ICAO APAC FPP

RNP AR Workshop

2026

RNP AR Missed Approach

- General Principles
- Z / Missed approach surface
- Permitted leg types

General Principles

- Begins: 1 RNP_{FAS} prior to LTP(FTP)
- END: a new approach, holding or return to en-route flight is initiated

- Standard missed approach RNP value is 1.0
- The missed approach RNP value of The RNP AR APCH ranges from 1NM to 0.1NM.
  - RNP value not less than final segment
  - Using RNP < 1 where is only important operational advantages.

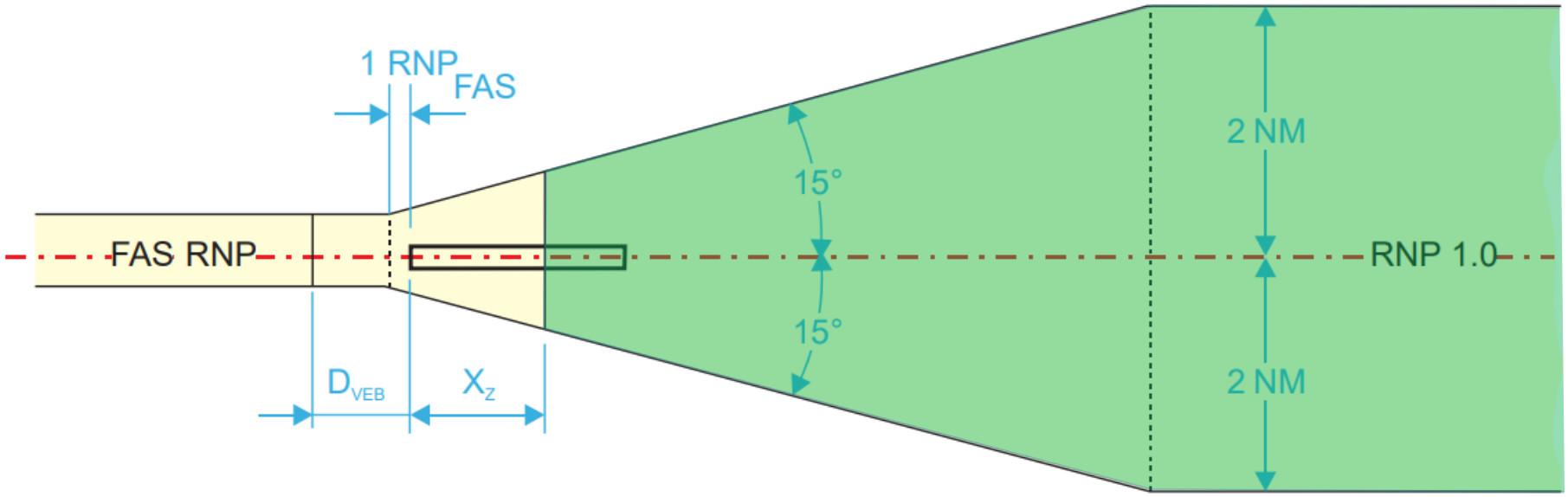
General Principles

- **0.3<RNP < 1**
  - missed approach turns must limit bank angles to 15 degrees
  - Fly By or RF turn
- RNP<0.3
  - Only RF turn

- RF turns should not start before departure end of runway (DER)

