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PBN Aeronautical Charts and Procedure Design

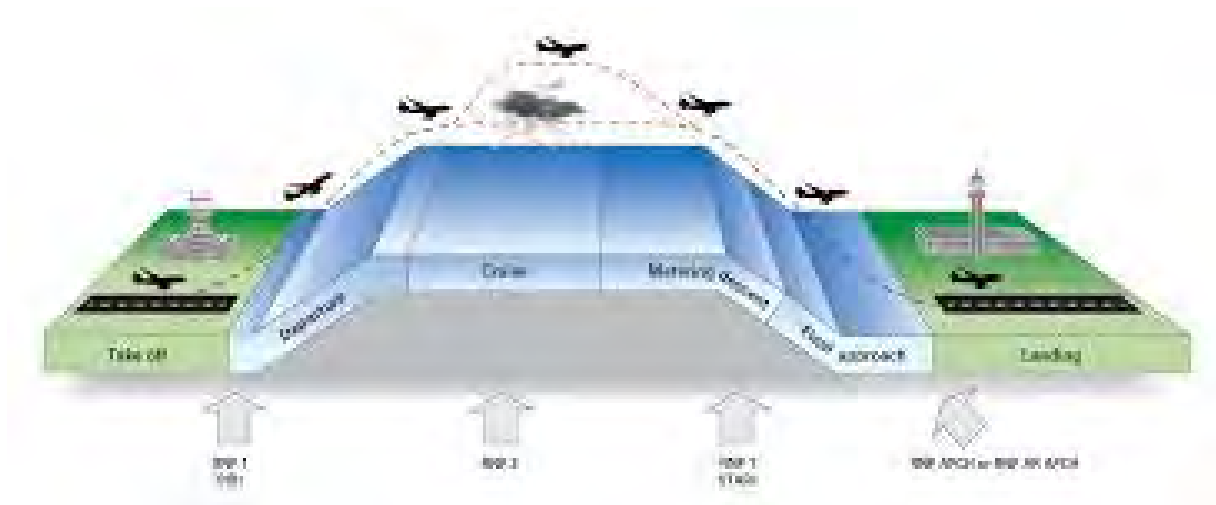
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- rmartinez@icao.int

