(1) Pre-flight procedures;

(2) AFN logon;

(3) Exchange of CPDLC messages;

(4) Transfer of connection;

(5) Disconnection;

(6) Contingency procedures.

There are no requirements for STD training or checking in relation to RNP 4 operations, but these operations should be introduced into training scenarios (where suitable). Recency for RNP 4 operations is satisfied by normal licensing recency requirements.

4.5 APPLICATION FOR RNP 4

4.5.1 Process

All operators must submit evidence of navigation performance capability with their application.

The application (refer Form SM 04 or Form SM 04A, as applicable) must address all of the sections on equipment, operational requirements, including documentation and training. General Aviation operators shall sign the "Declaration of Compliance" indicating all equipment, operational requirements, documentation and training meet the requirements for RNP 4 approval.

Commercial Air Transport operators shall submit documentary evidence of the required information in the application form.

4.5.2 Airworthiness Issues

The components of a RNP 4 capable aircraft are usually installed at manufacture of a new generation aircraft and the manufacturer includes statements as to navigation performance capability in the Aircraft Flight Manual, an AFM Supplement or STC.

Where an aircraft has been modified for RNP capability, the Commercial Air Transport operator must provide the CAA with all the aircraft navigation details for each aircraft registration and include the applicable software versions.

Unless the approved MEL already addresses the required navigation equipment, an amendment to the MEL should be submitted to the CAA for approval.

It is up to the operator to determine that the maintenance organisation used is capable of providing maintenance support of navigation equipment and software. The support includes, but is not limited to;

(a) addressing installation,

(b) modification,

(c) correction of reported system discrepancies,

(d) use of test equipment,

(e) procedures,

(f) MEL relief, and

(g) return to service authorisations.

4.5.3 Equipment

Two fully serviceable independent long-range navigation systems (LRNSs) based on GNSS and CPDLC communication capability.

4.5.4 Operational Requirements

To be eligible for a RNP 4 approval from the CAA, the following operational issues need to be addressed by the operator:

(a) Operating procedures (SOPs including Contingency Procedures)

(b) FCOM & Quick Reference Handbook changes (if applicable).

(c) Training programmes

(d) Provision of flight planning information for designated area (e.g. NOTAMs, AIP etc.); and

(e) Data base and software integrity.

4.5.5 Approval

The RNP 4 approval will be issued on a Specific Approval Certificate for General Aviation operators, a copy of which must be carried in the aircraft for all flights expected to be conducted in that airspace.

The RNP 4 approval will be granted by inclusion in the Operations Specifications of the AOC holder.

CHAPTER 5

RNP 1, RNAV 1 (P-RNAV) & RNAV 2 AIRSPACE

5.1 GENERAL

RNP 1 is presently required in China and will appear more frequently in the future whereas it is generally known as P-RNAV (European) and RNAV 2 is referred to as US RNAV (USA). An operational approval to this specification allows the conduct of RNP 1, RNAV 1 and/or RNAV 2 operations globally. The aircraft requirements for RNP 1, RNAV 1 and 2 are identical, while some operating procedures are different.

Note: The term RNP 1 and RNAV 1 are used in this CAP until a worldwide standard term is accepted.

The RNP 1, RNAV 1 and 2 navigation specification is applicable to all ATS routes, including routes in the en-route domain, standard instrument departures (SIDs), and standard arrival routes (STARs). It also applies to instrument approach procedures up to the final approach fix. RNP 1/RNAV 1 and RNAV 2 routes are envisioned to be conducted in direct controller-pilot communication environments. During operations in airspace or on routes designated as RNP 1/RNAV 1, the lateral total system error must be within ±1 nm for at least 95% of the total flight time. The along-track error must also be within ±1 nm for at least 95% of the total flight time.

During operations in airspace or on routes designated as RNAV 2, the lateral total system error must be within ±2 nm for at least 95% of the total flight time. The along-track error must also be within ±2 nm for at least 95% of the total flight time.

The RNP 1, RNAV 1 and 2 navigation specification is primarily developed for RNAV operations in a radar environment (for SIDs, radar coverage is expected prior to the first RNAV course change). However, RNP 1, RNAV 1 and RNAV 2 may be used in a non-radar environment or below minimum radar vectoring altitude (MRVA) if the implementing State ensures appropriate system safety and accounts for lack of performance monitoring and alerting.

5.2 AIRCRAFT EQUIPMENT REQUIREMENTS

RNP 1, RNAV 1 and RNAV 2 operations are based upon the use of RNAV equipment that automatically determines the aircraft position in the horizontal plane using input from the following types of position sensors (no specific priority):

(a) Global navigation satellite system (GNSS);

(b) DME/DME RNAV equipment;

(c) DME/DME/IRS RNAV equipment.

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

(a) aircraft with E/TSO-C129a sensor (Class B or C), E/TSO-C145() and the requirements of E/TSOC115b FMS, installed for IFR use in accordance with FAA AC 20-130A; or

(b) aircraft with E/TSO-C129a Class A1 or E/TSO-C146() equipment installed for IFR use in accordance with FAA AC 20-138 or AC 20-138A; or

(c) aircraft with RNP capability certified or approved to equivalent standards.

5.3 OPERATIONAL PROCEDURES

5.3.1 General

A RNP 1, RNAV 1 or RNAV 2 SID or STAR must not be flown unless it is retrievable by route name from the on-board navigation database and conforms to the charted route. However, the route may subsequently be modified through the insertion or deletion of specific waypoints in response to ATC clearances.

The manual entry or creation of new waypoints by latitude and longitude is not permitted.

Additionally, pilots must not change any RNAV SID or STAR database waypoint type from a fly-by to a fly-over or vice versa.

5.3.2 Before Flight Phase

In the before flight phase, flight crew should:

(a) Identify which portions of the flight are to be conducted in RNP 1, RNAV 1/RNAV 2 airspace and verify the entry and exit points;

(b) Ensure that the letter "R" is annotated in item 10 of the ATC Flight Plan. Additional information should be displayed in the Remarks section indicating the accuracy capability, such as RNP 1/RNAV 1 versus RNAV 2;

(c) Ensure that adequate navigation capability is available en-route to enable the aircraft to navigate to RNP 1/RNAV 1/RNAV 2 requirements.

Note: RAIM levels required for RNP 1, RNAV 1 and RNAV 2 can be verified either through NOTAMs (where available) or through prediction services. In the event of a predicted, continuous loss of appropriate level of fault detection of more than five minutes for any part of the RNP 1, RNAV 1 or RNAV 2 operation, the flight plan should be revised (e.g. delaying the departure or planning a different departure procedure).

(d) Check the Technical Log to ensure that there is no defect in navigational equipment that would preclude RNP 1/RNAV 1/RNAV 2 operations. The MEL identifies those alleviations that are not suitable for RNP 1/RNAV 1/RNAV 2 operations;

(e) Confirm that the navigation database is current for the duration of the flight;

(f) Crosscheck the cleared flight plan by comparing charts or other applicable resources with the FMS and the aircraft map display. If required, the exclusion of specific navigation aids should be confirmed.

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

(g) Check and brief the contingency procedures for the area in which RNP 1/RNAV 1/RNAV 2 operations are to be conducted.

5.3.3 Flying the Procedure

(a) **General**

For RNAV 2 routes, pilots should use a lateral deviation indicator, flight director or autopilot in lateral navigation mode.

Pilots may use a navigation map display with equivalent functionality as a lateral deviation indicator, without a flight director or autopilot. For RNP 1/RNAV 1 routes, pilots must use a lateral deviation indicator, flight director, or autopilot in lateral navigation mode.

Maintain route centrelines, unless authorised to deviate by ATC or under emergency conditions. For normal operations, any errors should be limited to ±½ the navigation accuracy associated with the procedure or route (i.e. 0.5 nm for RNP 1/RNAV 1, 1.0 nm for RNAV 2). Brief deviations from this standard (e.g. overshoots or undershoots) during and immediately after procedure/route turns, up to a maximum of 100% of the navigation accuracy (i.e. 1.0 nm for RNP 1/RNAV 1, 2.0 nm for RNAV 2), are allowable.

Note: Manually selecting aircraft bank limiting functions may reduce the aircraft's ability to maintain its desired track and is not recommended.

If ATC issues a heading assignment taking the aircraft off a route, the pilot should not modify the flight plan in the FMS until a clearance is received to re-join the route or the controller confirms a new route clearance.

(b) **RNAV SID Specific Requirements**

Before commencing the take-off, the flight crew should verify that the aircraft's RNAV system is available, operating correctly, and that the correct aerodrome, runway and RNAV procedure data are loaded. This is particularly important where a change of runway or procedure occurs and flight crew must verify that 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.

(c) **RNAV STAR Specific Requirements**

Before 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 CDU.

This includes confirmation of the waypoint sequence, reasonableness of track angles 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 navigation aid.

A route must not be used if doubt exists as to the validity of the route in the navigation database.

Note: The creation of new waypoints by manual entry into the RNAV system by the flight crew would invalidate the route and is not permitted. All published altitude and speed constraints must be observed.

Route modifications in the terminal area may take the form of radar 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.

5.3.4 Contingency Procedures

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

The flight crew must notify ATC of any loss of the RNAV capability, together with the proposed course of action. If unable to comply with the requirements of an RNAV route, the flight crew must advise ATS as soon as possible. The loss of RNAV capability includes any failure or event causing the aircraft to no longer satisfy the RNAV requirements of the route.

Note: Details of specific contingency procedures for each area or route can be found in the Route Guide (e.g. Jeppesen Manual).

5.4 RNP 1, RNAV 1 (P-RNAV) AND RNAV 2 TRAINING

5.4.1 General

Training for RNP 1/RNAV 1/RNAV 2 operations must include the following topics:

(a) Basic RNAV Concept Training (See Section 2.4.1);

(b) Airspace where RNP 1/RNAV 1/ RNAV 2 is required;

(c) Navigational equipment required to be operational for flight in designated RNP 1/RNAV 1/RNAV 2 airspace, and the limitations associated with RNP 1/RNAV 1/RNAV 2 equipment including MEL issues;

(d) Flight planning requirements;

(e) Charting, database and avionics issues including RNAV path terminator concepts especially:

(1) Use of the "CF" path terminator;

(2) Use of the “TF” path terminator.

(f) Use of RNAV equipment including:

(1) Retrieving a procedure from the database, briefing the procedure, comparing it with the charted procedure and action to be taken if discrepancies are noted;

(2) Using the autopilot, flight director and autothrottle at different stages of the procedure;

(3) Flight mode annunciations.

(g) Flying the procedure including:

(1) Use of lateral navigation mode and associated lateral control techniques;

(2) Use of vertical navigation mode and associated vertical control techniques.

(h) Contingency procedures.