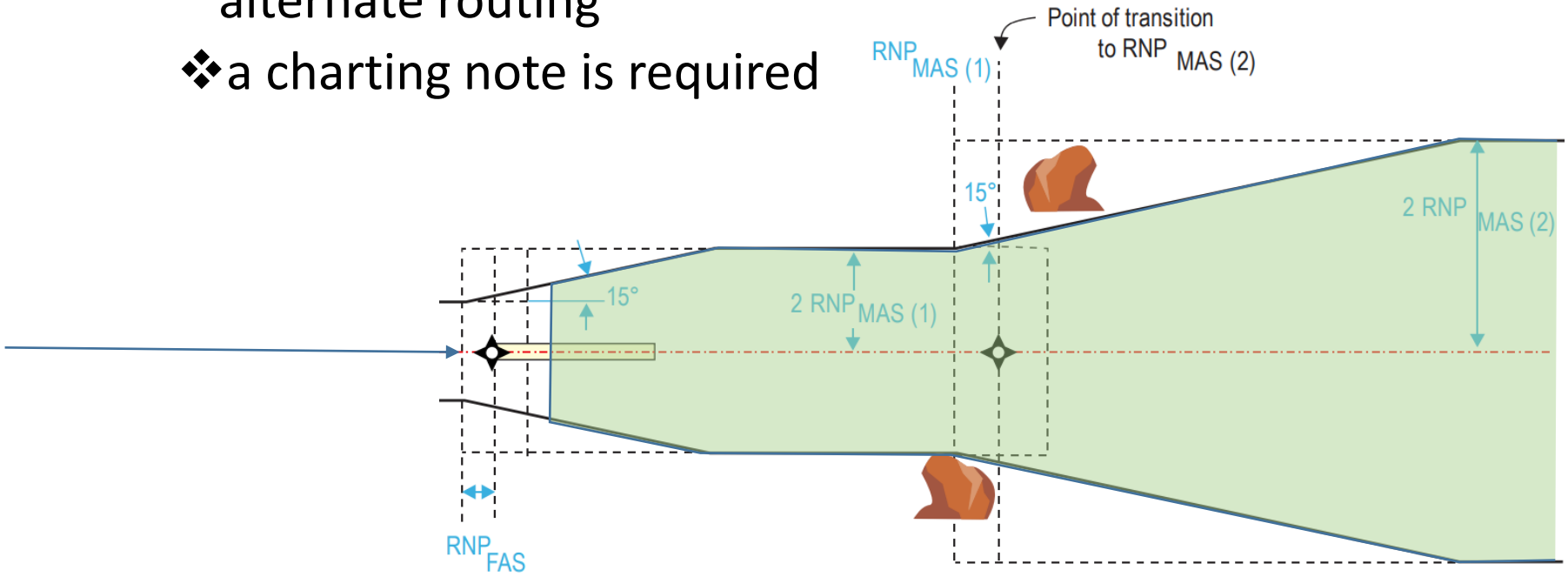
General Principles

- **1 RNP$_{FAS}$ prior to LTP(FTP)**
- **15 degrees relative to the nominal track**



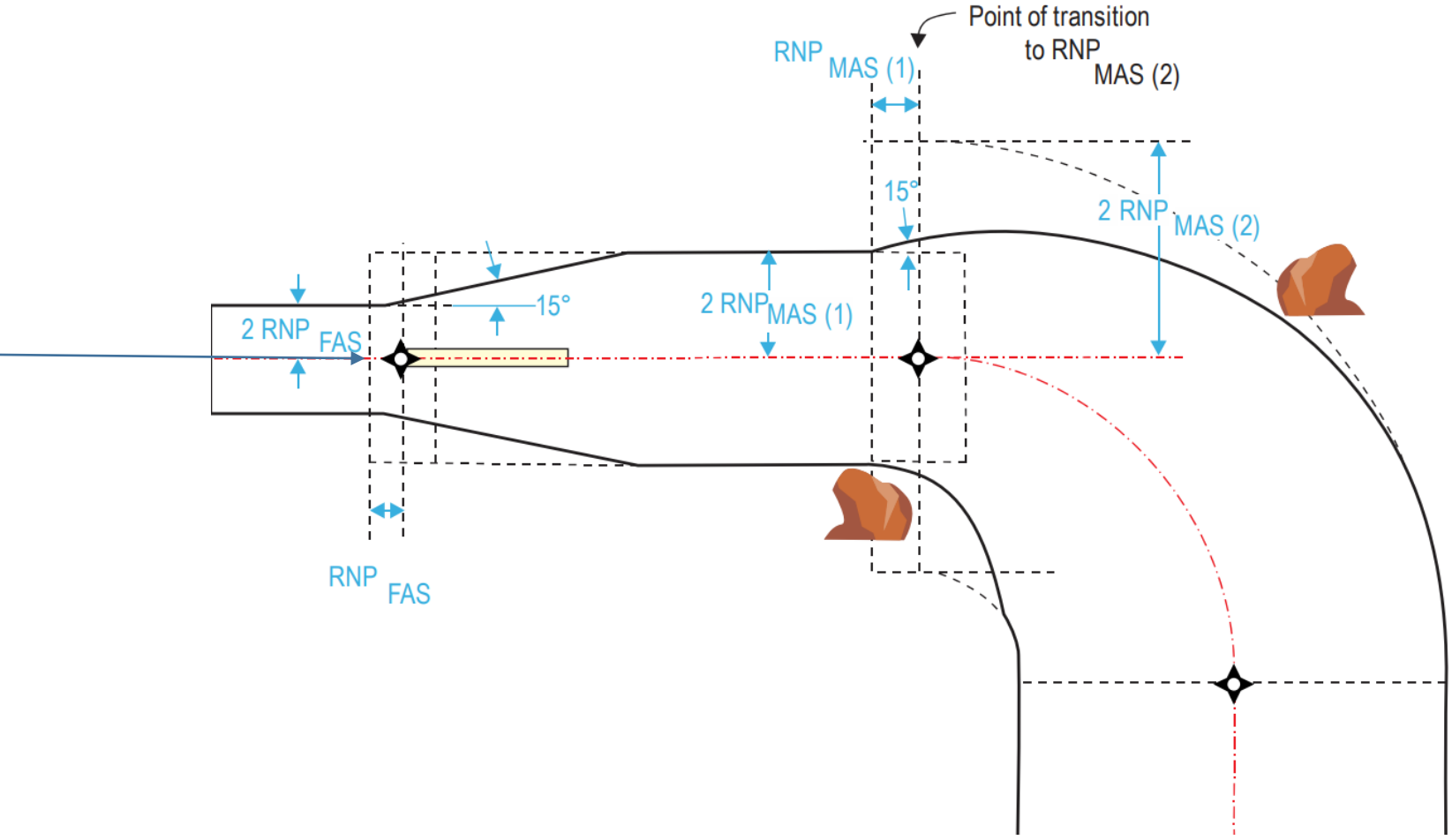
General Principles

- **RNP < 1**
  - ❖1.0 NM must be applied as soon as the obstacle situation allows
  - ❖other mitigations e.g. increased climb gradients or alternate routing
  - ❖a charting note is required



