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RNP AR DEP

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Presentation Outline

- Background
- RNP AR why needed?
- RNP DP
- RNP OCS
- RNP AR Segment width
- RNP APCH V RNP AR APCH
- RNP AR DP Operational approval
- RNP AR DP Aircraft requirements
- GNSS IRS
- RNP AR DP Operating procedures
- RNP AR DP Contingency procedures
- Equipment for RNP AR operations
- Navigation data base

Background

- Doc 9905, Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual, includes design criteria to aid States in the implementation of RNP AR approach procedures in accordance with the PBN Manual, Volume II, Part C, Chapter 6, Implementing RNP AR APCH.

Background

- RNP AR procedures can provide significant operational and safety advantages over other area navigation (RNAV) procedures by:

1) incorporating additional navigational accuracy;
2) Integrity; and
3) functional capabilities to permit operations using reduced obstacle clearance tolerances that enable approach and departure procedures to be implemented in circumstances where other types of approach and departure procedures are not operationally possible or satisfactory.

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RNP AR WHY NEEDED?

- RNP AR approach procedures to overcome difficulties with challenging terrain and raise accessibility to some airports.
- This is possible because RNP AR:

1) allows exploitation of high-quality,
2) managed lateral and vertical navigation (VNAV) capabilities that provide improvements in operational safety and
3) reduced controlled flight into terrain (CFIT) risks.

RNP AR DP

- The responsibility for developing design criteria for RNP AR departures lies with the Instrument Flight Procedure Panel (IFPP) of ICAO. Nevertheless, this task is on hold waiting for the results of the work performed by PBN Study Group (PBNSG) to develop navigation specification for RNP AR departures.

RNP AR DP

- RNP AR DP operational approvals build on the existing RNP AR APCH approval requirements.
- RNP AR DPs introduce additional aircraft performance considerations:
  - ✓ Synergy between the take-off and climb performance of the aircraft;
  - ✓ The operator's ability to use the RNP system while complying with demanding, nonstandard climb gradients and close-in departure turns.

RNP AR DP

- ✓ This synergy permits the safe application of RNP AR DPs with performance characteristics unavailable through any other navigation specification.

- ❑ RNP lateral navigation accuracy is limited to not less than RNP 0.3 for RNP AR DP.

RNP AR DP requirements are still in development; the contents of this section are subject to change.