Flight crews should be trained to proficiency in both PF and PM roles in flying RNP 1/RNAV 1 and RNAV 2 procedures using normal procedures. Initial training must include:

(a) At least three RNP 1/RNAV 1/RNAV 2 procedures flown by each flight crew member to include departures and arrivals;

(b) Failures such as map shift, sensor failure etc.

Following RNP 1/RNAV 1/RNAV 2 Training, a check must be completed consisting of a RNP 1/RNAV 1/RNAV 2 arrival procedure with an abnormality. RNP 1/RNAV 1/RNAV 2 recency is maintained by the inclusion in recurrent training of a RNP 1/RNAV 1/RNAV 2 arrival procedure with an abnormality.

5.4.2 Overlay Approach Training

When applicable, training for Overlay Approaches must include the following topics:

(a) Definition and concept of overlay approach procedures;

(b) Limitations on using overlay approaches;

(c) Precedence of raw data;

(d) Display management;

(e) Required navigation equipment for overlay approaches including MEL issues;

(f) Limitations on the use of vertical navigation modes;

(g) Retrieving the approach procedure from the database, briefing the procedure, comparing it with the charted procedure and action to be taken if discrepancies are noted;

(h) Flying the procedure:

(1) Use of autopilot, autothrottle and flight director;

(2) AFDS mode behaviour;

(3) Lateral and vertical path management;

(4) Adherence to speed and/or altitude constraints;

(5) The use of other aircraft equipment to support track monitoring, weather and obstacle avoidance.

(i) Contingency procedures;

(j) Missed approach procedures.

Flight crews should be trained to proficiency in both PF and PM roles in flying Overlay Approach Procedures using normal procedures. Training should include the following topics:

(a) Failures such as map shift, sensor failure etc; and

(b) Go-around from DH and/or an intermediate position.

Following Overlay Approach training, a check should be completed consisting of one approach with a system or sensor failure. Overlay Approach recency is maintained by the conduct of one approach with a system or sensor failure as part of recurrent training.

5.5 APPLICATION FOR RNP 1, RNAV 1 (P-RNAV) & RNAV 2

5.5.1 Process

All operators must submit evidence of navigation performance capability, as well as their operations manual procedures for electronic navigation data management, with their application.

The application (refer Form SM 04 & Form SM 04A, as applicable) must address all of the sections on equipment, operational requirements, including documentation and training. General Aviation operators shall sign the “Declaration of Compliance” indicating all equipment, operational requirements, documentation and training meet the requirements for RNP 1/RNAV 1/RNAV 2 approval. Commercial Air Transport operators shall submit documentary evidence of the required information in the application form.

5.5.2 Airworthiness Issues

The components of a RNP 1/RNAV 1/RNAV 2 capable aircraft are usually installed at manufacture of a new generation aircraft and the manufacturer includes statements as to navigation performance capability in the Aircraft Flight Manual, an AFM Supplement or STC.

Where an aircraft has been modified for RNP capability, both the private and commercial air transport operator must provide the CAA with all the aircraft navigation details for each aircraft registration and include the applicable software versions. Refer also to paragraph 5.2.

Unless the approved MEL already addresses the required navigation equipment, an amendment to the MEL should be submitted to the CAA for approval.

It is up to the operator to determine that the maintenance organisation used is capable of providing maintenance support of navigation equipment and software. The support includes, but is not limited to;

(a) addressing installation,

(b) modification,

(c) correction of reported system discrepancies,

(d) use of test equipment,

(e) procedures,

(f) MEL relief, and

(g) return to service authorisations.

5.5.3 Equipment

(a) Global navigation satellite system (GNSS); or

(b) DME/DME RNAV equipment; or

(c) DME/DME/IRS RNAV equipment.

5.5.4 Operational Requirements

To be eligible for a RNP 1/RNAV 1/RNAV 2 approval from the CAA, the following operational issues need to be addressed by the operator:

(a) Operating procedures (SOPs including Contingency Procedures and electronic navigation data management)

(b) FCOM & Quick Reference Handbook changes (if applicable).

(c) Training programmes

(d) Provision of flight planning information for designated area (e.g. NOTAMs, AIP etc.); and

(e) Data base and software integrity.

5.5.5 Approval

The RNP 1/RNAV 1/ RNAV 2 approval will be issued on a Specific Approval Certificate for General Aviation operators, a copy of which must be carried in the aircraft for all flights expected to be conducted in that airspace.

The RNP 1/RNAV 1/RNAV 2 approval will be granted by inclusion in the Operations Specifications of the AOC holder.

CHAPTER 6

RNP APCH OPERATIONS

6.1 GENERAL

RNP approach (RNP APCH) procedures include existing RNAV (GNSS) approach procedures designed with a straight segment. RNP APCH procedures are expected to be authorised by a number of regulatory agencies including the European Aviation Safety Agency (EASA) and the United States Federal Aviation Administration (FAA).

GNSS is the primary navigation system to support RNP APCH procedures. The instrument approach chart will clearly identify the RNP APCH application as RNAV (GNSS). The chart will provide sufficient data to support navigation data base checking by the crew (including waypoint name, track, distance for each segment and vertical path angle). All procedures will be based upon WGS 84 coordinates.

RNP APCH does not include specific requirements for communication or ATS surveillance. Adequate obstacle clearance is achieved through aircraft performance, operating procedures and procedure design. ATC may use radar vectoring techniques to place aircraft onto final approach axis when the RNAV system supports this function.

The Lateral and Longitudinal Total System Error (TSE) of the on-board navigation system must be equal to or better than:

(a) ±1 NM for 95% of the flight time for the initial and intermediate approach segments and for the RNAV missed approach.

b) ±0.3 NM for 95% of the flight time for the final approach segment.

6.2 DOCUMENTATION

This section details a means of airworthiness compliance for existing installations only. It also details specific points that should be considered during these approval processes. Relevant documentation demonstrating airworthiness compliance should be available to establish that the aircraft is equipped with an RNAV systems meeting RNP APCH requirements without or with vertical guidance (APV BAROVNAV).

Note: Aircraft that are approved for RNP AR APCH operations are considered compliant with this Section.

There must be an existing statement in the AFM that indicates the aircraft is approved;

- to perform RNP 0.3 GNSS approaches or, for

- instrument approaches including a specification of RNP GNSS capability that meets RNP 0.3 is considered acceptable for lateral performance.

The determination of eligibility for existing systems may consider the acceptance of manufacturer documentation. In this specific case, an AFM amendment is recommended to reflect the RNP APCH aircraft capability.

The (Master) Minimum Equipment List (MMEL/MEL) may need to be amended to identify the minimum equipment necessary to satisfy operations using the RNAV system.

For new or modified aircraft, the Aircraft Flight Manual (AFM) or the Pilot's Operating Handbook (POH), whichever is applicable, should provide at least the following information:

(a) A statement which identifies the equipment and aircraft build or modification standard certificated for RNP APCH operation with or without vertical guidance (APV BAROVNAV). This may include a very brief description of the RNAV/GNSS system, including the RNAV/GNSS airborne equipment software version, CDI/HSI equipment and installation and a statement that it is suitable for RNAV operations. A brief introduction to the RNAV(GNSS) approach concept using ICAO RNP APCH terminology may also be included.

(b) Appropriate amendments or supplements to cover RNP APCH approach operations in the following sections:

- Limitations – including use of VNAV, FD and AP; currency of navigation database; crew verification of navigation data; availability of RAIM or equivalent function; restrictions on use of GNSS for conventional Non Precision Approaches.
- Normal Procedures
- Abnormal Procedures – including actions in response to a Loss of Integrity (e.g. 'RAIM Position Warning', (or equivalent) message or a 'RAIM not available', (or equivalent) message).

6.3 RNP APCH TRAINING

Training for RNP APCH operations must include:

(a) Basic RNAV Concept Training (See Section 2.4.1);

(b) Definition of RNP APCH operations;

(c) Regulatory requirements for RNP APCH operations;

(d) Required navigation equipment for RNP APCH approach operations:

(1) GPS concepts and characteristics;

(2) RNP / ANP requirements;

(3) RAIM;

(4) MEL constraints.

(e) Limitations on the use of vertical navigation modes;

(f) Procedure characteristics:

(1) Chart depiction;

(2) Aircraft display depiction;

(3) Minima.

(g) Retrieving an RNP APCH approach procedure from the database, briefing the procedure, comparing it with the charted procedure and action to be taken if discrepancies are noted;

(h) Flying the procedure:

(1) Use of autopilot, autothrottle and flight director;

(2) AFDS mode behaviour;

(3) Lateral and vertical path management;

(4) Adherence to speed and/or altitude constraints;

(5) The use of other aircraft equipment to support track monitoring, weather and obstacle avoidance.

(i) The effect of temperature deviation and its compensation;

(j) ATC procedures;

(k) Contingency procedures.

RNP APCH STD training should include:

(a) When the pilot is current in flying overlay approach procedures:

(1) At least three RNP APCH procedures without failures;

(2) A system failure leading to a go-around; or

(b) When the pilot is not currently flying overlay approach procedures:

(1) Overlay approach training;

(2) At least four RNP APCH procedures flown with at least one approach each as PF and PM;

(3) A system failure leading to a go-around.

Following RNP APCH training, a check should be completed consisting of one approach with a system or sensor failure. RNP APCH recency is maintained by the conduct of three approaches, one of which may be in the aircraft. Recurrent training should include at least two RNP APCH approaches, one with system failure.

6.4 APPLICATION FOR RNP APCH

6.4.1 Process

All operators must submit evidence of navigation performance capability with their application.

The application (refer Form SM 04 or Form SM 04A, as applicable) must address all of the sections on equipment, operational requirements, including documentation and training. General Aviation operators shall sign the "Declaration of Compliance" indicating all equipment, operational requirements, documentation and training meet the requirements for RNP APCH approval.

Commercial Air Transport operators shall submit documentary evidence of the required information in the application form.

6.4.2 Airworthiness Issues

The components of a RNP 4 capable aircraft are usually installed at manufacture of a new generation aircraft and the manufacturer includes statements as to navigation performance capability in the Aircraft Flight Manual, an AFM Supplement or STC.

Where an aircraft has been modified for RNP capability, the Commercial Air Transport operator must provide the CAA with all the aircraft navigation details for each aircraft registration and include the applicable software versions.

Unless the approved MEL already addresses the required navigation equipment, an amendment to the MEL should be submitted to the CAA for approval.

It is up to the operator to determine that the maintenance organisation used is capable of providing maintenance support of navigation equipment and software. The support includes, but is not limited to;

(a) addressing installation,

(b) modification,

(c) correction of reported system discrepancies,

(d) use of test equipment,

(e) procedures,

(f) MEL relief, and

(g) return to service authorisations.