General Principles

- **RNP < 1 & RF turn**



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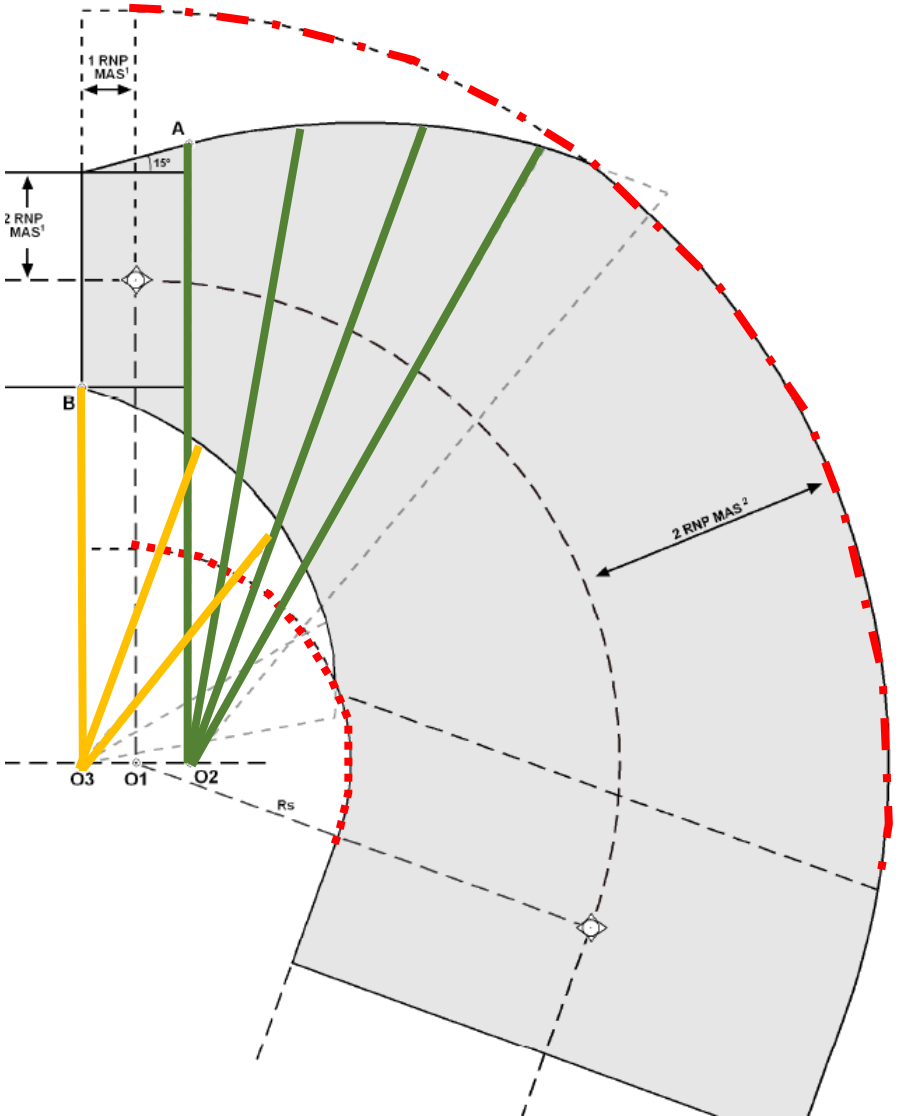

Z/ Missed approach surface

- **Origin of the Z surface (Xz)**
  - at THR level
  - based on a height loss (HL) and a transition distance (TrD)

$$Xz = [(HL_{Cat} - RDH)/\tan(VPA)] - TrD$$

Z/ Missed approach surface

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Table 4-2. Height loss margins

The following height loss margins shall be applied to all approach and equivalent approach obstacles				
	Margin using RA		*Margin using pressure altimeter*	
Aircraft category (V_{at})	*Metres*	*Feet*	*Metres*	*Feet*
A – 169 km/h (90 kt)	13	42	40	130
B – 223 km/h (120 kt)	18	59	43	142
C – 260 km/h (140 kt)	22	71	46	150
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Z/ Missed approach surface

- $Xz = [(HL_{Cat} - RDH)/\tan(VPA)] - TrD$

  TrD = transition distance

$$TrD = \frac{t \times MaxGndSpeed}{3600} + \frac{4}{3}\sqrt{anpe^2 + wpr^2 + fte^2}$$