RNP AR DP

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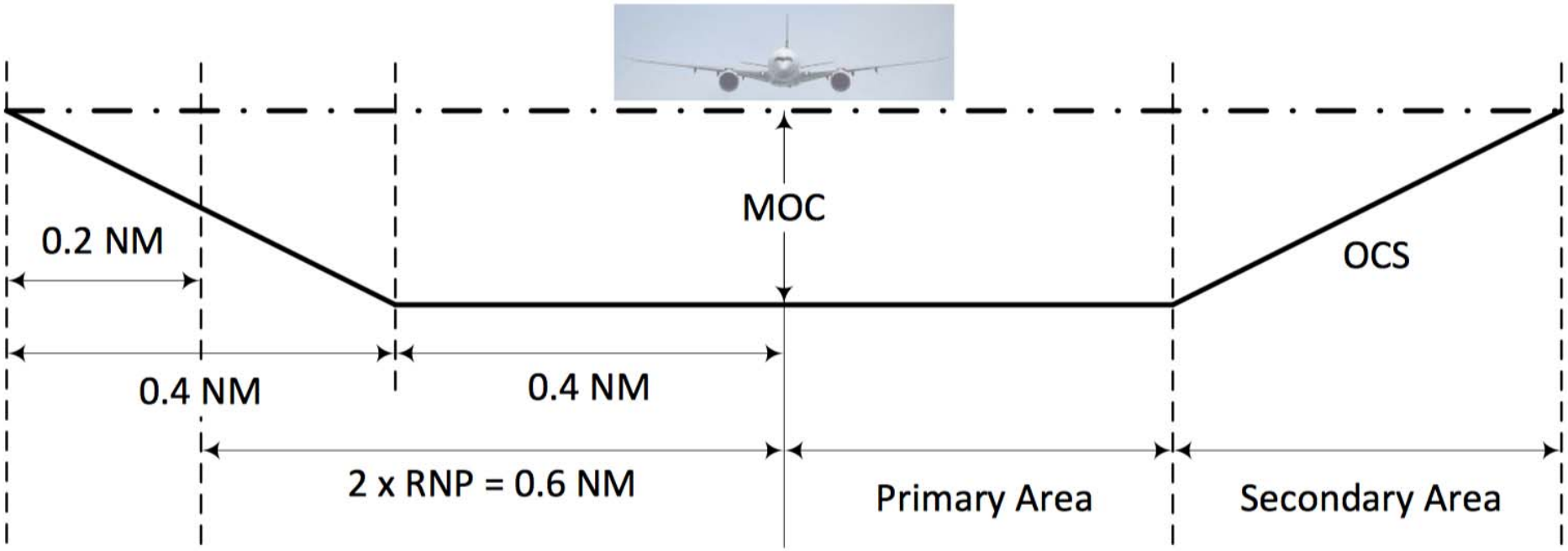
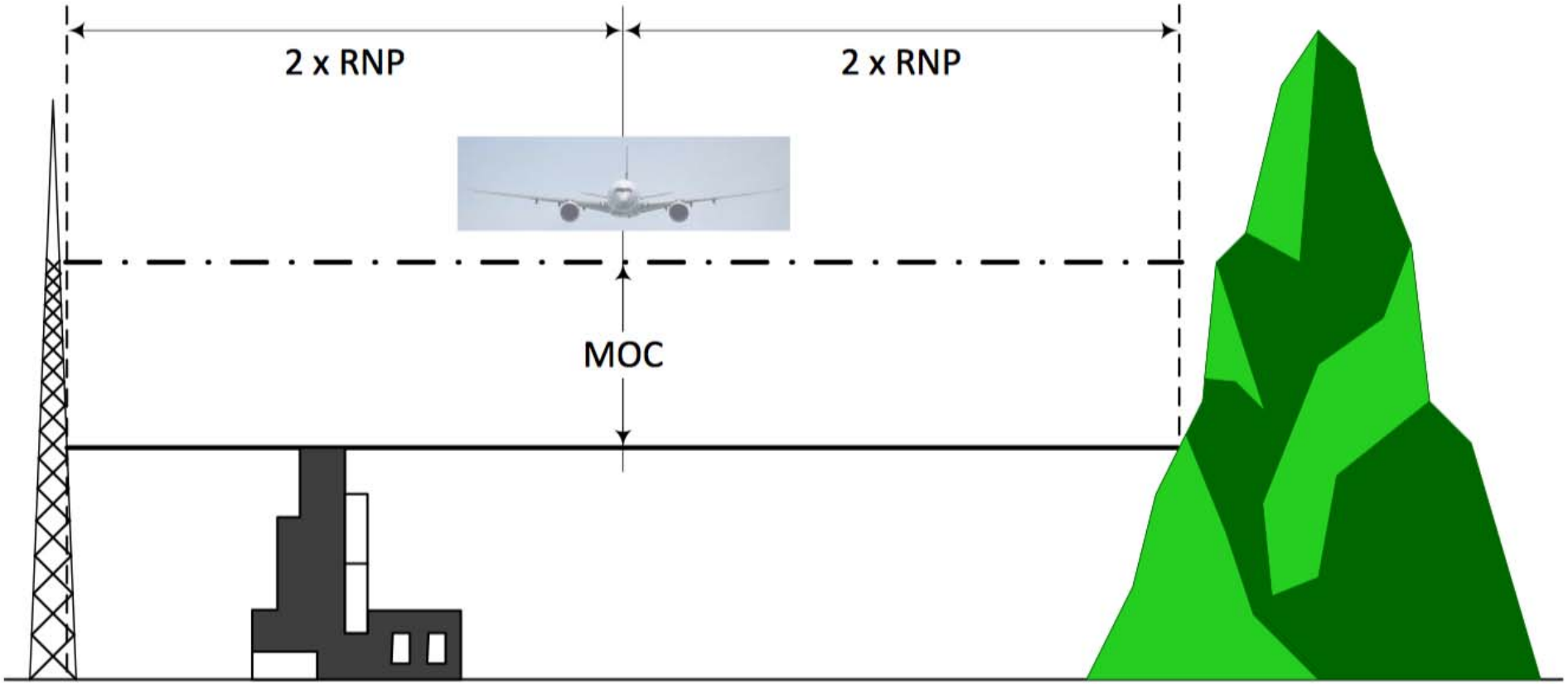
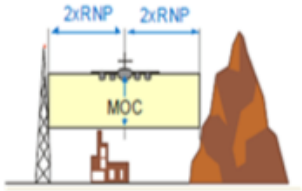
RNP APCH OCS


MOC
0.2 NM
OCS
0.4 NM
0.4 NM
2 x RNP = 0.6 NM
Primary Area
Secondary Area

RNP AR Segment Widths



RNP APCH v RNP AR APCH

	RNP APCH LNAV/VNAV	RNP AR APCH
Obstacle Evaluation		
RNP (Final)	0.3	0.3 to 0.1
Final XTK	0.15 NM	0.15 NM to 0.05
Turns (Final)	None	RF
Missed Approach	Terminal Mode (RNP 1.0); TF/RF	RNP 1.0 or less; TF/RF
Initial/Intermediate	Terminal Mode (RNP 1.0); TF/RF	RNP 1.0 to 0.3; TF/RF
Lowest DH	250ft	250ft
Equipment	Single	Dual (Typically)
Safety Assessment	Standard QA	FOSA

RNP AR DP Operational Approval

- To obtain a RNP AR DP approval, the operator must have:
  - ✓ An RNP AR DP configuration list and MEL detailing their aircraft equipment that RNP AR DP operations require.
  - ✓ Training and procedures specific to RNP AR DPs.
  - ✓ Application and use of any aircraft performance tools necessary to ensure compliance with takeoff and climb performance demands of a RNP AR DP.
  - ✓ Any new additions to their OMs and checklists necessary to conduct RNP AR DPs.