6.4.3 Equipment

Global navigation satellite system (GNSS) equipment as approved in accordance with the requirements of ICAO Doc. 9613, Performance Based Navigation Manual;

6.4.4 Operational Requirements

To be eligible for a RNP APCH approval from the CAA, the following operational issues need to be addressed by the operator:

(a) Operating procedures (SOPs including Contingency Procedures and electronic navigation data management);

(b) FCOM & Quick Reference Handbook changes (if applicable);

(c) Training programmes;

(d) Provision of flight planning information for designated airports (e.g. NOTAMs, AIP etc.); and

(e) Data base and software integrity.

6.4.5 Approval

The RNP APCH approval will be issued on a Specific Approval Certificate for General Aviation operators, a copy of which must be carried in the aircraft for all flights expected to be conducted in that airspace.

The RNP APCH approval will be granted by inclusion in the Operations Specifications of the AOC holder.

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CHAPTER 7

RNP AR APCH OPERATIONS

7.1 GENERAL

RNP AR APCH (RNP Authorisation Required Approach) is based on GNSS as the primary navigation aid for approaches to airports where limiting obstacles exist and/or where significant operational efficiencies can be gained.

These procedures require additional levels of scrutiny, control and authorisation. A critical component of RNP is the ability of the aircraft navigation system to monitor its achieved navigation performance, and to identify to the pilot whether the operational requirement is or is not being met during an operation.

In addition to receiving approval by the CAA to conduct RNP AR (Authorisation Required) APCH procedures, additional approval from the State within which the procedure is located may also be required.

The instrument approach chart will clearly identify the RNP AR APCH application as RNAV (GNSS) and also indicates the required navigation standard (e.g. RNP AR APCH. (Refer to example at Attachment 1)

The chart will provide sufficient data to support navigation data base checking by the crew (including waypoint name, track, distance for each segment and vertical path angle). All procedures will be based upon WGS 84 coordinates.

RNP AR APCH does not include specific requirements for communication or ATS surveillance. Adequate obstacle clearance is achieved through aircraft performance, operating procedures and procedure design.

The Lateral and Longitudinal Total System Error (TSE) of the on-board navigation system must be ± 0.1 to ± 0.3 NM for 95% of the flight time (depending on the approach chart requirement)

7.2 EQUIPMENT REQUIREMENTS

7.2.1 Supporting Documentation

Relevant documentation demonstrating airworthiness compliance must be available to establish that the aircraft is equipped with an RNAV systems meeting RNP AR APCH requirements without or with vertical guidance (APV BAROVNAV).

The design approval holder will demonstrate compliance, and the approval will be documented in manufacturer documentation. If the operator's aircraft documentation does not contain such a statement, the application for RNP AR APCH authorisation cannot proceed.

There must be an existing statement in the AFM that indicates the aircraft is approved;

(a) to perform RNP 0.1 to 0.3 GNSS approaches or,

(b) instrument approaches including a specification of RNP GNSS capability that meets RNP 0.3 is considered acceptable for lateral performance.

An aircraft may meet the aircraft eligibility and equipment requirements by indicating in its Aircraft Flight Manual compliance with FAA AC 90-101(), EASA AMC 20-26 or TCCA AC 700-024 for the purpose of demonstrating its ability to conduct RNP AR APCH operations.

7.2.2 Equipment

An aircraft is eligible for an RNP AR navigation authorisation if the aircraft is equipped with the following minimum equipment. For aircraft certified to TSO-C145a/C146a (or equivalent) standards:

(a) 2 FMS;

(b) 2 GNSS receivers (may be included in a (MMR);

(c) 1 Flight Director;

(d) 1 Flight Mode Annunciator;

(e) 1 RADALT;

(f) Duplicated primary flight and navigation displays;

(g) Duplicated aircraft power sources (APU may be used);

(h) 1 Autopilot channel; and

(i) 1 TAWS appropriate to class of operation, which

(1) should be updated to have the most current version of its functional software;

(2) should be updated to the most current version of the terrain and obstacle database

(3) must meet the altitude accuracy alerting criteria of TSO-C151b (or later version):

(i) without any pilot action or input;

(ii) independent of altimeter setting on the altimeter(s); and

(iii) independent of temperature and pressure deviations from the International Standard Atmosphere (ISA);

(4) should use a navigation source that is independent of the navigator/FMS position (usually the GNSS position can be considered independent of the navigation source if used directly by TAWS, and is not the same position as that used by the flight crew an auto flight systems).

Note: Aeroplanes with TSO-C129 (cancelled) equipment installations will require an assessment of aircraft capability which may include individual assessments made by a number of sources including the aircraft manufacturer, avionics supplier, the operator, CAA, and other regulatory bodies.

7.3 RNP AR APCH REQUIREMENTS

7.3.1 Pre-flight Considerations

(a) *Minimum Equipment List (MEL)*

The MEL must establish guidance, restrictions and procedures (as required) in the MEL for use in the event of RNP AR APCH equipment unavailability, and amend its Maintenance Programme accordingly. The MEL should be developed/revised to address the equipment requirements for RNP AR APCH instrument approaches depending on the intended navigation accuracy and whether the missed approach requires an RNP less than 1.0 Nautical Mile (nm).

(b) *TAWS*

An operable Class A terrain awareness warning system (TAWS) is required for all RNP AR APCH procedures.

(c) *Autopilot and Flight Director*

RNP AR APCH procedures with lateral navigation accuracy less than RNP 0.3 nm or with RF legs require the use of an autopilot or flight director driven by the RNP system in all cases. Thus, the autopilot/flight director must be serviceable and able to track the lateral and vertical paths defined by the procedure.

(d) *Dispatch RNP Availability Prediction*

The operator must have a predictive performance capability which can forecast whether or not the specified RNP will be available at the time and location of a desired RNP AR APCH operation. This capability can be a ground service and need not be resident in the aircraft's avionics equipment. The operator must establish procedures requiring use of this capability as both a pre-flight dispatch tool and as a flight-following tool, where required, in the event of reported failures. The RNP assessment must consider the specific combination of the aircraft capability (sensors and integration).

(1) *RNP assessment when GNSS updating*. This predictive capability must account for known and predicted outages of GNSS satellites or other impacts on the navigation system's sensors. The prediction programme should not use a mask angle below 5 degrees, as operational experience indicates that satellite signals at low elevations are not reliable. The prediction must use the actual GNSS constellation with the integrity monitoring algorithm (Receiver Autonomous Integrity Monitoring (RAIM), Aircraft Autonomous Integrity Monitoring (AAIM) etc.) identical to that used in the actual equipment. For RNP AR APCHs with high terrain, use a mask angle appropriate to the terrain.

(2) RNP AR APCH operations must have GNSS updating available prior to commencement of the procedure.

(e) *NAVAID Exclusion*

The operator must establish procedures to exclude NAVAID facilities in accordance with NOTAMs (e.g. DMEs, VORs, localizers).

(f) *Navigation Database Currency*

During system initialization, flight crew members of aircraft equipped with an RNP capable system must confirm that the navigation database is current. Navigation databases are expected to be current for the duration of the flight. If the AIRAC cycle will change during flight, operators and flight crew members must establish procedures to ensure the accuracy of the navigation data, including the suitability of the navigation facilities used to define the routes and procedures for the flight.

7.3.2 In-flight Considerations

(a) *Modification of the Flight Plan*

Flight crew members are not authorised to fly a published RNP AR APCH procedure unless it is retrievable by the procedure name from the aircraft navigation database and conforms to the charted procedure. The lateral path must not be modified, with the exception of:

(1) accepting a clearance to go direct to a fix in the approach procedure, that is before the FAF and that does not immediately precede an RF leg.

(2) changing the altitude and/or airspeed waypoint constraints on the initial, intermediate, or missed approach segments (e.g. to apply cold temperature corrections or comply with an Air Traffic Control (ATC) clearance/instruction).

(b) *Required List of Equipment*

The flight crew members must have a required list of equipment for conducting RNP AR APCH operations or alternate methods to address in-flight equipment failures prohibiting RNP AR APCHs (e.g. a quick reference handbook).

(c) *RNP Management*

The flight crew member's operating procedures must ensure the navigation system uses the appropriate navigation accuracy throughout the approach. If multiple lines of minima associated with different navigation accuracies are shown on the approach chart, the flight crew members must confirm that the desired navigation accuracy is entered in the RNP system. If the navigation system does not extract and set the navigation accuracy from the on- board navigation database for each leg of the procedure, then the flight crew member's operating procedures must ensure that the smallest navigation accuracy value (i.e. highest degree of accuracy) required to complete the approach or the missed approach is selected before initiating the procedure (e.g. before the

initial approach fix (IAF)). Different segments may have different navigation accuracy requirements, which are annotated on the approach chart.

(d) *GNSS Updating*

All RNP AR APCH instrument approach procedures require GNSS updating of the navigation position solution. The flight crew members must verify that GNSS updating is available prior to commencing the RNP AR APCH procedure. If GNSS updating is lost at any time during an RNP AR APCH procedure, the flight crew members must abandon the RNP AR APCH procedure unless the flight crew members have the visual references in sight required to continue the approach. See also para 7.3.3 on Contingency Procedures for more information.

(e) *Radio Updating*

Initiation of all RNP AR APCH procedures is based on the availability of GNSS updating. DME/DME and VOR updating are not authorised for use as the primary form of positioning during RNP AR APCH procedures. The flight crew members must comply with the operator's procedures for inhibiting specific facilities.

(f) *Procedure Confirmation*

The flight crew members must confirm that the correct procedure has been selected. This process includes confirmation of the waypoint sequence, reasonableness of track angles and distances, and any parameters that can be altered by the flight crew members, such as altitude or speed constraints. A navigation system textual display or navigation map display must be used.

(g) *System Cross-check*

For approaches with navigation accuracy less than RNP 0.3 nm, the flight crew members must monitor the lateral and vertical guidance provided by the navigation system by ensuring it is consistent with other available data and displays that are provided by an independent means.

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

(h) *Approach Procedures*

(1) Procedures with RF Legs

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

(2) Indicated Airspeed Limitations

When flying an RNP AR approach, flight crew members must not exceed the maximum airspeeds shown in the following table throughout the approach segment being flown.

For example, a Category C aircraft must slow to 140 KIAS at the final approach fix (FAF) or may fly as fast as 165 KIAS if using Category D minima. A missed approach prior to the DA may require the segment speed for that segment be maintained.

Note: The following are the maximum approach segment airspeed by aircraft approach category. Note that these speeds are the most restrictive and TERPS (FAA) speeds are higher for the initial and intermediate fix segments for Cat B & C aeroplanes.