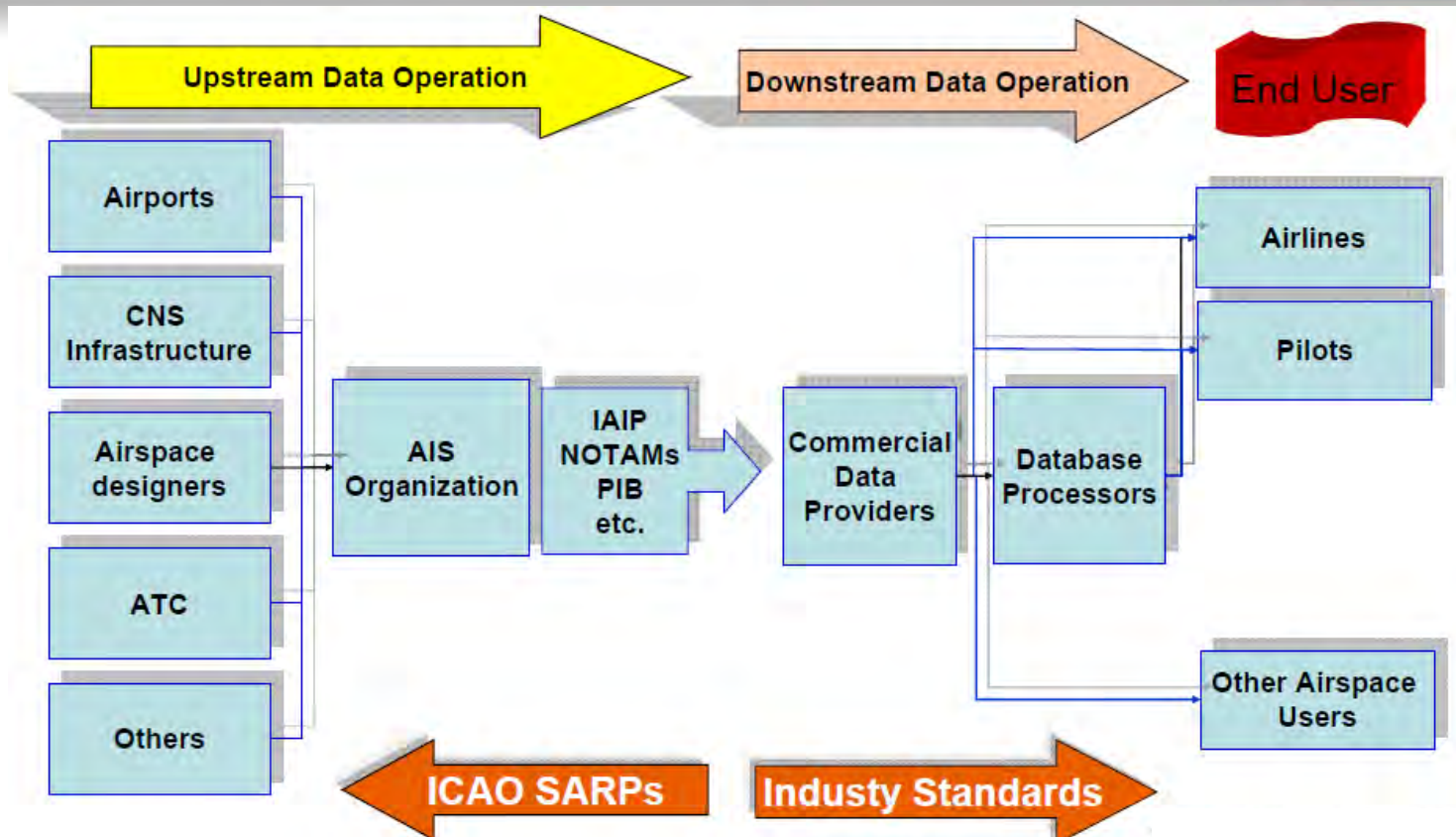
ICAO NACC
05 May 2015

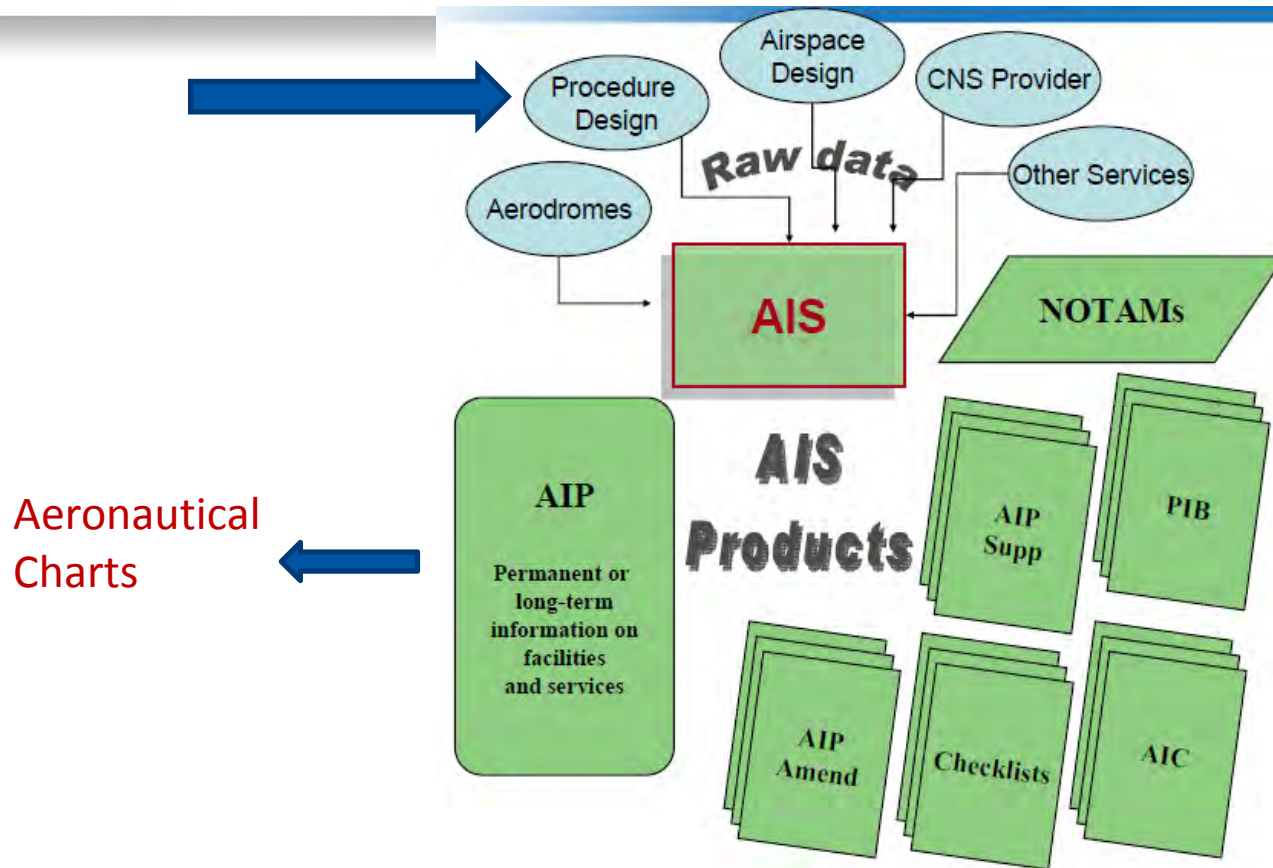


Topics

1. AIS/AIM
2. Data flow
3. ICAO PBN Documents
4. Procedures design
5. PBN Aeronautical Charts



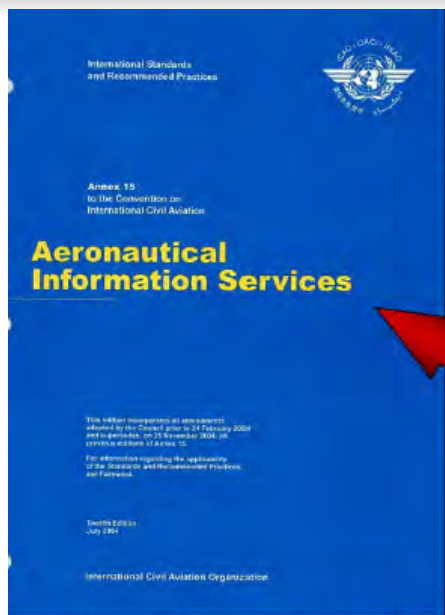






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Key elements of DO-201A incorporated in ICAO Annex 15, Aeronautical Information Services



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- CHAPTER 5. Aerodrome Terrain and Obstacle Chart — ICAO (Electronic)
- CHAPTER 6. Precision Approach Terrain Chart — ICAO
- CHAPTER 7. Enroute Chart — ICAO
- CHAPTER 8. Area Chart — ICAO
- CHAPTER 9. Standard Departure Chart — Instrument (SID) — ICAO
- CHAPTER 10. Standard Arrival Chart — Instrument (STAR) — ICAO
- CHAPTER 11. Instrument Approach Chart — ICAO
- CHAPTER 12. Visual Approach Chart — ICAO
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- CHAPTER 15. Aircraft Parking/Docking Chart — ICAO
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- CHAPTER 17. Aeronautical Chart — ICAO 1:500 000
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- CHAPTER 19. Plotting Chart — ICAO
- CHAPTER 20. Electronic Aeronautical Chart Display — ICAO
- CHAPTER 21. ATC Surveillance Minimum Altitude Chart — ICAO

International Standards
and Recommended Practices



Annex 4
to the Convention on
International Civil Aviation

Aeronautical Charts

This edition incorporates all amendments adopted by the Council prior to 5 March 2009 and supersedes, on 19 November 2009, all previous editions of Annex 4.

For information regarding the applicability of Standards and Recommended Practices, see Chapter 1 and the Foreword.

Eleventh Edition
July 2009

International Civil Aviation Organization



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Appendix A. Example outline of a State transition plan

Appendix B. Extract from Amendment 6 to PANS-OPS (Doc 8168), Volume II, regarding chart identification

Appendix C. Hazard log — RNAV to RNP approach chart identification

Cir 336
AN/195



Area Navigation (RNAV) to Required Navigation Performance (RNP) Instrument Approach Chart Depiction

Approved by the Secretary General
and published under his authority



INSTRUMENT APPROACH CHART - ICAO		AERODROME ELEV 30 m HEIGHTS RELATED TO THR RWY 27L - ELEV 20 m	APP 119.1 TWR 118.1	DONLON/Intl (EADD) RNAV RWY 27L
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RNP APCH

INSTRUMENT APPROACH CHART - ICAO	SBAS Ch 40123 W27A	AERODROME ELEV 30 m HEIGHTS RELATED TO THR RWY 27L - ELEV 20 m	APP 119.1 TWR 118.1	DONLON/Intl (EADD) RNAV Z RWY 27L (LPV ONLY)
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RNP APCH