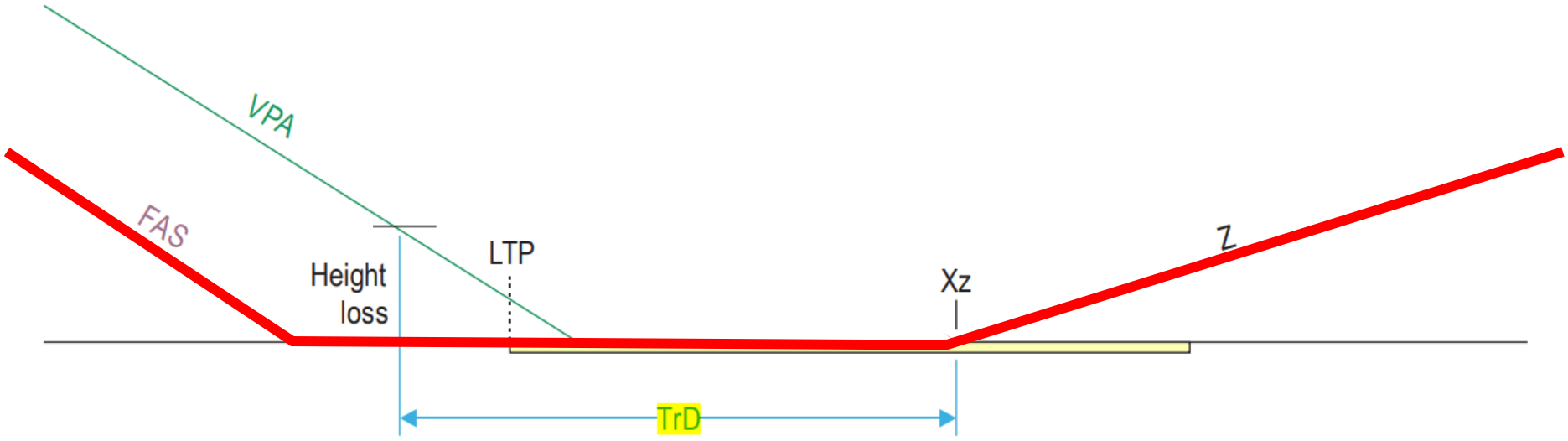
- **t=15 s, Consistent with traditional procedure and PBN procedure calculations;**
- **Max GndSpeed=maximum final approach TAS for the aircraft category, calculated at aerodrome elevation and ISA+15 plus a 19 km/h (10 kt) tailwind;**
- **anpe=1.225×RNP (99.7 per cent along-track error) (RNP_{MAS});**
- **wpr=60 ft (99.7 percent waypoint resolution error);**
- **fte=75/tan VPA ft (99.7 percent flight technical error).**

Z/ Missed approach surface

$$Xz = [(HL_{Cat} - RDH)/\tan(VPA)] - TrD$$

- **MAS gradient**

1. **Standard 2.5%**
2. **Maximum 5% (but must provide 2.5% alternative procedure)**