Indicated airspeed (knots)					
Approach Segment	**Indicated airspeed by aircraft category**				
	CAT A	**CAT B**	**CAT C**	**CAT D**	**CAT E**
Initial and Intermediate (IAF to FAF)	150	150	240	250	310
Final (FAF to DA)	90	120	140	165	250
Missed approach (DA to MAHF)	110	150	240	265	310
Airspeed restriction*	As Specified				
***RNP AR APCH** procedure design may use airspeed restrictions unique to the procedure, and published on the approach plate, to reduce the design turn radius regardless of aircraft category. Operators, therefore, need to ensure they comply with the limiting speed for planned RNP AR APCH operations under all operating configurations and conditions.					

(i) *Navigation System with Temperature Compensation*.

For aircraft with temperature compensation capabilities, approved operating procedures may allow flight crew members to disregard the temperature limits on RNP AR APCH procedures if the operator provides flight crew member training on the use of the temperature compensation function. Temperature compensation by the system is applicable to the baro-VNAV guidance and is not a substitute for the flight crew members correcting, as required, for the cold temperature effects on minimum altitudes such as DA and MSA. Flight crew members should be familiar with the effects of the temperature compensation on intercepting the compensated path.

(j) *Navigation System without Temperature Compensation*

For aircraft without temperature compensation capabilities, the operation must occur within the temperature limits (T_{Lim}) published on the approach chart. Despite being uncompensated, the baro-VNAV path in the final segment will provide the required obstacle clearance. The flight crew members must correct, as required, for the cold temperature effects on minimum altitudes such as IAF, IF, FAF, DA, MA and MSA. In below ISA temperatures the baro-VNAV path will cross the FAF at an altitude below the temperature-corrected FAF crossing altitude. It is permissible to follow the baro-VNAV path from the temperature-corrected intermediate segment altitude.

(k) *GNSS Vertical Navigation*

When using augmented GNSS vertical guidance on RNP AR APCH operations (e.g. SBAS or GBAS), the temperature limits for the procedure do not apply. However, the flight crew members must still correct, as required, for the cold temperature effects on minimum altitudes such as DA and MSA.

(l) *Altimeter setting*

RNP AR APCH instrument approach procedures use barometric data to drive vertical guidance. The flight crew members must ensure that the current local QNH is set prior to the FAF. The use of remote altimeter settings is not permitted.

(m) *Altimeter cross-check*

The intent of this check is to detect a gross error or a bias error in an altimeter system. The flight crew members must complete an altimetry cross-check prior to commencing the procedure ensuring both pilots' altimeters agree within 100 ft (±30 m). If the altimetry cross-check fails, then the procedure must not be conducted. This operational cross-check is not necessary if the aircraft automatically compares the altitudes to within 100 ft (30 m).

(n) *Lateral and Vertical Path Deviation Monitoring*

(1) Flight crew members must use a lateral deviation indicator and/or flight director in lateral navigation mode on RNP AR APCH procedures. Flight crew members of aircraft with a lateral deviation indicator must ensure that lateral deviation indicator scaling (full-scale deflection) is suitable for the navigation accuracy associated with the various segments of the RNP AR APCH procedure. All flight crew members are expected to maintain procedure centrelines, as depicted by on-board lateral deviation indicators and/or flight guidance during all RNP operations described in this AC, unless authorised to deviate by ATC or under emergency conditions. For normal operations, cross-track error/deviation (the difference between the RNP system computed path and the aircraft position relative to the path) should be limited to ±½ the navigation accuracy associated with the procedure segment. Brief lateral deviations from this standard (e.g. overshoots or undershoots) during and immediately after turns, up to a maximum of one-times the navigation accuracy of the procedure segment are tolerable.

(2) The vertical deviation must be within 75 ft (22 m) during the final approach segment, noting that transients in excess of 75 ft (22 m) above the vertical path are acceptable (e.g. configuration changes or energy management actions). Vertical deviation should be monitored above and below the glide path. While being above the glide path provides margin against obstacles on the final approach, continued intentional flight above the vertical path can result in a go-around decision closer to the runway and reduce the margin against obstacles in the missed approach.

(3) Pilots must execute a missed approach if the lateral deviation exceeds 1 × RNP or the vertical deviation exceeds 75 ft (22 m) below the vertical path, unless the flight crew members have the visual references in sight required to continue the approach.

(i) Some aircraft navigation displays do not incorporate lateral and vertical deviations scaled for each RNP AR APCH operation in the primary field of view. Where a moving map, low-resolution vertical deviation indicator (VDI), or numeric display of deviations are to be used, flight crew member training and procedures must ensure the effectiveness of these displays. Typically, this involves the demonstration of the procedure with a number of trained flight crews and inclusion of this monitoring procedure in the recurrent RNP AR APCH training programme.

(ii) For installations that use a CDI for lateral path tracking, the AFM or aircraft qualification guidance should state which navigation accuracy and operations the aircraft supports and the operational effects on the CDI scale. The flight crew members must know the CDI full-scale deflection value. The avionics may automatically set the CDI scale (dependent on the phase of flight) or the flight crew members may manually set the scale. If the flight crew members manually select the CDI scale, the operator must have procedures and training in place to assure the selected CDI scale is appropriate for the intended RNP operation. The deviation limit must be readily apparent, given the scale (e.g. full-scale deflection).

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

(o) *VNAV Altitude Transitions*

The aircraft barometric VNAV system provides fly-by vertical guidance, and may result in a path that starts to intercept the vertical path prior to the FAF. The small vertical displacement which may occur at a vertical constraint (e.g. the FAF) is considered operationally acceptable, and may provide a smoother transition to the next flight path vertical segment. This momentary deviation below the published minimum procedure altitude is acceptable provided the deviation is limited to no more than 100 ft (30 m) and is a result of a normal VNAV capture. This applies to “level off” and “altitude acquire” segments following a climb or descent; or vertical climb or descent segment initiation; or joining of climb or descent paths with different gradients.

(p) *Non-standard Climb Gradient*

When an approach procedure specifies a non-standard climb gradient, the operator and flight crew members must ensure the aircraft is capable of complying with the published climb gradient at the aircraft landing weight under ambient atmospheric conditions.

(q) *Go-around or Missed Approach*

(1) Where possible, the missed approach will require a navigation accuracy value of RNP 1.0 nm. Where necessary, a navigation accuracy value less than RNP 1.0 nm (i.e. a higher degree of accuracy) will be used in the missed approach.

(2) In some aircraft, activating take-off/go-around (TOGA) during the initiation of a go-around or missed approach, may cause a change in lateral navigation mode or functionality (i.e. TOGA disengages the autopilot and flight director from LNAV guidance) and track guidance may revert to track-hold function. In such cases, LNAV guidance to the autopilot and flight

director should be re-engaged as quickly as possible.

(3) The flight crew member procedures and training must address the impact on navigation capability and flight guidance if the flight crew member initiates a go-around while the aircraft is in a turn. When initiating an early go-around, the flight crew members must ensure adherence to the published track unless ATC has issued a different clearance. The flight crew members should also be aware that RF legs are designed for a maximum ground speed. Initiating an early go-around at speeds higher than those considered in the design may cause the aircraft to diverge throughout the turn and require flight crew member intervention to maintain the path.

7.3.3 Contingency Procedures

(a) Operator contingency procedures must, as a minimum, incorporate the manufacturer contingency procedures.

(b) *Contingency procedures — failure while en route*. The aircraft RNP capability is dependent on operational aircraft equipment and GNSS. The flight crew members must be able to assess the impact of equipment failure or inadequate GNSS constellation configuration on the ability to conduct RNP AR APCH procedures, and take appropriate action.

(c) *Contingency procedures — failure on approach*. The operator's contingency procedures need to address at least the following conditions:

(1) Failure of the RNP system components, including those affecting lateral and vertical deviation performance (e.g. failures of a GPS sensor, the flight director or automatic pilot);

(2) Loss of navigation signal in-space (loss or degradation of external signal); and

(3) Identification of hazards and special procedures unique to a particular approach.

7.4 NAVIGATION DATABASE

7.4.1 General

The procedure stored in the navigation database defines the lateral and vertical path. Navigation database updates occur every 28 days, and the navigation data in every update are critical to the integrity of every RNP AR APCH procedure. Given the reduced obstacle clearance associated with these procedures, validation of navigation data warrants special consideration. This section provides guidance for the operator's procedures for validating the navigation data associated with RNP AR APCH procedures.

7.4.2 Data Process

(a) The operator must identify the responsible manager for the data updating process within their procedures.

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

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

7.4.2.1 Initial Data Validation

The operator must validate every RNP AR procedure before flying the procedure in instrument meteorological conditions (IMC) to ensure compatibility with their aircraft and to ensure the resulting path matches the published procedure.

As a minimum, the operator must:

(a) compare the navigation data for the procedure(s) to be loaded into the RNP system with the published procedure;

(b) validate the loaded navigation data for the procedure, either in a simulator or in the actual aircraft in visual meteorological conditions (VMC). The depicted procedure on the map display must be compared to the published procedure. The entire procedure must be flown to ensure the path does not have any apparent lateral or vertical path disconnects, and is consistent with the published procedure; and

(c) once the procedure is validated, retain and maintain a copy of the validated navigation data for comparison to subsequent data updates.

7.4.2.2 Data Updates

Upon receipt of each navigation data update, and before using the navigation data in the aircraft, the operator must compare the update to the validated procedure.

This comparison must identify and resolve any discrepancies in the navigation data. If there are significant changes (any change affecting the approach path or performance) to any portion of a procedure and source data verifies the changes, the operator must validate the amended procedure in accordance with initial data validation.

7.4.2.3 Data Supplier

Data suppliers must have an LOA for processing navigation data (e.g. FAA AC 20 153, EASA Conditions for the issuance of Letters of Acceptance for navigation database Suppliers by the Agency, or equivalent). An LOA recognizes the data supplier as one whose data quality, integrity and quality management practices are consistent with the criteria of DO-200A/ED-76. The operator's supplier (e.g. the FMS company) must have a Type 2 LOA, and their respective suppliers must have a Type 1 or 2 LOA.

7.4.2.4 Aircraft Modifications

If an aircraft system required for RNP AR APCH operations is modified (e.g. software change), the operator is responsible for validating of RNP AR APCH procedures using the navigation database and the modified system. This may be accomplished without any direct evaluation if the manufacturer verifies that the modification has no effect on the navigation database or path computation. If no such assurance from the manufacturer is available, the operator must conduct an initial data validation using the modified system noting that flight control computers, FMS OPS and display software changes are particularly critical.

7.5 RNP AR APCH TRAINING

7.5.1 General

The operator must provide training for flight crew members, dispatchers and maintenance personnel in RNP AR APCH procedures and concepts as they apply to the responsibilities of these personnel. Operators utilising third party service providers for dispatch and/or maintenance must ensure that those service providers are knowledgeable and capable in respect to RNP AR APCH requirements.