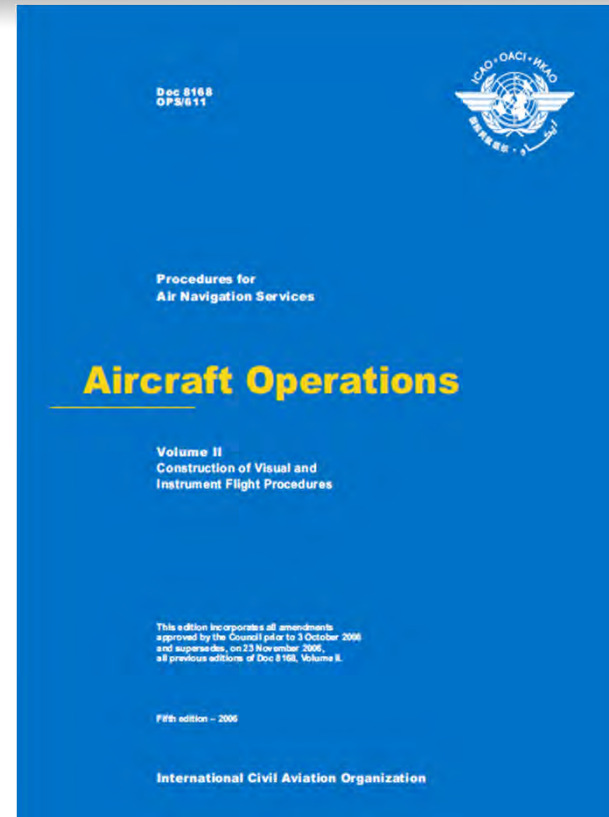
INSTRUMENT APPROACH CHART - ICAO		AERODROME ELEV 30 m HEIGHTS RELATED TO THR RWY 27L - ELEV 20 m	APP 119.1 TWR 118.1	DONLON/Intl (EADD) RNAV X RWY 27L (AR)
---	--	---	--------------------------------------	---

RNP AR
RF Leg Required



Operating and Design Criteria

- ICAO Doc 8168 PANS-OPS 611 Vol I & Vol II





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Quality Assurance Criteria

- Doc 9906 AN472
Vol I
- FPD QA System
- First Edition





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Training Criteria

- Doc 9906
AN472 Vol 2
- FPD Training
- First Edition





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Software Criteria

- Doc 9906
AN472 Vol 3
- FPD Software
Validation
- First Edition
Corrigendum 1





FPD Validation Criteria

- Doc 9906 AN472
Vol 5
- Validation of FPD
- First Edition





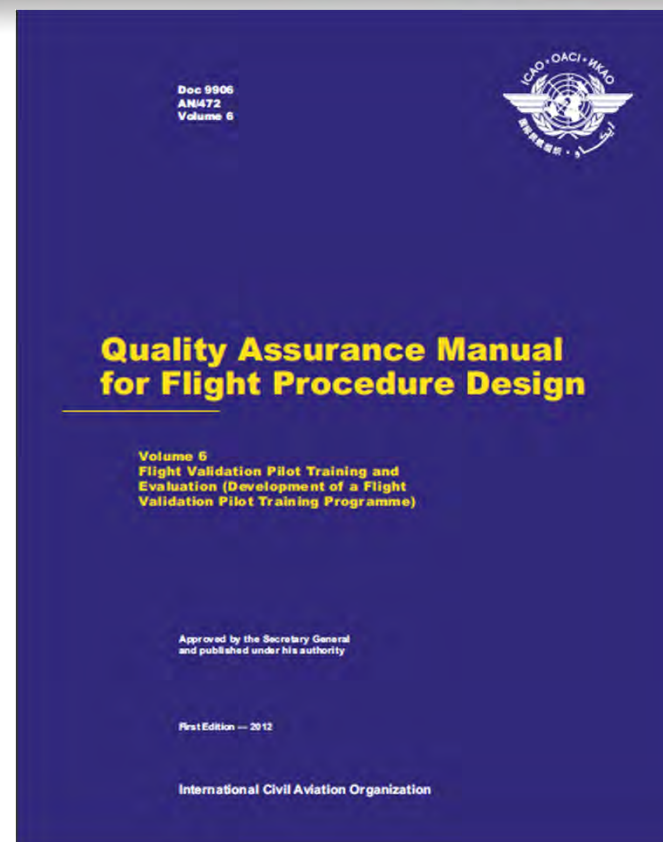
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Flight Validation Pilot Criteria

- Doc 9906 AN472 Vol 6
- Flight Validation Pilot Training and Evaluation
- First Edition





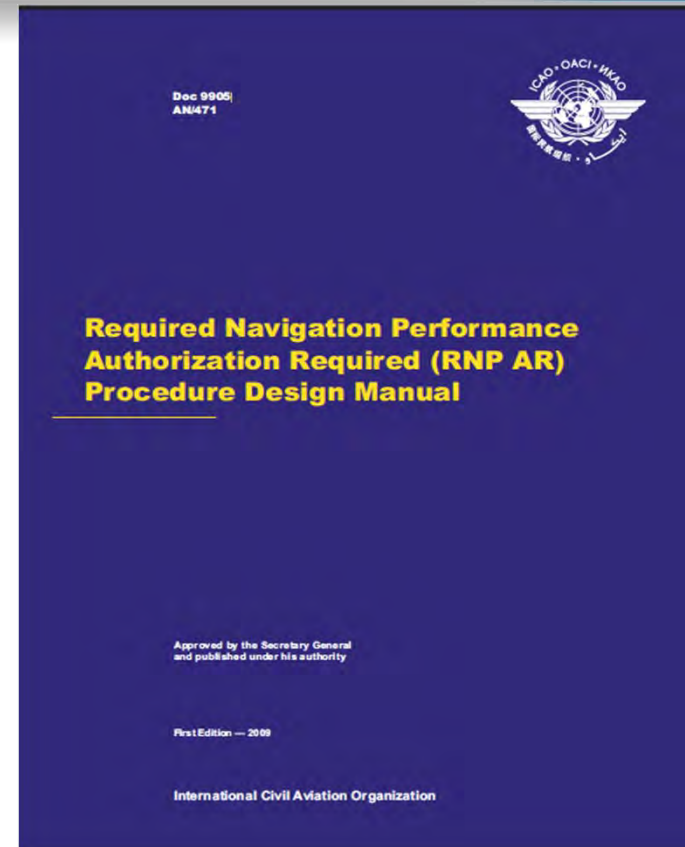
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RNP AR Design Criteria

- Doc 9905 AN471
- RNP AR Procedure Design Manual
- First Edition,
Corrigendum 1





Additional Guidance - Airspace Design/CDO/CCO

- Doc 9992 AN494 - Manual on PBN in Airspace Design
- Doc 9993 CCO Manual
- Doc 9931/AN476 - CDO Manual