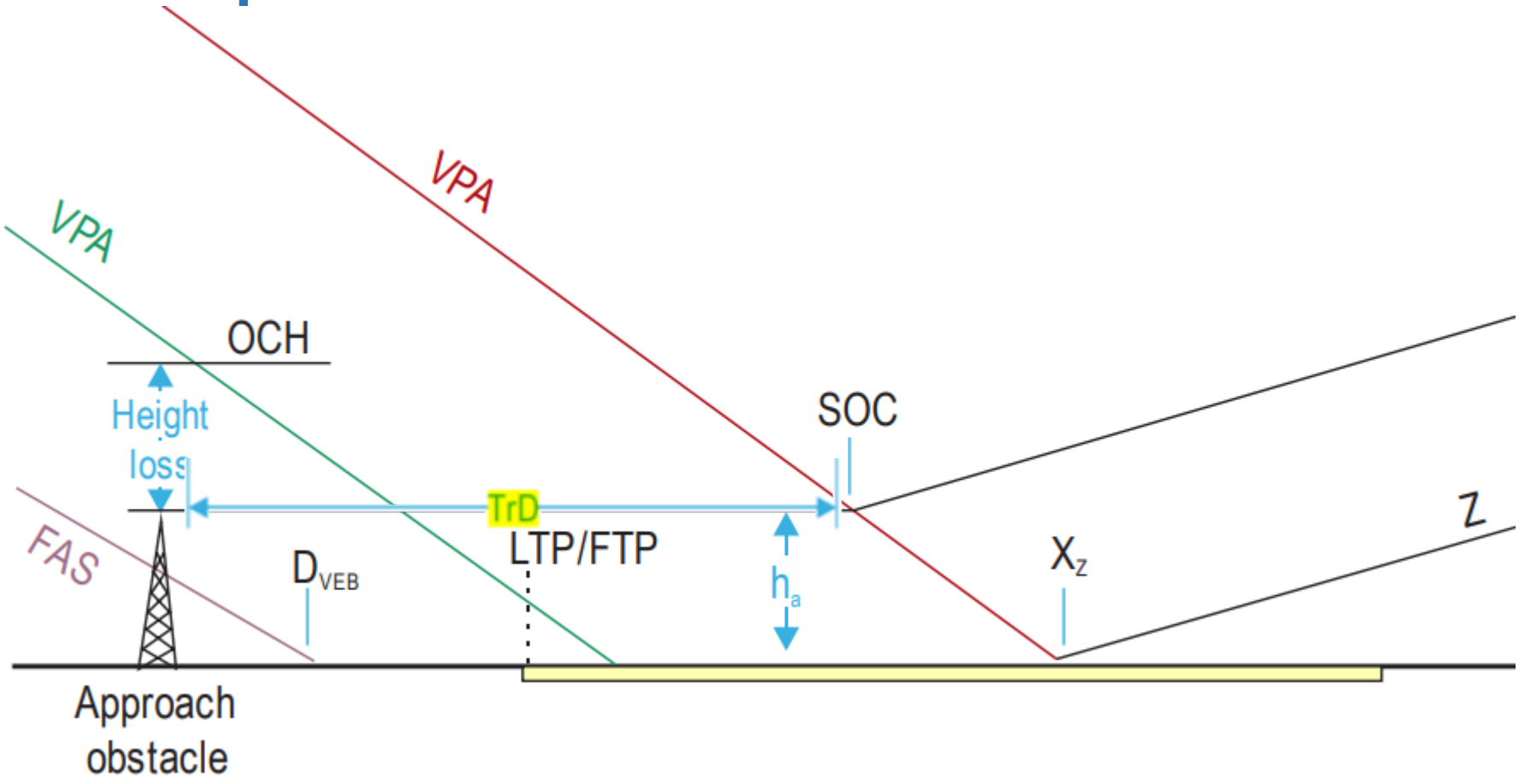
Z/ Missed approach surface

- **Example:**
- **Cat C，VPA=3°，Final approach RNP =0.3,**
- **MA RNP=1.0，IAS=160kt; Aerodrome elev=1000ft;**

- **TrD=?**

Z/ Missed approach surface

- SOC position



Z/ Missed approach surface

- SOC position

$$XSOC_{Cat} = [(OCH_{Cat} - RDH)/\tan VPA] - TrD$$

- $XSOC_{Cat}$=range of the SOC for the aircraft category, **positive before threshold, negative after threshold;**
- OCH_{Cat} =OCH for the aircraft category
- RDH =vertical path reference height
- tan VPA =gradient of the VPA
- TrD = transition distance

Z/ Missed approach surface

- SOC position

$$XSOC_{Cat} = [(OCH_{Cat} - RDH)/\tan VPA] - TrD$$

Example:

Cat C， Final approach RNP=0.3, MA RNP=1.0，OCH=300ft； RDH=15m; VPA=3°；Aerodrome elevation=1000ft；IAS=160kt; Xsoc=?

Permitted leg types

- The recommended leg types are RF and TF
  - **Other leg types PBN manual 6.3.3.3 may be use.**
- RNP<1.0, DF or CF legs cannot be applied

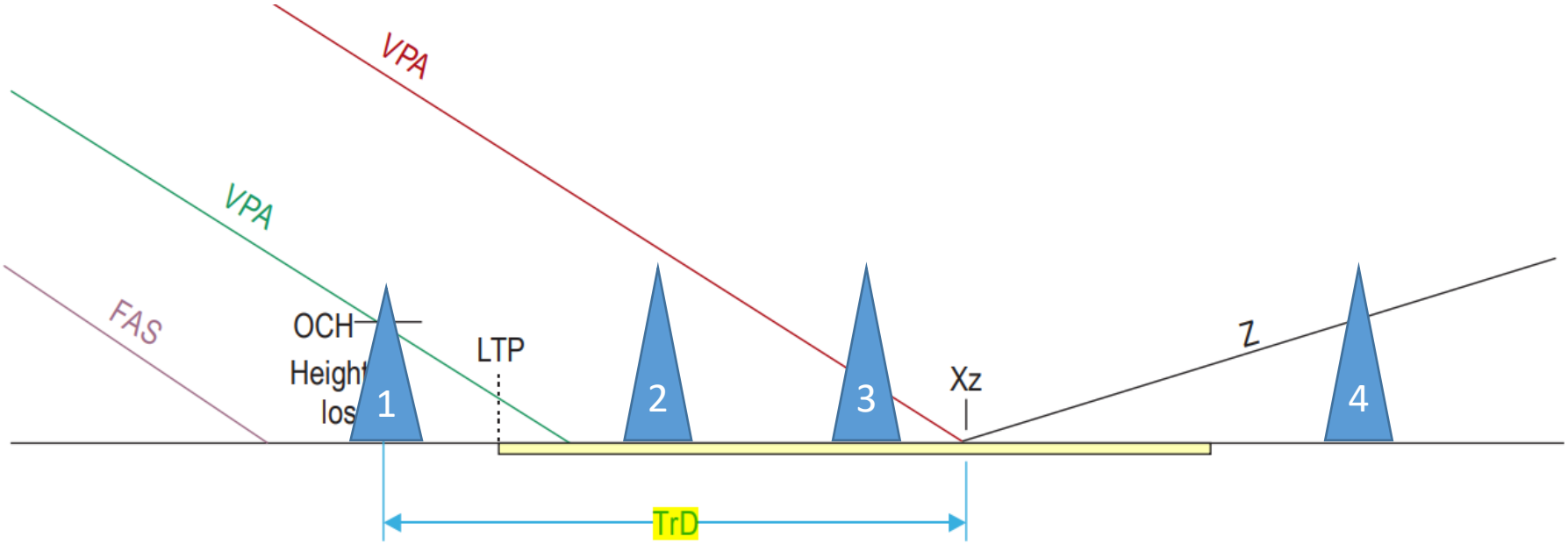
OCH Computation

Determination of OCA/H

- OAS surface
  FAS, horizontal plane surface and Z surface
- Approach obstacles
- Missed approach obstacles