A thorough understanding of the operational procedures and best practices is critical to the safe operation of aircraft during RNP AR APCH operations. The flight crew member training must provide sufficient detail on the aircraft's navigation and flight control systems to enable the flight crew members to identify failures affecting the aircraft's RNP capability and the appropriate abnormal/emergency procedures. Training must include both knowledge and skill assessments of the flight crew members' and dispatchers' duties.

7.5.2 Ground Training Programme

The ground training syllabus must address the following subjects in an approved RNP AR APCH training programme during the initial introduction of an operator's personnel to RNP AR APCH operations:

(a) General Knowledge

(1) The definition of RNP AR APCH;

(2) The differences between RNAV and RNP;

(3) The types of RNP AR APCH procedures and familiarity with the chart depiction of these procedures;

(4) The importance of specific equipment during RNP AR APCH operations;

(5) The requirement for GNSS for all RNP AR APCH procedures;

(6) The RNP AR APCH regulatory requirements and procedures including any restrictions associated with the operations specification/specific approval (e.g. RF legs not authorised);

(7) The RNP AR APCH availability (considering aircraft equipment capabilities);

(b) ATC and Flight Planning

(1) The prefixes and suffixes to be used on flight plans;

(2) Any ATC procedures applicable to RNP AR APCH operations;

(3) The use of GPS RAIM (or equivalent) forecasts and the effects of RAIM availability on RNP AR APCH procedures;

(4) The use of WAAS NOTAMS if the aircraft avionics are WAAS capable;

(5) The impact of a failure of any avionics or a known loss of ground- or space- based systems on the remainder of the flight plan.

(c) Equipment and Procedures

(1) The RNP terminology, symbology, operation, optional controls, and display features including any items unique to an operator's implementation or systems;

(2) The description of failure alerts;

(3) The equipment used in RNP operations and any limitations on the use of the equipment during those operations;

(4) The Programming and displaying of RNP and aircraft specific displays (e.g. actual navigation performance (ANP display));

(5) How to enable and disable the navigation updating modes related to RNP;

(6) The navigation accuracy appropriate for different phases of flight, including RNP AR APCH procedures, and how to select the navigation accuracy, if required;

(7) When and how to terminate RNP navigation and transfer to traditional navigation due to the loss of RNP and/or required equipment;

(8) How to determine database currency and whether it contains the navigational data required for use of GNSS waypoints;

(9) An explanation of the different components that contribute to the total system error and their characteristics;

(10) *Temperature compensation* — flight crew members operating avionics systems with compensation for altimetry errors introduced by deviations from ISA may disregard the temperature limits on RNP AR APCH procedures if they have received approved training from the operator on the use of the temperature compensation function and the compensation function is utilised by the flight crew members. However, the training must also recognise that the temperature compensation by the system is applicable to the VNAV guidance and is not a substitute for the flight crew correcting, as required, for the cold temperature effects on minimum altitudes such as DA and MSA;

(11) The normal and abnormal flight crew operating procedures, responses to failure alerts, and any equipment limitations, including related information on RNP modes of operation;

(12) The contingency procedures for loss or degradation of RNP capability. The flight operations manuals approved for use by the flight crews (e.g. flight operations manual (FOM) or pilot operating handbook (POH)) should contain this information.

(d) MEL Operating Provisions

(1) The MEL requirements supporting RNP AR APCH operations.

7.5.3 Flight Training Programme

(a) Flight training programmes must cover the proper execution of RNP AR APCH procedures in concert with the OEM's documentation. The operational training must include;

(1) RNP AR APCH procedures and limitations;

(2) standardization of the set-up of the cockpit's electronic displays during an RNP AR APCH procedure;

(3) recognition of the aural advisories, alerts and other annunciations that can impact compliance with an RNP AR APCH procedure; and

(4) the timely and correct responses to loss of RNP AR APCH capability in a variety of scenarios, within the group of the RNP AR APCH procedures which the operator plans to use.

(b) This training must address the following specific elements:

(1) briefing all RNP AR APCH procedures and the important role cockpit resource management (CRM) plays in successfully completing an RNP AR APCH procedure;

(2) verifying that each pilot's altimeter has the current setting before beginning the final approach of an RNP AR APCH procedure, including any operational limitations associated with the source(s) for the altimeter setting, and the cross-checking of the altimeters approaching the FAF;

(3) using aircraft radar, TAWS, GPWS, or other avionics systems to support the flight crew member's track monitoring, and weather and obstacle avoidance;

(4) determining the source of positioning information, and confirming that GNSS has been given priority over all others (i.e. DME/DME, VOR/DME);

(5) confirming and correcting, as applicable, the required RNP accuracy value;

(6) recognising alerts associated with the loading and use of improper navigation accuracy data for a desired segment of an RNP AR APCH procedure;

(7) coupling the autopilot/flight director to the navigation system's lateral guidance on RNP AR APCH procedures requiring an RNP of less than RNP 0.3 nm;

(8) recognising the effect of wind on aircraft performance during RNP AR APCH procedures and the need to remain within RNP containment area, including any operational wind limitation and aircraft configuration essential to safely complete an RNP AR procedure;

(9) identifying any bank angle restrictions or operational limitations on RNP AR APCH procedures (e.g. temperature limitations);

(10) recognising the potentially detrimental effect on the ability to comply with an RNP AR APCH procedure when reducing the flap setting, reducing the bank angle or increasing airspeed;

(11) understanding that aircraft are expected to maintain the standard speeds associated with the applicable category and that RNP AR APCH aircraft category airspeeds associated with RF legs, as published in the above table are the most restrictive. Operators intending to conduct RNP AR APCH procedures designed to TERPS criteria must train flight crew members on the speed limits applicable to RF legs included in those procedures;

(12) understanding the relationship between RNP and the appropriate approach minima line on an approved published RNP AR APCH;

(13) Missed Approach

(i) responding to the loss of GNSS during a procedure;

(ii) identifying the events triggering a missed approach when using the aircraft's RNP capability;

(iii) recognising the effect of activating TOGA while in a turn;

(iv) monitoring of and the impact on go-around decision and operation;

(v) following flight crew contingency procedures for a loss of RNP capability during a missed approach. Due to the lack of navigation guidance, the training should emphasise the flight crew contingency actions that achieve separation from terrain and obstacles.

(14) Meet the evaluation requirements of section 7.5.4.

7.5.4 Evaluation Requirements

7.5.4.1 Initial Evaluation of RNP AR APCH Operations Knowledge and Procedures

The operator must evaluate each individual pilot's knowledge of RNP AR APCH procedures prior to employing RNP AR APCH procedures. As a minimum, the review must include a thorough evaluation of pilot procedures and specific aircraft performance requirements for RNP AR APCH operations.

An acceptable means for this initial assessment includes one of the following:

(a) an evaluation during a proficiency check (OPC) by an authorised instructor/evaluator, CAA Inspector or check-airman using an approved simulator or training device;

(b) an evaluation by an authorised instructor/evaluator, CAA Inspector or check-airman during line operations, training flights, practical tests events, operating experience, route checks, and/or line checks; or

(c) LOFT/LOE programmes using an approved simulator that incorporates RNP operations that employ the unique RNP AR APCH characteristics (i.e. RF legs, RNP missed approach) of the operator's approved procedures.

Note: Evidence of the evaluation must be submitted as supporting documentation for all operators.

7.5.4.2 Evaluation Content

Specific elements that must be addressed in this evaluation module are:

(a) demonstrate the use of any RNP limits that may impact various RNP AR APCH procedures;

(b) demonstrate the application of radio-updating procedures, such as enabling and disabling ground-based radio updating of the FMC (i.e. DME/DME and VOR/DME updating) and knowledge of when to use this feature. If the aircraft's avionics do not include the capability to disable radio updating, then the training must ensure the pilot is able to accomplish the operational actions that mitigate the lack of this feature;

(c) demonstrate the ability to monitor the actual lateral and vertical flight paths relative to the programmed flight path and complete the appropriate flight crew procedures when exceeding a lateral or vertical FTE limit;

(d) demonstrate the ability to read and adapt to a RAIM (or equivalent) forecast, including forecasts predicting a lack of RAIM availability;

(e) demonstrate the proper set-up of the FMC, the weather radar, TAWS, and moving map for the various RNP AR APCH operations and scenarios the operator plans to implement;

(f) demonstrate the use of pilot briefings and checklists for RNP AR APCH operations, as appropriate, with emphasis on CRM;

(g) demonstrate knowledge of and ability to perform an RNP AR APCH missed approach procedure in a variety of operational scenarios (e.g. loss of navigation or failure to acquire visual conditions);

(h) demonstrate speed control during segments requiring speed restrictions to ensure compliance with an RNP AR APCH procedures;

(i) demonstrate competent use of RNP AR APCH procedure plates, briefing cards, and checklists;

(j) demonstrate the ability to complete a stable RNP AR APCH operation including bank angle, speed control, and remain on the procedure's centre line; and

(k) knowledge of the operational limit for deviation below the desired flight path on an RNP AR APCH procedure and how to accurately monitor the aircraft's position relative to the vertical flight path.

7.5.5 Recurrent Training/Evaluation

(a) Recurrent training for RNP AR APCH must occur at least every 12 months (e.g. during the OPC). The operator should incorporate recurrent RNP training that employs the unique RNP AR approach characteristics of the operator's approved procedures (i.e. RF legs, RNP missed approach) as part of the overall programme.

(b) A minimum of two RNP AR APCHs must be flown by each pilot (pilot flying and pilot monitoring), with one culminating in a landing and one culminating in a missed approach.

(c) Recurrent evaluation or check for RNP AR APCH should occur during or following each training event where training for RNP AR APCH was conducted, and may be conducted by an authorised instructor/evaluator, CAA Inspector or check-airman, as applicable.

7.6 APPLICATION FOR RNP AR APCH

7.6.1 Process

All operators must submit evidence of navigation performance capability with their application.

The application (refer Form SM 04 or Form SM 04A, as applicable) must address all of the sections on equipment, operational requirements, including documentation and training. General Aviation operators shall sign the "Declaration of Compliance" indicating all equipment, operational requirements, documentation and training meet the requirements for RNP AR APCH approval.

However GA operators must submit evidence of the evaluation required by section 7.5.4.

The CAA may, upon request, require a review of General Aviation operator procedures.

Commercial Air Transport operators shall submit documentary evidence of the required information in the application form.

7.6.2 Approval

The RNP AR APCH approval will be issued on a Specific Approval Certificate for General Aviation operators, a copy of which must be carried in the aircraft for all flights expected to be conducted in that airspace.

The RNP AR APCH approval will be granted by inclusion in the Operations Specifications of the AOC holder.