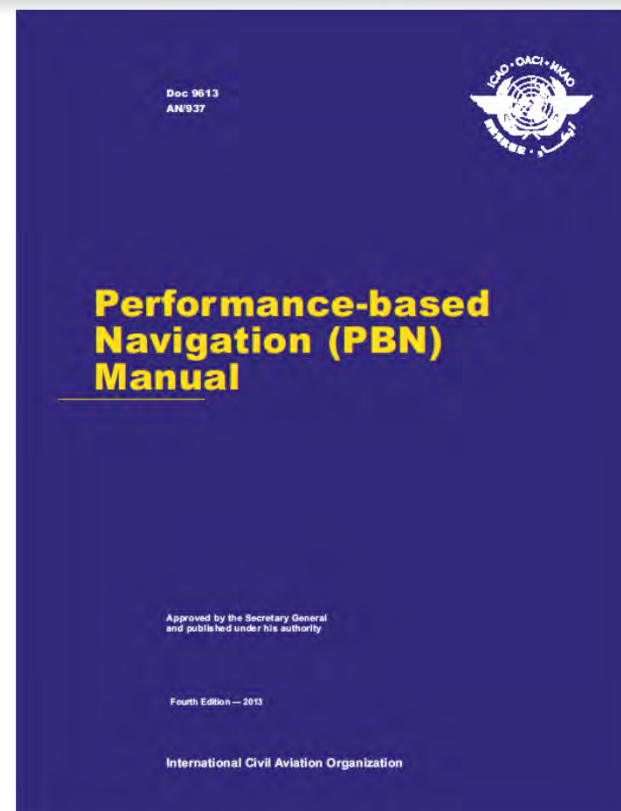
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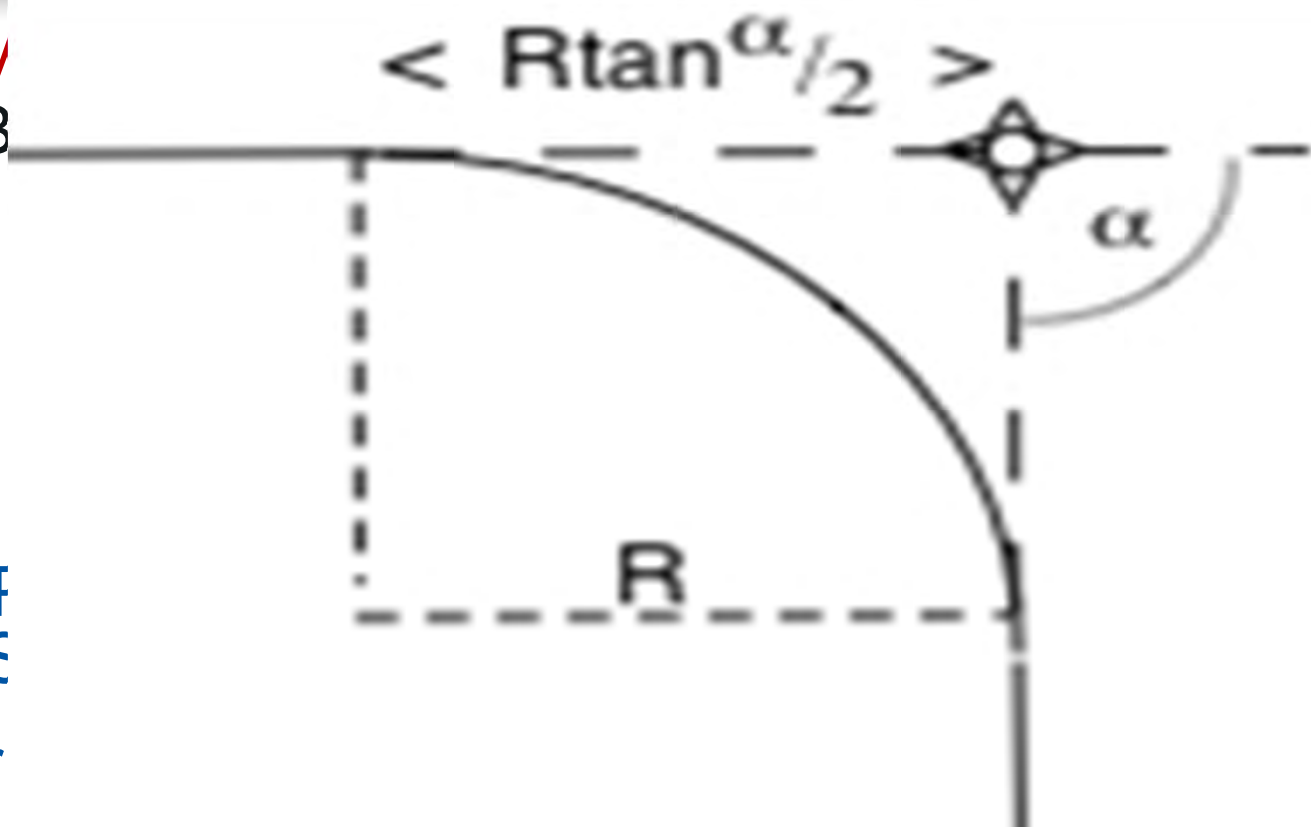
PBN

- Doc 9613/AN937
- PBN Manual
- Edition 4






- **Doc 8168 V** following PB
 - En-route -
 - Terminal -
 - Approach Localizer F (LPV) (U.S)
 - Helicopter





- Where SBAS performance meets the requirements of Annex 10, Vol I, Attch D:
∴  **Cat I**
- **Cat I SBAS LPV** is based on ILS OAS with
DH \geq 200ft.