Determination of OCA/H

- Approach obstacles
- Missed approach obstacles



Determination of OCA/H

➢Missed approach obstacles

$$ha = [(hma + MOC) \times \cot Z + (X - X_Z)]/(\cot VPA + \cot Z)$$

- ha = height of the equivalent approach obstacle;
- hma = height of the missed approach obstacle;
- X = distance of the obstacle from threshold (positive prior to the LTP threshold, negative after/distance is computed along (r-0.1Nm) trajectory for RF legs);
- cot Z = cotangent of the Z surface angle;
- cot VPA = cotangent of the VPA;
- XZ = X coordinate of the origin of the missed approach surfaceX

Determination of OCA/H

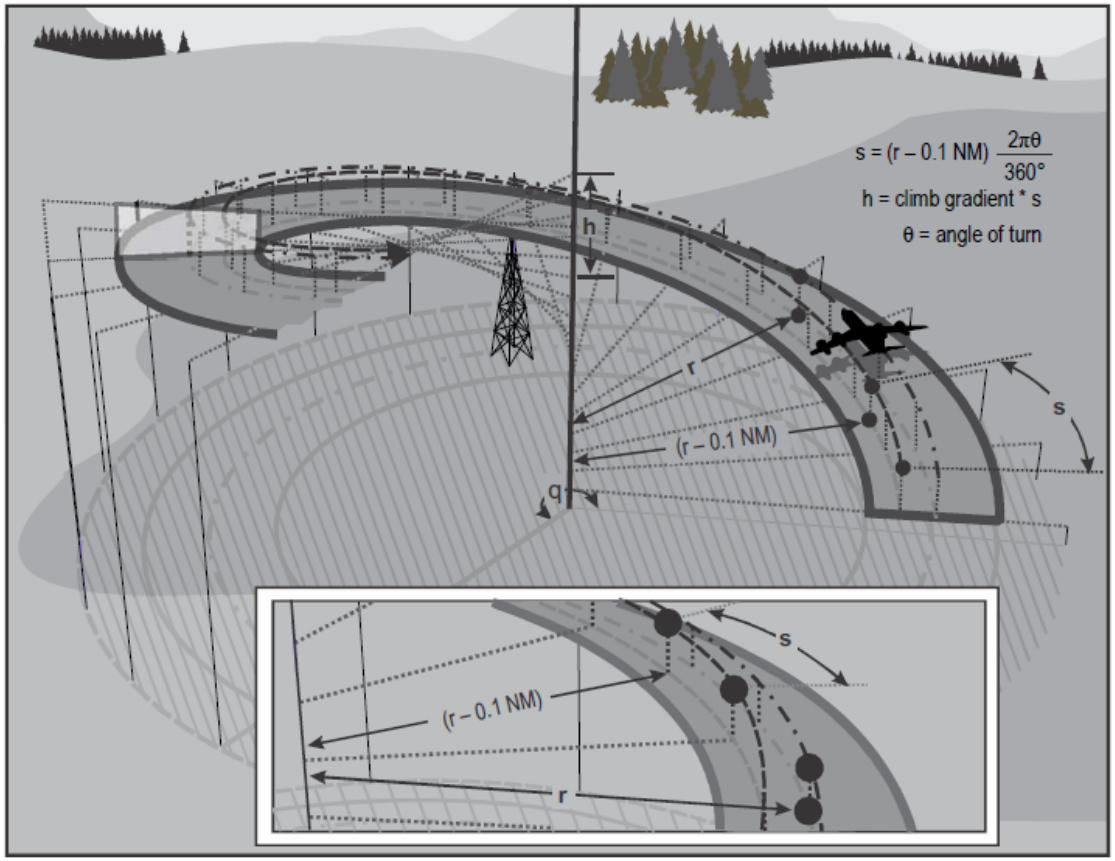
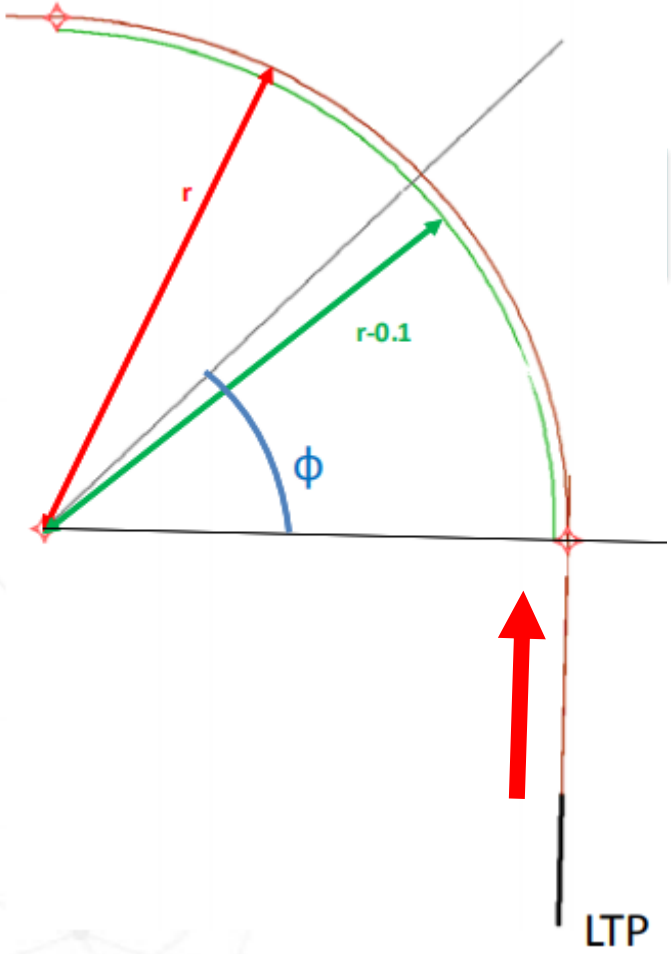