7.7 RNP AR APCH MONITORING PROGRAMME

(a) Operators must have an RNP monitoring programme to ensure continued compliance with the guidance of this CAP and to identify any negative trends in performance. Operators must collect and periodically review these data items to identify potential safety concerns:

(1) total number of RNP AR APCH procedures conducted;

(2) number of satisfactory approaches by aircraft/system (satisfactory if completed as planned without any navigation or guidance system anomalies);

(3) reasons for unsatisfactory approaches, such as:

(i) UNABLE REQ NAV PERF, NAV ACCUR DOWNGRAD, or other RNP messages during approaches;

(ii) excessive lateral or vertical deviation;

(iii) TAWS warning;

(iv) autopilot system disconnect;

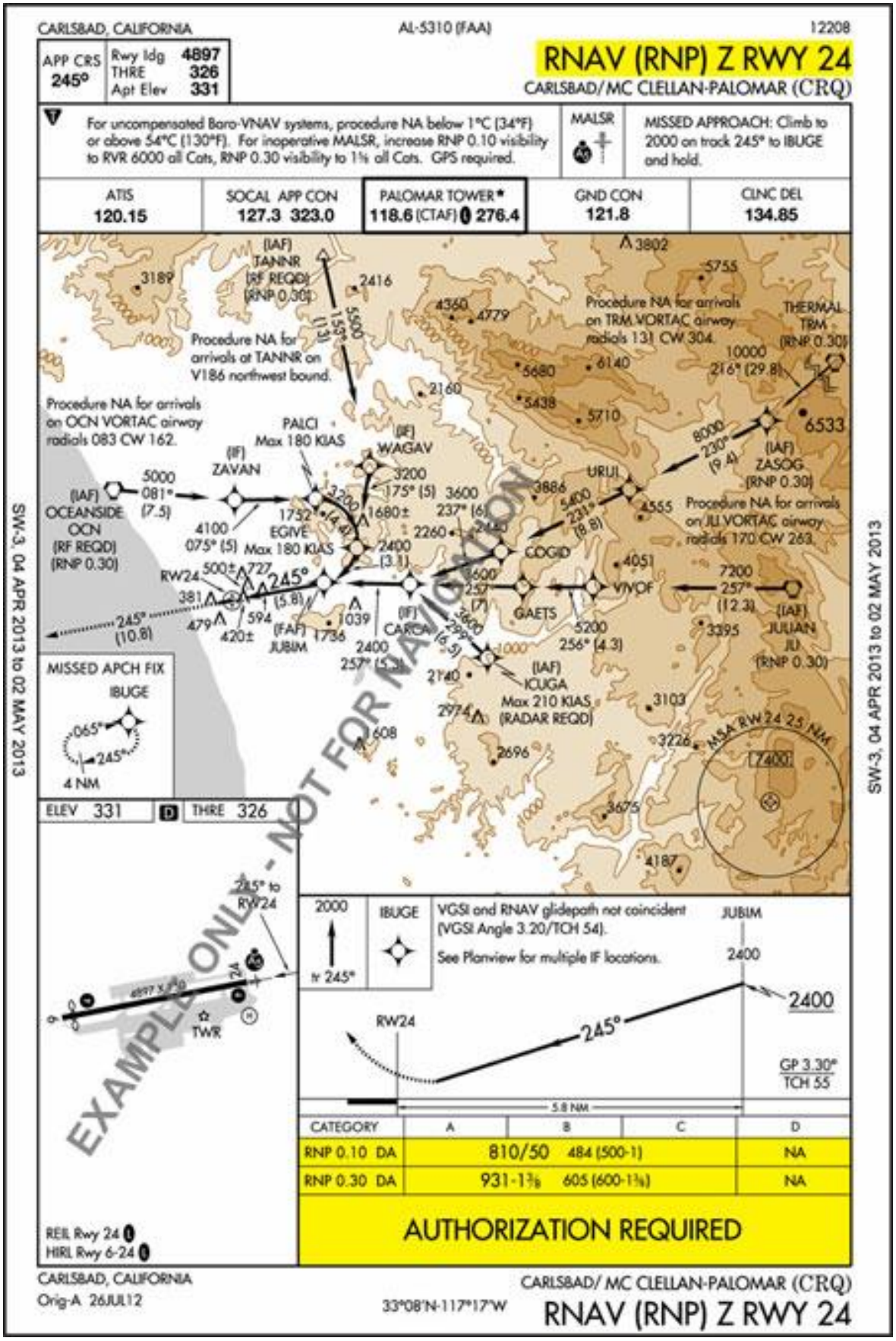
(v) navigation data errors; and

(vi) pilot report of any anomaly.

(b) Crew comments

ATTACHMENT 1 TO CHAPTER 7

EXAMPLE OF RNP AR APCH APPROACH CHART



CHAPTER 8

NORTH ATLANTIC HIGH LEVEL AIRSPACE (NAT HLA)

8.1 INTRODUCTION

All San Marino registered aircraft planning to operate within the North Atlantic High Level Airspace NAT HLA (previously known as MNPS) shall be required to obtain an approval from the CAA before the commencement of operations. As there is Reduced Vertical Separation Airspace (RVSM) airspace within NAT HLA, operators must also hold a RVSM approval as well.

Note: At least RNP/RNAV 10 approval is required. Please refer to Chapter 2.

8.1.2 References

(a) ICAO Annexes, PANS/RAC (Doc. 4444)

(b) ICAO Regional Supplementary Procedures (Doc. 7030)

(c) Relevant State AIP's

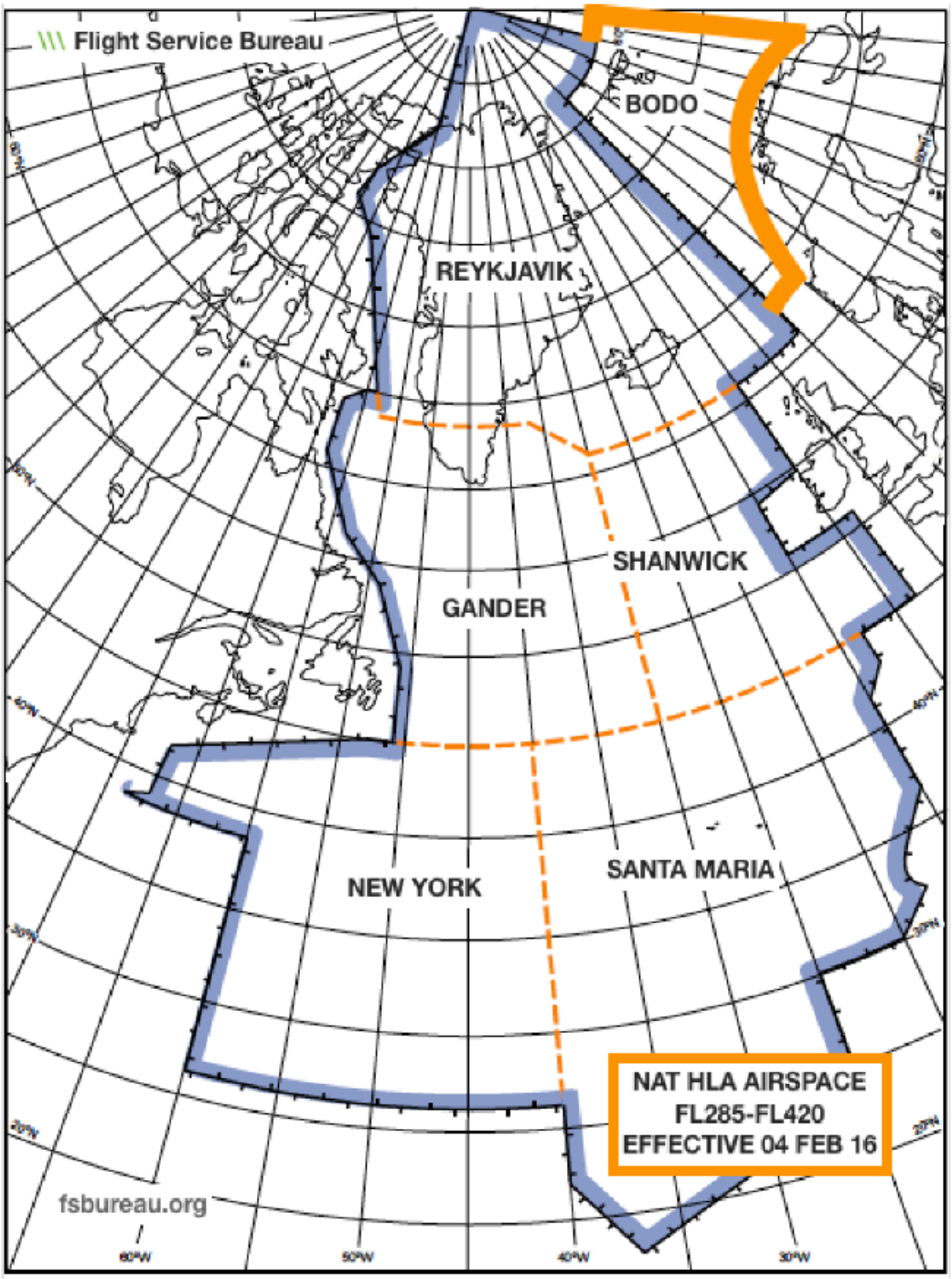
(d) North Atlantic NAT Doc 007 (primary reference).

8.1.3 NAT HLA Defined Area

NAT HLA vertical dimension airspace is that portion of the North Atlantic airspace between FL290 and FL410 inclusive. The lateral dimensions include the following Control Areas (CTAs): REYKJAVIK, SHANWICK, GANDER and SANTA MARIA OCEANIC plus the portion of NEW YORK OCEANIC which is North of 27N but excluding the area which is west of 60°W & south of 38°30'N

With effect from 5 June 2008 the previous West Atlantic Route System (WATRS) together with the Atlantic portion of Miami Oceanic Airspace and the San Juan FIR has been designated "WATRS Plus Airspace". RNAV/RNP 10 or RNP 4 approval is required in order for NAT HLA approved aircraft to benefit from the 50 nm minimum lateral separation.

Bodo Oceanic was added in 2016 (refer overleaf).



8.2 NAT HLA AIRSPACE ACCURACY REQUIREMENTS

8.2.1 Navigation

Aircraft conducting flights within the volume of airspace specified shall have a navigation performance capability such that;

(a) The standard deviation of later track errors shall be less than 6.3 NM (11.7 km). This can be interpreted as a need for aircraft to remain within 12.6 NM (23 km) off track for 95% of the time (RNP 12.6). The present RNAV/RNP 10 meets this.

Note: Under the ICAO PBN concept this will become RNAV 10 and possibly RNP 4 in designated airspace with associated ADS-C and CPDLC functionalities.

(b) The proportion of the total flight time spent by aircraft between 30 NM (55.6 km) off the cleared track shall be less than one hour per 2000 flight hours.