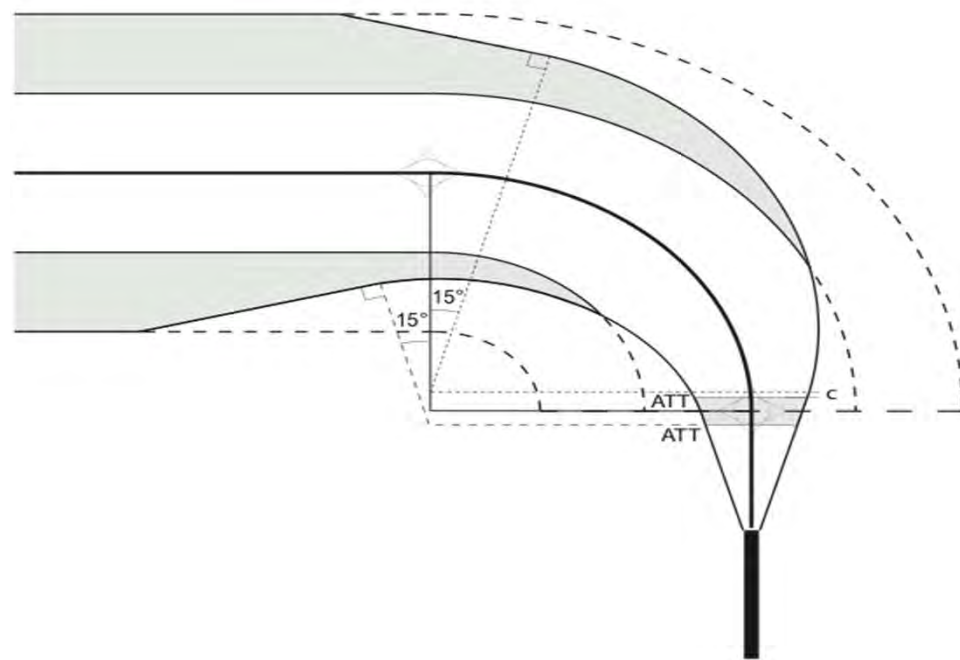


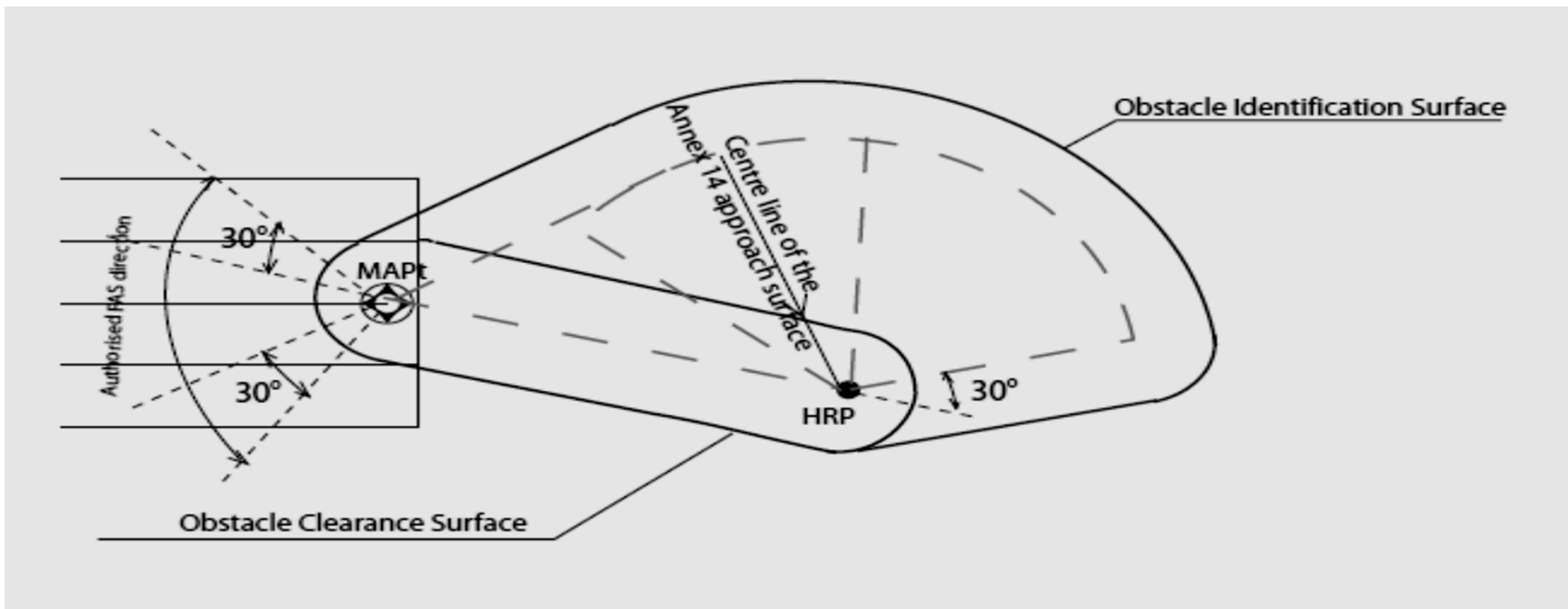
- Following 3 years of IFP Panel deliberations, the following PBN changes are expected to be published in 2013/2014:
 - En-route - RNP 2, **A-RNP** and RNP 0.3 (Cat H)
 - Terminal - **A-RNP** and RNP 0.3 (Cat H)
 - Approach - RNP APCH (LNAV/VNAV)
 - Helicopter Point in Space (PinS)
 - Departures
 - Approaches and departures with maneuvering areas.



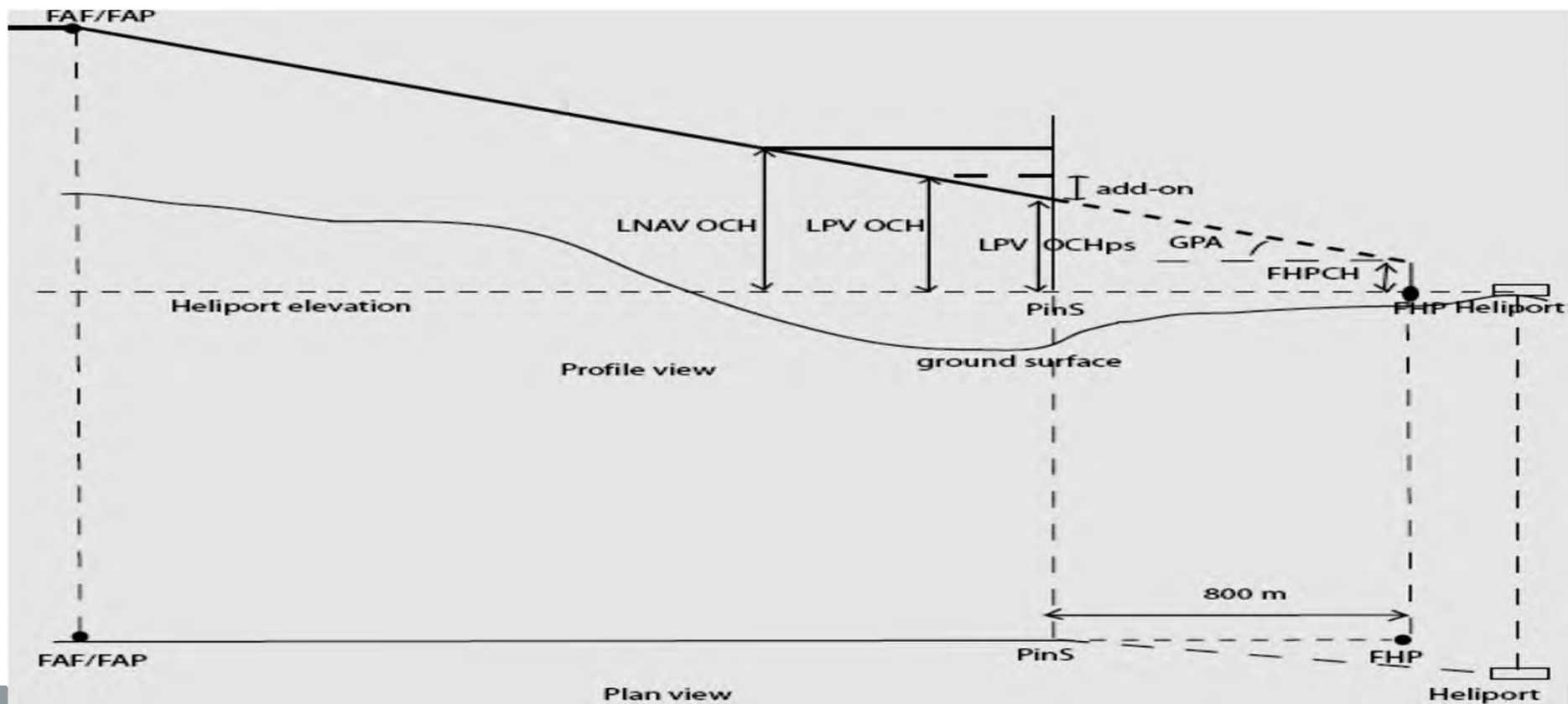
A-RNP

- **RF** is a requirement. New criteria developed including use of splay and reduced ATT values
- Scalability is an option. This means that any value between 0.3 and 1.0 can be used **once** the aircraft have been approved