Figure 4-9 b). OCS for RF missed approach segments (MAS)



Determination of OCA/H

➢MOC

- ✈ MOC is 0 m/(0 ft) for a straight missed approach;
- ✈ MOC is 30 m/(98 ft) for TF-TF turns up to 15 degrees;
- ✈ MOC is 50 m/(164 ft) for TF-TF turns greater than 15 degrees.
- ✈ MOC is bg (body geometry) for RF turns

Determination of OCA/H

- Obstacle elevation/height shall be less than (Fly-By turn)

(OCA/H–HL)＋ (dz＋ do) tan Z–MOC

- **do = shortest distance from the obstacle to the earliest turning point (TP) ;**
- **dz = horizontal distance from SOC to the earliest TP;**
- **MOC =50 m (164 ft) for turns more than 15 degrees;**
- **MOC =30 m (98 ft) for turns 15 degrees or less.**

Determination of OCA/H

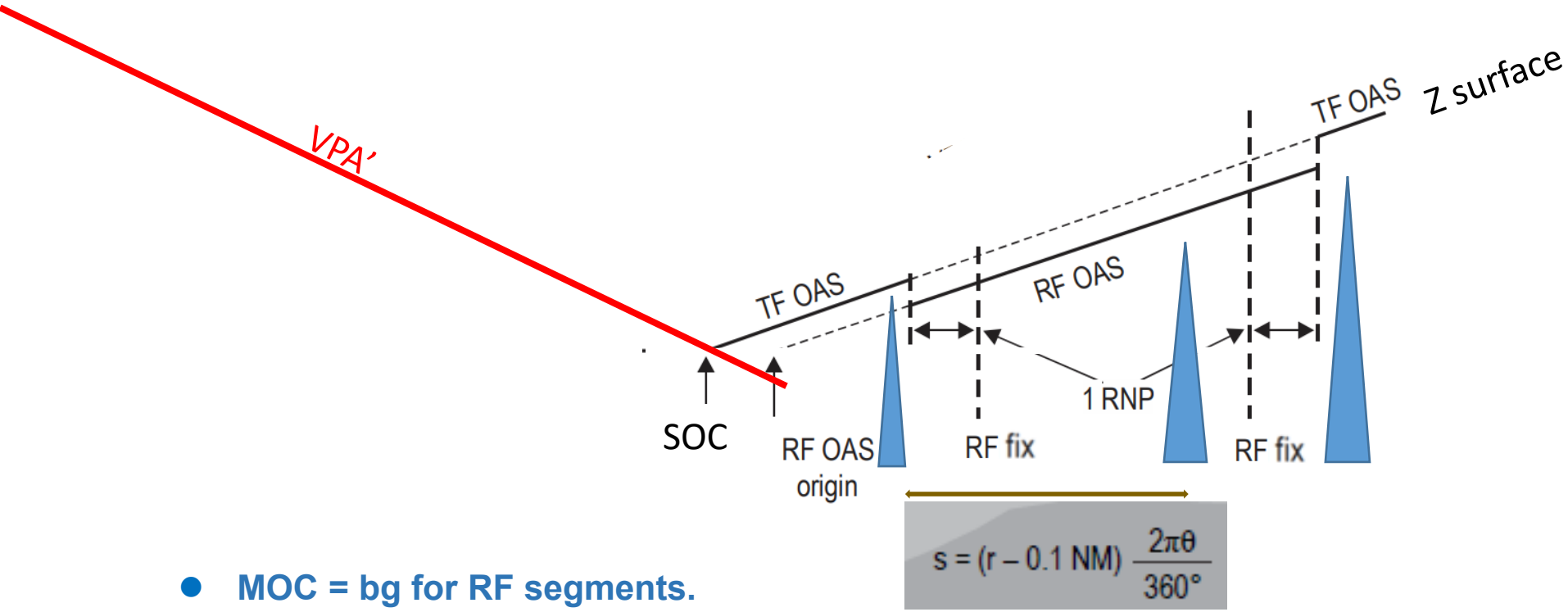
- Obstacle elevation/height shall be less than (RF turn)