RNP AR DP Operational Approval

- The RNP AR APCH and RNP AR DP operational approvals are separate approvals.
- Operators can hold a RNP AR APCH approval without holding a RNP AR DP approval.
- A RNP AR APCH approval is required to obtain a RNP AR DP approval.
- RNP AR DP requirements are additional to the RNP AR APCH requirements.
- Operator holding a RNP AR APCH approval is not able to meet the requirements for a RNP AR DP approval.

RNP AR DP Aircraft Requirements

- The aircraft's RNP system must be capable of:
  - ✓ Loading and executing a flight plan where the RNP AR DP defined path begins at or just beyond the departure end of the takeoff runway (DER), including use of an RF leg.
  - ✓ RNP system must be able to provide lateral path guidance (i.e. engage LNAV) no later than 50 FT above the DER during takeoff.
  - ✓ The achieved aircraft track with LNAV engaged must be tangent to an extension of the runway's centreline prior to the aircraft crossing the DER.

GNSS & IRS

- GNSS must be available immediately prior to take-off.
- To support an RNP AR DP operation, the RNP system must:
  - ✓ Be capable of reversion to IRS-only navigation in case of the loss of GNSS at any point during the procedure.
  - ✓ The IRS and RNP system installation must include the ability to conduct a full IRS alignment and a subsequent position update during ground operations immediately prior to takeoff.

RNP AR DP Operating Procedures

- Preflight:
  - ✓ Ensure required equipment is available.
  - ✓ Apply the aircraft's takeoff and climb performance data in support of preflight planning RNP AR DPs.
- The operator must analyze:
  - ✓ the aircraft's performance during the takeoff phase of an RNP AR DP; and
  - ✓ then analyze the climb phase of the DP from the point on the DP where the takeoff phase ends and the aircraft achieves the desired climb airspeed.

RNP AR DP Operating Procedures

- The operator must include:
  - ✓ Non-standard climb gradients.
  - ✓ Forecast and actual weather reports must be considered.
  - ✓ For close-in RF legs, verify LNAV performance.

RNP AR DP Contingency Procedures

- The operator must define the contingency procedures to ensure theaircraft can safely extract from a departure airport should a performance loss or system failure compromise the ability to complete an RNP AR DP after committing to the takeoff.
- Since RNP AR DPs are complex, the contingency procedures for each procedure may vary greatly, and pilot route knowledge of all the contingency procedures is impractical. With this in mind, it is recommended the operator create documentation containing the contingency procedures for each RNP AR DP.

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- Sure OEI should exist

Equipment for RNP AR Operations

Typical aircraft equipment for a RNP AR APCH Ops Approval is:

- ❑ 2 GNSS receivers;
- ❑ 2 TSO C115b FMS with:
  - ✓ RF leg, Fly-by and Fly-over waypoint transition capability.
  - ✓ Automatic reversion to an alternate sensor if the primary sensor fails.
- ❑ 2 or 3 IRS compliant with 14 CFR Part 121 Appendix G;

Equipment for RNP AR Operations

Typical aircraft equipment for a RNP AR APCH Ops Approval is:

- ❑ 2 Baro-VNAV systems;
  - ✓ TSO C145 GNSS using SBAS within the SBAS service volume and in an operating mode that will output VPL is acceptable.
- ❑ 2 Flight Directors;
- ❑ 2 Flight Mode Annunciators;
- ❑ 2 RADALTs;
- ❑ Duplicated primary flight and navigation displays;
- ❑ Duplicated power sources (APU may be used);
- ❑ 1 autopilot channel;

Equipment for RNP AR Operations

Typical aircraft equipment for a RNP AR APCH Ops Approval is:

- 1 TAWS / EGPWS with excess below glidepath deviation alerting;
  - ✓ Mode 5 GPWS or Class A TAWS alerting.

Notes:

- Redundant systems are not required by the PBN Manual.
- Some limitations may apply to non-duplicated systems.
- FOSA provides the mechanism to evaluate aircraft for RNP AR acceptability.

Navigation Database

- Documented data management process
- Responsible data manager
- Cyclic data validation:
  - ✓ Detect unintended changes in navigation database
- Initial data validation by operator:
  - ✓ Ensure that the data is compatible with the aircraft avionics
  - ✓ For each aircraft/configuration

Thank you