Visual Maneuvering



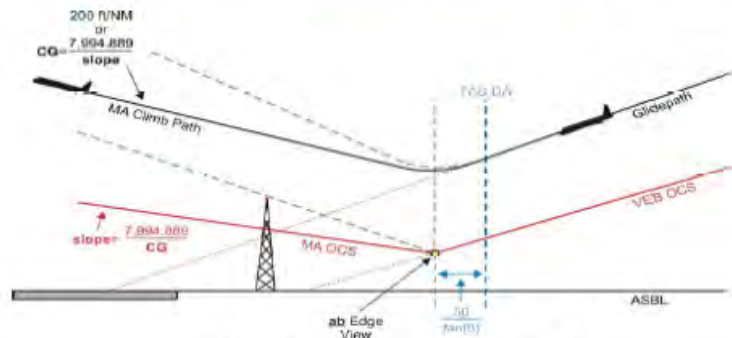
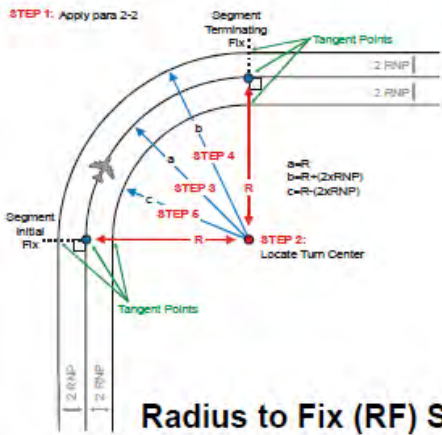


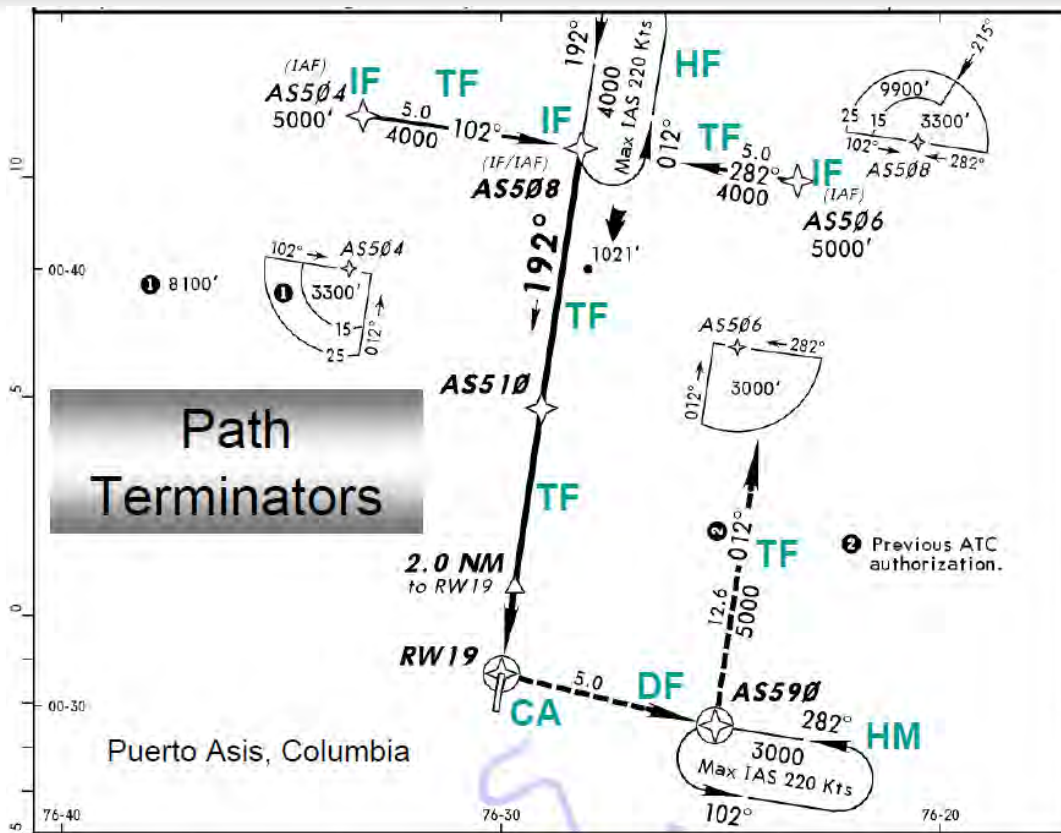
Narrow lateral linear segments
(RNP-0.3 or less with no secondary buffers)

Curved segments anywhere along the approach
(Radius-to-fix legs with shorter leg lengths)

Guided, narrower turns on missed approaches
(Radius-to-fix legs, and RNP-1 or less)

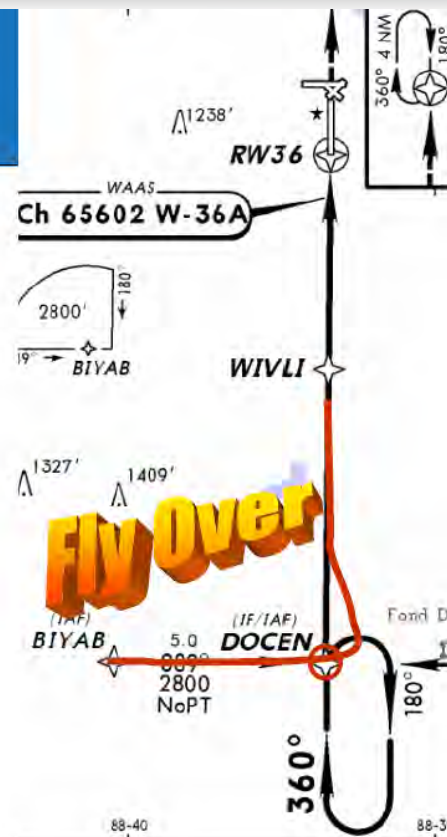
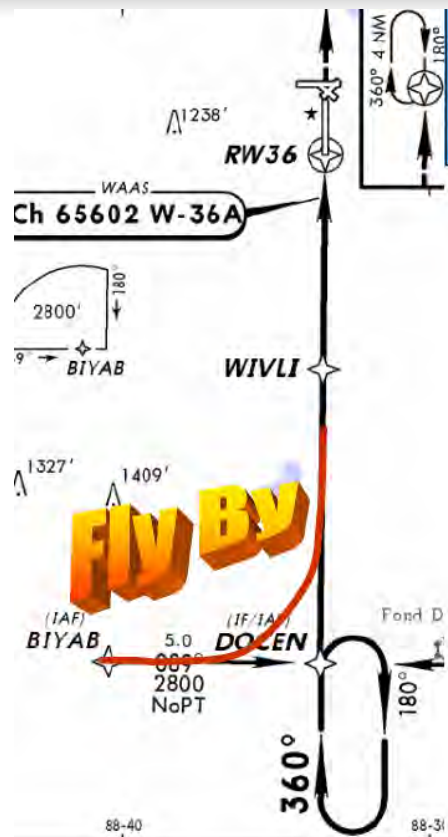
Performance-based Vertical Buffers
(Vertical Error Budget)