(c) The portion of the total flight time spent by aircraft between 50 and 70 NM (92.6 and 129.6 km) off the cleared track shall be less than one hour per 8000 flight hours.

(d) A RNP 10 approval issued by the San Marino CAA as the State of Registry.

(e) A RNP 4 approval issued by the CAA is required for the use of RLAT Tracks (Half-tracks) as well as CPDLC and ADS-C.

8.2.2 Altimetry

The separation requirements are 1000 ft (305 metres) vertical to FL 290 and 2000 ft (610 metres) vertical above FL 290 in opposite directions. Where RVSM airspace is in force, the altimetry and level keeping accuracy requirements apply. Operators must hold a RVSM approval issued by the San Marino CAA as the State of Registry.

8.2.3 Communications

Operators must carry the required communication equipment for NAT HLA airspace although the requirements vary with different FIRs within NAT HLA airspace. Generally the requirement is for the carriage of fully serviceable/redundant HF communications equipment although SATCOM voice may also be used with only one HF if relief is available under the MEL. Pilots electing to use SATCOM voice as an alternative to HF voice communications remain responsible for operating SELCAL or maintaining a listening watch on the assigned HF frequency.

Datalink communications are gradually being introduced into the NAT HLA airspace environment for position reporting (via FANS 1/A ADS & CPDLC and through ACARS).

8.3 OPERATIONAL PROCEDURES

8.3.1 Before Flight Phase

During the before flight phase the flight crew should pay particular attention to conditions that may affect operation in NAT HLA airspace. These include, but may not be limited to:

(a) Verifying that the aircraft equipment is approved for NAT HLA operations;

(b) Reported and forecast weather on the route of flight;

(c) Minimum equipment (MEL) requirements pertaining to track keeping systems;

(d) If required for the specific aircraft group, accounting for any aircraft operating restriction related to NAT HLA airworthiness approval;

(e) The use of the letter "X" (for NAT HLA) and "W" (for RVSM) in item 10.

(f) The use of the following in item 10a

(1) "J5" to indicate CPDLC FANS1/A SATCOM (Inmarsat) or "J7" to indicate CPDLC FANS1/A SATCOM (Iridium) data link equipment;

(2) "P2" to indicate RCP 240 approval;

(g) The use of the following in item 10b

(1) "D1" to indicate ADS with FANS1/A capabilities; and

(2) "B1" or "B2" to indicate ADS-B approval;

Note: Any NAT HLA aircraft intending to also fly in the West Atlantic Route System (WATRS Plus) airspace should ensure that its RNP Approval status is included in the Flight Plan. Specifically such operators should:

(a) Annotate ICAO Flight Plan Item 10 (Equipment) with the letters "R" and "Z", and

(b) Annotate Item 18 (Other Information) with, as appropriate, "NAV/RNP10" or "NAV/RNP4" or "L1" for RNP4 and RSP 180.

8.3.2 En-route Procedures

Operating procedures contained in the Operations Manual must contain relevant guidance information for in-flight procedures.

Contingency procedures for equipment failure and navigation inaccuracies prior to, and after entry, must be addressed.

Note: Details of specific contingency procedures for each area or route can be found in the Route Guide (e.g. Jeppesen Manual).

8.3.3 Post Flight Procedures

Pilots should log the navigation accuracy at the completion of a flight. In making technical entries for a malfunction or inaccuracy in a track keeping system, the pilot should provide sufficient detail to enable an effective and timely repair.

8.4 TRAINING REQUIREMENTS

All operators must receive formal training on NAT HLA procedures. Recurrent training is required on an annual basis and the items detailed below should be incorporated into training programmes and operating procedures.

(a) Knowledge, understanding and compliance of standard ATC phraseology and track messages used in each area of operations;

(b) NAT HLA procedures;

(c) Changes to charting and documents to reflect NAT HLA;

(d) Navigation equipment required to be operational for flight in designated NAT HLA, limitations associated with the RNAV equipment;

(e) Flight planning requirements;

(f) Entry, in-flight and exit requirements and procedures;

(g) Contingency procedures for system failures or navigation inaccuracies;

(h) Position error log and notification requirements; and

(i) Operations Manual information and procedures.

8.5 APPLICATION FOR NAT HLA

8.5.1 Process

The application (refer Form SM 04 or Form SM 04A, as applicable) must address all of the sections on equipment, operational requirements, including documentation and training. General Aviation operators shall sign the "Declaration of Compliance" indicating all equipment, operational requirements, documentation and training meet the requirements for NAT HLA approval.

Commercial Air Transport operators shall submit documentary evidence of the required information in the application form.

8.5.2 Airworthiness Issues

An operator is required to hold an RNAV/RNP 10 and RVSM approval from the CAA. Please refer to the applicable Sections of this CAP for the application process, which includes equipment and airworthiness issues.

8.5.3 Operational Requirements

To be eligible for a NAT HLA approval from the CAA, the following operational issues need to be addressed by the operator:

(a) Operating procedures (SOPs including Contingency Procedures);

(b) FCOM & Quick Reference Handbook changes (if applicable);

(c) Minimum Equipment List (MEL) as required by the applicable equipment;

(d) Training programmes;

(e) Provision of flight planning information for designated area (e.g. NOTAMs, AIP etc.); and

(f) Data base and software integrity for the PBN.

8.5.4 Approval

The NAT HLA approval will be issued on a Specific Approval Certificate for General Aviation operators, a copy of which must be carried in the aircraft for all flights expected to be conducted in that airspace.

The NAT HLA approval will be granted by inclusion in the Operations Specifications of the AOC holder.

CHAPTER 9

RVSM

9. INTRODUCTION

9.1 GENERAL

9.1.1 Purpose

This guidance material is intended for all operators of San Marino registered aircraft planning to operate in Reduced Vertical Separation Minima (RVSM) airspace. This Chapter provides information on the implementation plan, required equipment, the approval process, as well as guidance on operational procedures and training. All San Marino registered aircraft planning to operate in RVSM airspace shall be required to obtain an approval from the CAA before the commencement of operations. Operators must be aware that airspace restrictions and operational penalties may be incurred if the aircraft is not approved for operations in RVSM airspace**.**

9.1.2 General

Airspace where RVSM is applied should be considered special qualification airspace. The specific aircraft type or types that the operator intends to use will need to be approved by the CAA before the operator conducts flight in RVSM airspace.

9.1.3 References

(a) Federal Aviation Administration (FAA)

(1) AC 91-85 – RVSM –Approval of Operators/Aircraft for RVSM Operations.

(b) International Civil Aviation Organisation (ICAO)

(1) ICAO Doc. 9574 – Manual on the Implementation of a 300 m (1000 ft) Vertical Separation Minimum Between FL 290 – FL 410 Inclusive.

(2) ICAO Doc. 7030/4 – Regional Supplementary Procedures (for appropriate region) contain operational and contingency procedures unique to the regional airspace concerned, specific flight planning requirements, and the approval requirements for aircraft in the designated region.

(c) Joint Aviation Authorities (JAA)

(1) JAA TGL 6 – Guidance Material on the Approval of Aircraft and Operators for flight in Airspace above Flight Level 290 where a 300 m (1000 ft) Vertical Separation Minimum is applied.

9.2 AIRCRAFT EQUIPMENT FOR RVSM OPERATIONS

The minimum equipment fit should be:

(a) Two independent altitude measurement systems. Each system should be composed of the following elements:

(1) Cross-coupled static source/system, provided with ice protection if located in areas subject to ice accretion;

(2) Equipment for measuring static pressure sensed by the static source, converting it to pressure altitude and displaying the pressure altitude to the flight crew;

(3) Equipment for providing a digitally coded signal corresponding to the displayed pressure altitude, for automatic altitude reporting purposes;

(4) Static source error correction (SSEC), if needed to meet performance requirements; and

(5) The equipment fit should provide reference signals for automatic control and alerting at a selected altitude. These signals should preferably be derived from an altitude measurement system.

(b) One SSR altitude reporting transponder. If only one is fitted, it should have the capability for switching to operate from either altitude measurement system;

(c) An altitude alert system, the threshold being $\pm$ 90 m (300 ft);

(d) An automatic altitude control system, indicating to the flight crew the flight level being flown and maintenance of a selected flight level.

9.3 OPERATIONAL PROCEDURES

9.3.1 Flight Planning

During flight planning the flight crew and the dispatcher should pay particular attention to conditions that may affect operation in RVSM airspace. These include, but may not be limited to:

(a) Verifying that the airframe is approved for RVSM operations;

(b) Reported and forecast weather on the route of flight;

(c) Minimum equipment requirements pertaining to height-keeping systems;

(d) Any airframe or operating restriction related to RVSM approval;

(e) Ensuring that **"W"** is stated in item 10 of the ATC flight plan to indicate RVSM approval.

9.3.2 Pre-flight Procedures

The following actions should be accomplished by flight crew during the pre-flight procedure:

(a) Review technical logs and forms to determine the condition of equipment required for flight in the RVSM airspace. Ensure that maintenance action has been taken to correct defects to required equipment;

(b) During the external inspection of aircraft, particular attention should be paid to the condition of static sources and the condition of the fuselage skin near each static source and any other component that affects altimetry system accuracy. This check may be accomplished by a qualified and authorised person other than the pilot (e.g., a flight engineer or ground engineer);

(c) Before take-off, the aircraft altimeters should be set to the QNH of the airfield and should display a known altitude, within the limits specified in the aircraft operating manuals. The two primary altimeters should also agree within limits specified by the aircraft operating manual.

Note: The maximum value for these checks cited in operating manuals should not exceed 75 ft.

(d) Before take-off, equipment required for flight in RVSM airspace should be operative, and any indications of malfunction should be resolved.

9.3.3 Procedures Prior to RVSM Airspace Entry

The following equipment should be operating normally at entry into RVSM airspace:

(a) Two primary altitude measurement systems;

(b) One automatic altitude-control system;

(c) One altitude-alerting device;

(d) Operating Transponder (subject to operational area requirements).

Note: Should any of the required equipment fail prior to the aircraft entering RVSM airspace, the pilot should request a new clearance to avoid entering this airspace.

9.3.4 In-flight Procedures

The following practices should be incorporated into flight crew training and procedures:

(a) Flight crews must comply with any aircraft operating restrictions, if required for the specific aircraft group, given in the RVSM airworthiness approval;

(b) Emphasis should be placed on promptly setting the sub-scale on all primary and standby altimeters to 1013.2 (hPa) when passing the transition altitude, and rechecking for proper altimeter setting when reaching the initial cleared flight level;

(c) In level cruise it is essential that the aircraft is flown at the cleared flight level. This requires that particular care is taken to ensure that ATC clearances are fully understood and followed. The aircraft should not intentionally depart from the cleared flight level without a positive clearance from ATC unless the crew is conducting contingency or emergency manoeuvres;

(d) When changing levels, the aircraft should not be allowed to overshoot or undershoot the cleared flight level by more than 150 ft (45 m);

Note: It is recommended that the level off be accomplished using the altitude capture feature of the automatic altitude-control system, if installed.