$$Ho < (OCA/H - HL) + (dz + s)\tan Z - MOC$$

- s=distance measured along the arc(s), calculated for RF segments using a radius of (r – 0.1 NM),
- $$s = (r - 0.1\ NM)\frac{2\pi\theta}{360^\circ}$$
- dz=horizontal distance from SOC to the turning fix.
- MOC = 0+bg for RF segments.

Determination of OCA/H

- Obstacle elevation/height shall be less than (RF turn)



- **MOC = bg for RF segments.**

Determination of OCA/H

- OCH=the height of the highest approach obstacle (real or equivalent) + HL

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For Specific Vat

$(0.068V_{at} + 28.3)$ metres where V_{at} is in km/h

$(0.125V_{at} + 28.3)$ metres where V_{at} is in kt

Determination of OCA/H

- Height loss margins

Adjustments for high aerodrome elevations:

- ✈ **airfield elevation higher than 900 m (2 953 ft). HL shall be increased by 2% of RA per 300 m (984 ft) airfield elevation.**

Example: Aircraft Category C — Aerodrome elevation: 1 650 m above MSL;

Tabulated allowances: radio altimeter 22 m

(Table II-1-1-2) pressure altimeter 46 m

Correction for aerodrome elevation:

$$22 \times \frac{2}{100} \times \frac{1\,650}{300} = 2.42 \text{ m}$$

Determination of OCA/H

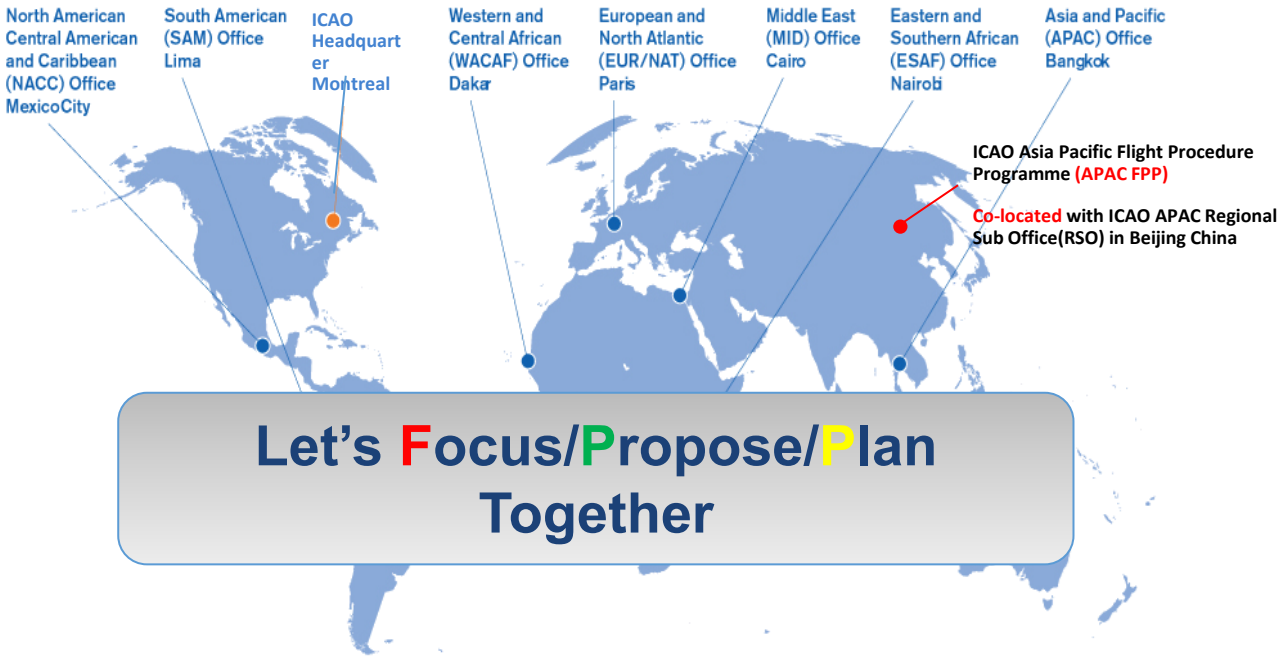
- Height loss margins

Adjustments for steep VPA (VPA <3.5):

Vertical path angles greater than 3.2 degrees

height loss margins shall be increased by 5% of the radio altimeter margin

per 0.1 degree increase in glide path angle



Let's Focus/Propose/Plan Together