Fly-By versus Fly-Over Fixes



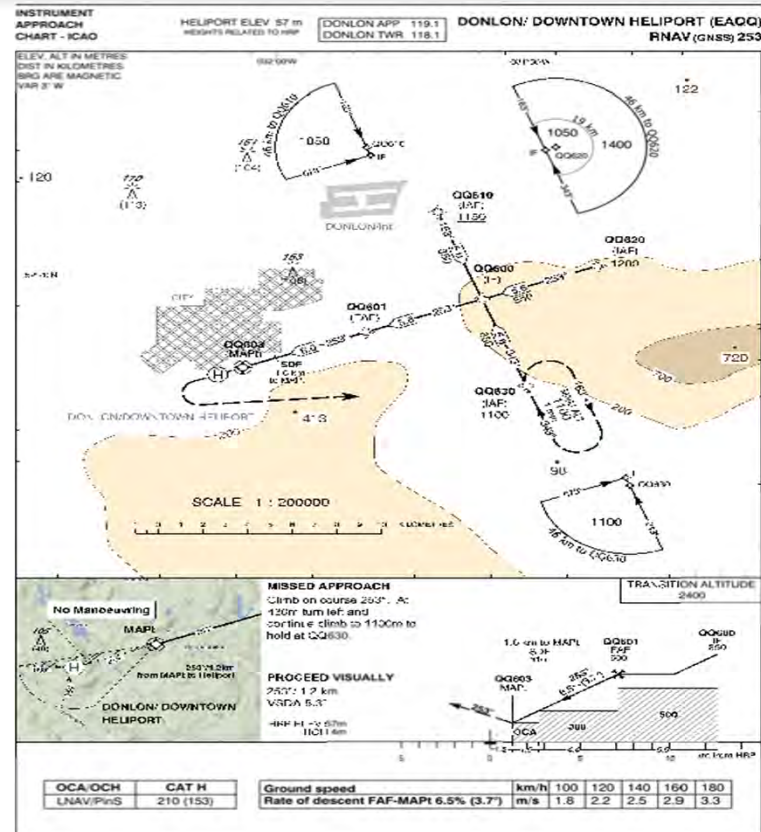
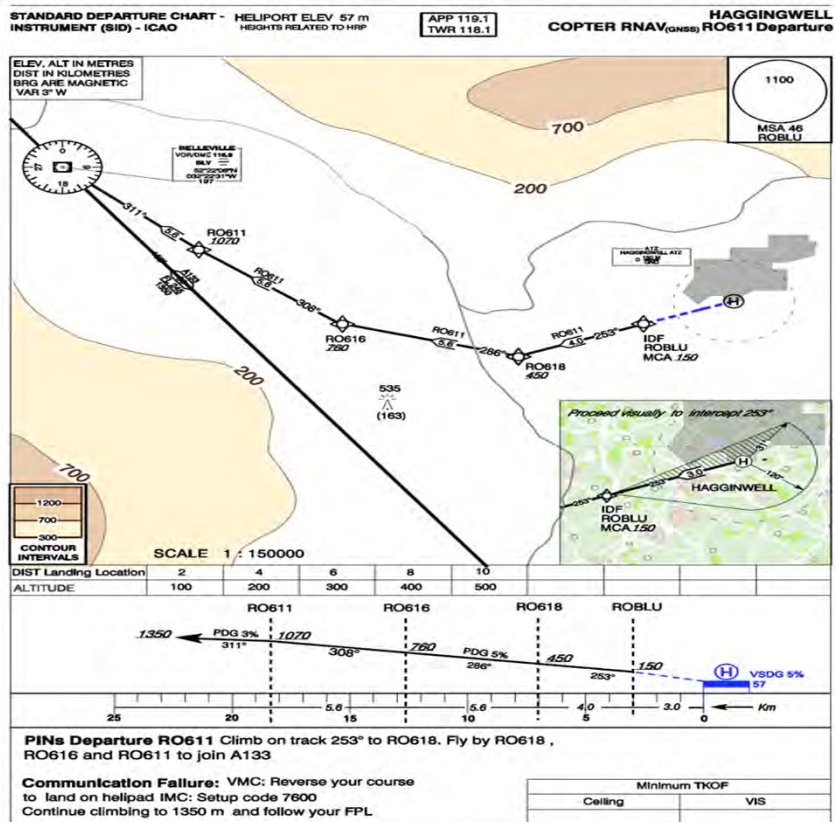
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New Approach Classification								
Domain	Document	Aspect						
Approach Operations	Annex 6	Classification	Type A ($\geq 250'$)		Type B CAT I ($\geq 200'$)	CAT II ($\geq 100'$)	CAT III ($<100'$)	
		Method	2D	3D				
		Minima	MDA/H	DA/H*				
Approach Runways	Annex 14	M(DA/H) \geq VMC	Non Instrument RWY					
		M(DA/H) $\geq 250'$ Visibility $\geq 1000m$	Non Precision Approach RWY					
		DA/H $\geq 200'$ Visibility $\geq 800m$ or RVR $\geq 550m$	Precision Approach RWY, Category I					
		DA/H $\geq 100'$ RVR $\geq 300m$	Precision Approach RWY, Category II					
		DA/H $\geq 0'$ RVR $\geq 0m$	Precision Approach RWY, Category III (A, B & C)					
System Performance Procedures	Annex 10 PANS-OPS Vol. II	NPA	NDB, Lctr, LOC, VOR, Azimuth, GNSS					
		APV		GNSS/Baro/SBAS				
		PA	ILS, MLS, SBAS, GBAS					

* For guidance on applying a continuous descent final approach (CDFA) flight technique on a non-precision approach procedures refer to PANS-OPS (Doc. 8168) Vol. I Section 1.7



Title (Part One)	Duplicate Procedure Identification Or Circling Suffix (Part Two)	Runway Or Final Approach Course (Part Three)	Parens (Part Four)
RNAV	X, Y, Z Or A, B, C ¹	Rwy 17L Or 234 ²	See Below in Section 2.4

Parens Explanation

No Parenthetical minimms)	(at least LNAV line of minimums, may also have any valid combination of the other lines of
LPV Only	(has only LPV lines of minimums)
LNAV/VNAV Only	(has only LNAV/VNAV lines of minimums)
LPV, LNAV/VNAV Only	(has both LPV and LNAV/VNAV lines of Minimums but no LNAV)
LP Only	(has only LP lines of minimums)
AR	(Authorization Required based on Doc 9613 and Doc 9905)

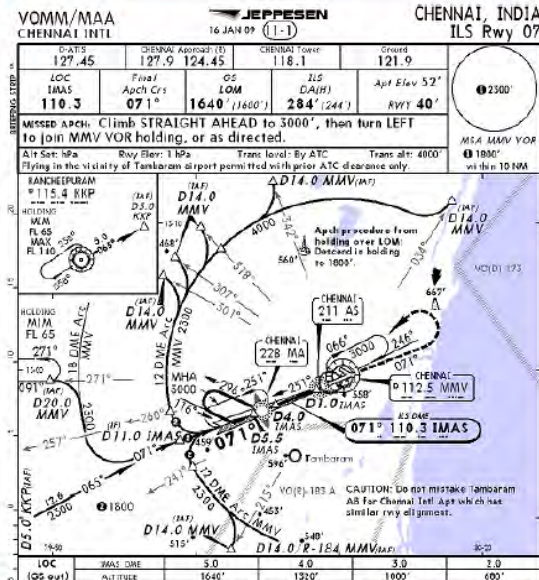
RNAV will change to RNP in 2028



Evolution of Procedure Design and Charting

Analog Past

Ground-Navaid, Complex, Fixed paths, Non-standard, Manually flown, Paper



Digital Future

Satellite-based, Simple, Flexible paths, Repeatable, Predictable, Data-driven, Electronic





