

# Safe and precise RNP 0.1 AR procedures in difficult terrain. The latest results and lessons learnt from the ARIOS project (Advanced Rotorcraft IFR Operations in Switzerland)

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*REGA*



# Safe and precise RNP 0.1 AR procedures in difficult terrain



## ARIOS

Advanced Rotorcraft  
IFR Operation in Switzerland

Heinz Leibundgut  
Rega NPFO Helicopter  
EUROPEAN ROTORS Cologne, Nov 16. – 18. 2021

# Agenda

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About us

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HEMS Tripel A's

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ARIOS Project

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ARIOS Insights

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Fixed Radius Transition (FRT)

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Summary

# About Rega



- HEMS operator with 12 bases in Switzerland
- AOC CAT SPA HEMS, -HHO, -NVIS, -PBN; SPO HEC, HESLO, SAR
- ATO, CAMO, MRO, DO
- 7 H145 D2 + 1 H145 D3 (Q4 21)
- 11 Leonardo AW109SP & from 2023 additionally
- 3 AW169 "IceBird"
- AW109 / AW169 (2023)
- Full Flight Simulator
- 3 Challenger CL-650

# Anytime Operation 24/7/365



# Anywhere





# Any weather conditions?

- Also the 600 patients, who cannot be flown today for bad weather conditions are entitled to optimal medical care by air.



# Motivation to push for all-weather OPS

- Improve emergency medical helicopter services by developing and applying procedures that take into account the unique flight dynamics of modern equipped IFR helicopters and access to GNSS navigation solutions.



GIANT: GNSS Introduction in the Aviation Sector



HEDGE: Helicopters Deploy GNSS in Europe



**HEDGE-NEXT**

Helicopter Deploy GNSS in Europe - NEXT

**GARDEN** GNSS-based ATM  
for Rotorcraft to Decrease Noise



European  
Global Navigation  
Satellite Systems  
Agency

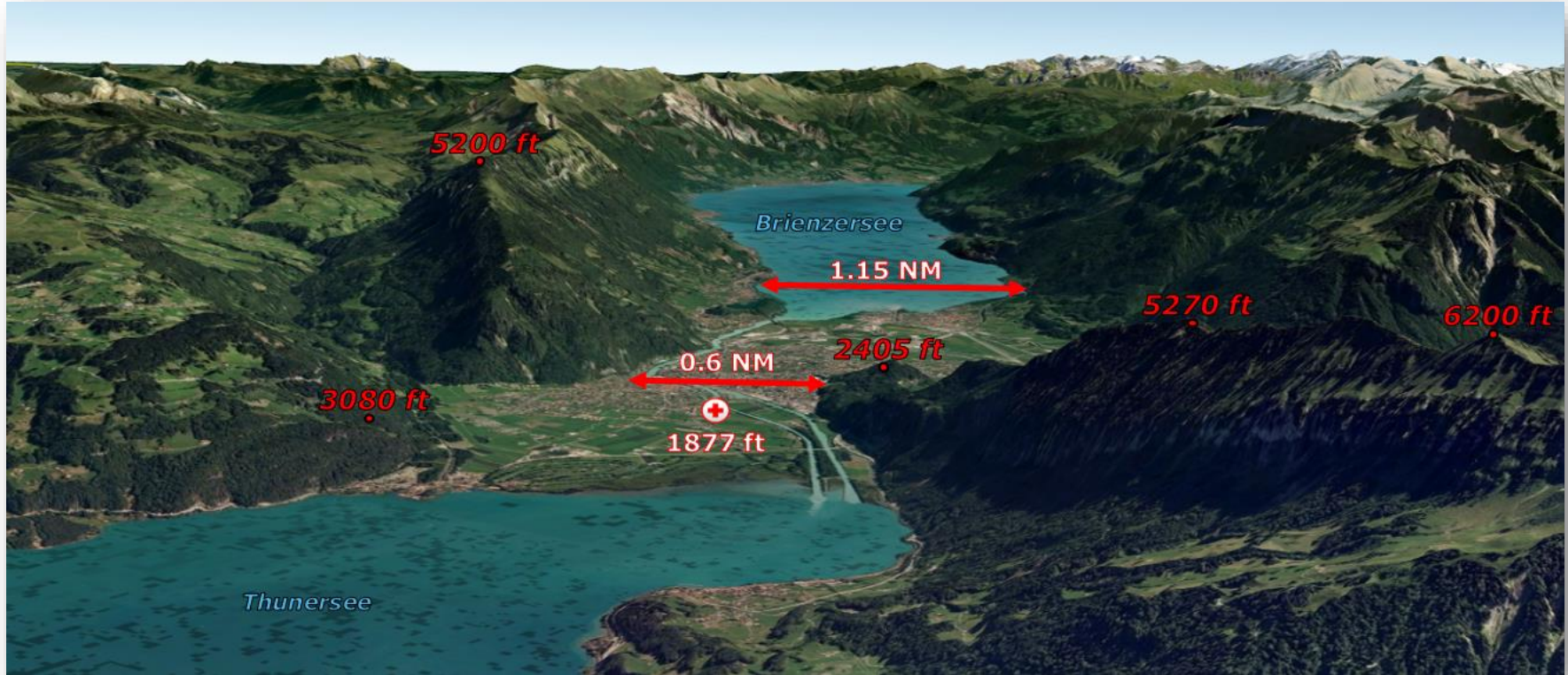
HORIZON 2020



# Helicopter instrument flight procedures in an ambitious landscape



# Location Interlaken/Bernese Highlands







Brienzersee

## Interlaken Hospital LSHK

N 46° 40' 51"