(e) An automatic altitude-control system should be operative and engaged during level cruise, except when circumstances such as the need to re-trim the aircraft or turbulence require disengagement. In any event, adherence to cruise altitude should be done by reference to one of the two primary altimeters;

(f) Ensure that the altitude-alerting system is operative;

(g) At intervals of approximately one hour, cross-checks between the primary altimeters should be made. A minimum of two must agree within ±200 ft (±60 m). Failure to meet this condition will require that the altimetry system be reported as defective and notified to ATC:

(1) The usual scan of flight deck instruments should suffice for altimeter cross-checking on most flights;

(2) Before entering oceanic RVSM airspace, the initial altimeter cross-check of primary and standby altimeters should be recorded.

Note: Future systems may make use of automatic altimeter comparators.

(h) In normal operations, the altimetry system being used to control the aircraft should be selected for the input to the altitude reporting transponder transmitting information to ATC;

(i) If the pilot is advised in real time that the aircraft has been identified by a height-monitoring system as exhibiting a Total Vertical Error greater than ± 300 ft (± 90 m) and/or an ASE greater than ± 245 ft (± 75 m) then the pilot should follow established regional procedures to protect the safe operation of the aircraft. This assumes that the monitoring system will identify the Total Vertical Error or Altimetry System Error within the set limits for accuracy;

(j) If the pilot is notified by ATC of an Assigned Altitude Deviation error which exceeds ±300 ft (±90 m) then the pilot should take action to return to the cleared flight level as quickly as possible.

9.3.5 Contingency procedures after entering RVSM airspace

(a) **Notification**

The pilot should notify ATC of contingencies, such as equipment failures, system inaccuracies and severe turbulence, which affect the ability to maintain the cleared flight level, and co-ordinate a plan of action. If unable to contact ATC and obtain an ATC clearance prior to deviating from the cleared flight level, the pilot should follow established contingency procedures as defined by the region of operation and obtain ATC clearance as soon as possible.

(b) **Notification of Equipment Failures**

The types of equipment failures, which should be notified to ATC, are:

(1) Failure of all automatic altitude-keeping devices;

(2) Loss of redundancy of all, or part of, altimetry systems;

(3) Failure of all altitude reporting transponders;

(4) Loss of thrust on an engine necessitating descent;

(5) Any other equipment failure affecting the ability to maintain the cleared Flight Level.

(c) **Post Flight**

In making technical log entries against malfunctions in height-keeping systems, the pilot should provide sufficient detail to enable maintenance to effectively trouble shoot and repair the system. The pilot should detail the actual defect and the crew action taken to try to isolate and rectify the fault. The following information should be noted when appropriate:

(1) Primary and standby altimeter readings;

(2) Altitude selector setting;

(3) Subscale setting on altimeter;

(4) Autopilot used to control the aeroplane and any differences when the alternate system was selected;

(5) Differences in altimeter readings, if alternate static ports selected;

(6) Use of air data computer selector for fault diagnosis procedure;

(7) The transponder selected to provide altitude information to ATC and any difference noted when an alternative transponder was manually selected.

9.4 TRAINING REQUIREMENTS

The following items should be standardised and incorporated into training programmes and operating practices and procedures. This document is written for all users of RVSM airspace, and as such is designed to present all required actions. All operators should refer to the applicable ICAO Doc 7030/4 to ensure appropriate regional supplementary procedures are addressed in the Operations Manual and training programmes.

In addition to the operating procedures in Section 9.3, the following items should also be included in flight crew training programmes:

(a) Knowledge and understanding of standard ATC phraseology used in each area of operations;

(b) Importance of crew members cross checking to ensure that ATC clearances are promptly and correctly complied with;

(c) Use and limitations in terms of accuracy of standby altimeters in contingencies. Where applicable, the pilot should review the application of static source error and pressure error correction through the use of correction cards;

(d) Problems of visual perception of other aircraft at 1,000 ft (300 m) planned separation during darkness, when encountering local phenomena such as northern lights, for opposite and same direction traffic, and during turns;

(e) Characteristics of aircraft altitude capture systems, which may lead to flight level overshoots.

(f) Relationship between the aircraft's altimetry, automatic altitude control and transponder systems in normal and abnormal conditions.

(g) Any airframe operating restrictions, if required for the specific aircraft group, related to RVSM airworthiness approval.

(h) Use of TCAS in RVSM airspace.

(i) Effect of wake turbulence.

9.5 APPLICATION PROCESS

9.5.1 General

An application may be submitted electronically and allow sufficient lead time to obtain height accuracy confirmation. The approval process involves three separate processes;

(a) the CAA determines the airworthiness requirements and if satisfied makes the aircraft eligible for height monitoring;

(b) the CAA then notifies the appropriate Regional Monitoring Agency (RMA) that the aircraft is eligible for height monitoring;

(c) Once the RMA has confirmed the height accuracy, the CAA will issue an approval.

[Note: Refer to para 9.5.4 for height monitoring requirements for group and non-group aircraft.]

9.5.2 Process

All operators must submit evidence of altimetry performance capability with their application.

The application (refer Form SM 04 or Form SM 04A, as applicable) must address all of the sections on equipment, operational requirements, including documentation and training. General Aviation operators shall sign the "Declaration of Compliance" indicating all equipment, operational requirements, documentation and training meet the requirements for RVSM approval.

Commercial Air Transport operators shall submit documentary evidence of the required information in the application form.

9.5.3 Airworthiness Issues

The components of a RVSM capable aircraft are usually installed at manufacture of a new generation aircraft and the manufacturer includes statements as to altimetry performance capability in the Aircraft Flight Manual, an AFM Supplement or STC.

Unless the approved MEL already addresses the required equipment, an amendment to the MEL should be submitted to the CAA for approval.

It is up to the operator to determine that the maintenance organisation used is capable of providing maintenance support for altimetry equipment.

9.5.4 Over flight Assessment

9.5.4.1 Group Aircraft

[Aircraft are considered to belong to the same group if they are designed and assembled by one manufacturer and are of nominally identical design and build with respect to all details which could influence the accuracy of height-keeping performance.

ICAO, FAA and Eurocontrol publish a list of aircraft which may be used by the CAA to determine if an aircraft may be classified as a group aircraft for RVSM over flight assessment purposes. For the latest list enter "RVSM Monitoring Groups And Minimum Monitoring Requirements" in a search engine.

An initial over flight assessment is not a prerequisite for "group aircraft" but it is for "non-group aircraft".

9.5.4.2 Non-group aircraft

Operators of non-group aircraft must apply on an individual aircraft basis and monitoring by an HMU/GMU or ADS-B is a pre-requisite to obtain RVSM (operational) approval.

Once the aircraft has successfully conducted an over flight assessment, there is no requirement for further assessments unless there is a change to the required aircraft equipment. A successful over flight assessment conducted by a RMA is acceptable for all RMAs.

After the CAA has granted airworthiness approval, operators of non-group aircraft should take steps to either overfly the Height Monitoring Unit (HMU) near the following locations;

- Strumble, UK
- Linz, Austria
- Nattenheim, Germany
- Geneva, Switzerland

These systems are fully automatic and designed to operate 24 hours a day, 365 days of the year. However, the operator is advised to confirm the serviceability of the HMUs before conducting a dedicated height monitoring flight.

Other method is to arrange with a Regional Monitoring Agency for ADS-B monitoring or GPS monitoring involving the carriage of a global positioning system (GPS) monitoring unit (GMU). If monitoring occurs before the CAA has informed the appropriate RMA, the accrued data may still be used provided that it is dated after the modification/inspection was completed.

Any monitoring conducted by a RMA is acceptable to the CAA and to other RMAs. Operators can consult the ARINC Bulletin Board, EUROCONTROL or the appropriate RMA to ascertain if its aircraft have been monitored and acceptable performance has been demonstrated.

The application form for monitoring can be obtained from the applicable RMA website.

- North Atlantic Central Monitoring Agency (NATCMA)
- Australian Airspace Monitoring Agency (AAMA)
- Africa and Indian Ocean (AFI) Regional Monitoring Agency (ARMA)
- Monitoring Agency For Asia Region (MAAR)
- China Regional Monitoring Agency (China RMA)
- Regional Monitoring Agency EURASIA
- European Regional Monitoring Agency (EURRMA)

- Japan Airspace Safety Monitoring Agency (JASMA)
- Middle East Regional Monitoring Agency (MIDRMA)
- North American Approvals Registry and Monitoring Organization (NAARMO)
- Pacific Approvals Registry and Monitoring Organization (PARMO)
- Caribbean and South American Monitoring Agency (CARSAMMA)
- South Atlantic Monitoring Agency (SATMA)

9.5.5 Periodic Monitoring

It is a CAA requirement that those operators who have already obtained Operational approval will have to perform RVSM HMU/GMU/ADS-B height monitoring under a periodic monitoring programme. Every operator is required to ensure that a minimum of two aeroplanes of each aircraft type grouping of the operator have their height keeping performance monitored, at least once every two years or within intervals of 1000 flight hours per aeroplane, whichever period is longer. If an operator aircraft type grouping consists of a single aeroplane, monitoring of that aeroplane shall be accomplished within the specified period.]

9.5.6 Approval

The RVSM approval will be issued on a Specific Approval Certificate for General Aviation operators, a copy of which must be carried in the aircraft for all flights expected to be conducted in that airspace.

The RVSM approval will be granted by inclusion in the Operations Specifications of the AOC holder.

9.6 OVERSIGHT

9.6.1 CAA Action

The CAA has a mechanism for receiving the reports of height-keeping performance issued by the monitoring agencies established.

Any San Marino operator reported to be operating in RVSM airspace without approval could face administrative penalties.

Any aircraft with faulty equipment or operating incorrectly could jeopardise the safety of other users of the airspace. An operator that consistently incurs equipment or operational errors may be required to forfeit authority for RVSM operations.

The CAA may consider revoking RVSM operational approval if the operator response to a height-keeping error is not effective or timely. The CAA will also consider the operator's past performance record in determining the action to be taken. If an operator shows a history of operational and/or airworthiness errors, then approval may be revoked until the root causes of these errors are shown to be eliminated and RVSM programmes and procedures effective.

Should a RVSM approval be withdrawn, advice shall be sent to the appropriate RMA.

Following any rectification work the operator would again be expected to demonstrate compliance with the RVSM requirements for monitoring by an independent height monitoring system.

9.6.2 Operator Responsibility

As part of their Safety Management System, all operators should conduct their own continuing surveillance and reporting action as described in Section 1.6.1.