Dynamic Gate-to-Gate Charting and Procedures





PBN Box

Navigation Specification:

RNP APCH,
RNP AR APCH

Functional Requirements

RF Required
Missed Approach requires less than RNP 1
RNP Less than 0.3

Hybrid Procedure Requirements

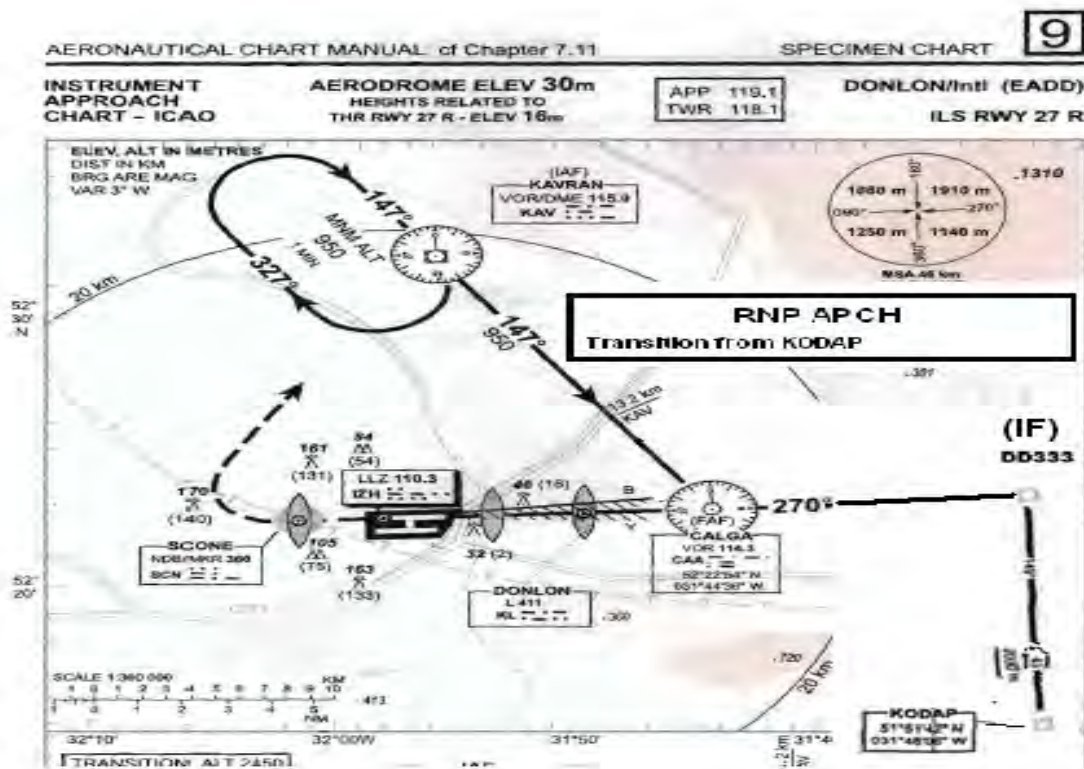
Conventional procedure charts that include PBN segments will include the appropriate Nav Spec name and functional requirements



Aeronautical data processes are expected to operate under a Quality Management System (QMS)



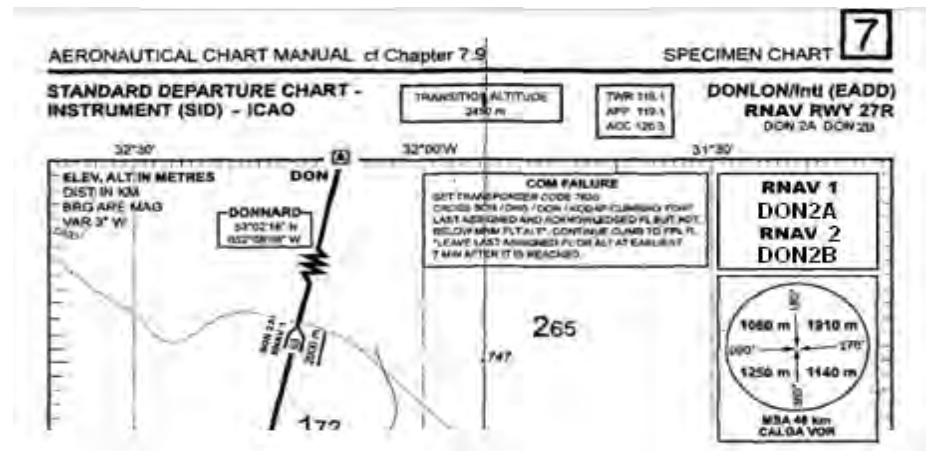
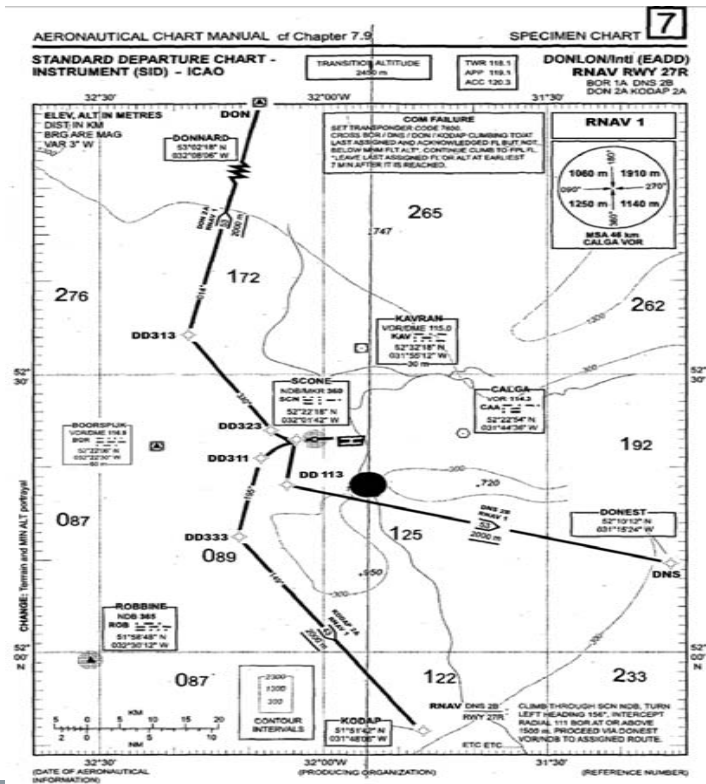
- Corrective action
- Document control
- Records management
- Management review
- Nonconforming products
- Letters of Acceptance
- Certificates of Conformity
- Audits
- Preventative actions





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Thank You