E 07° 50' 39"

1877ft

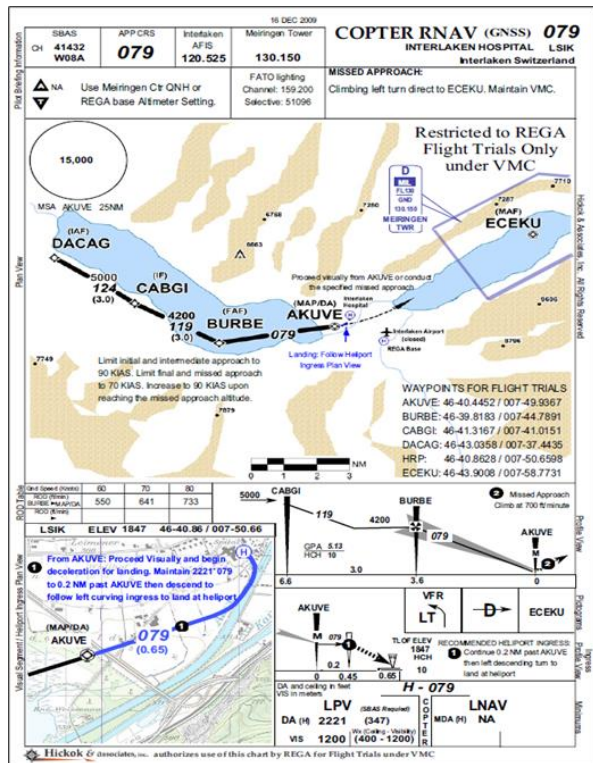


# "History"



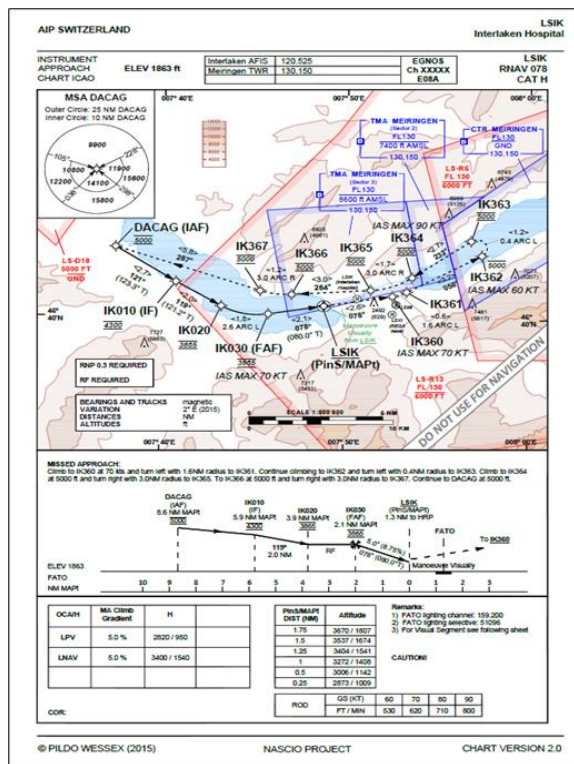
## Main features:

- DEC 2009
- FAA criteria
- RNP APCH
- GPA 5.13°
- MAS towards Lake Brienz to ECEKU and maintain VMC
- MACG 8%



DA and ceiling in feet VIS in meters		<b>H - 079</b>	
LPV		(SBAS Required)	LNNAV
DA (H)	2221	(347)	MDA (H) NA
VIS	1200	Wx (Ceiling Visibility) (400 - 1200)	

# "History"



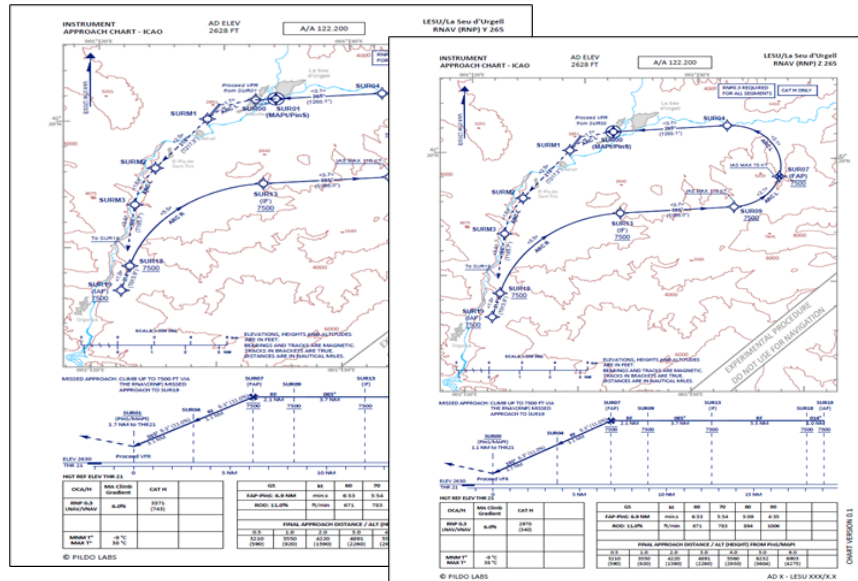
## Main features:

- AUG 2015
- RNP 0.3 + RNP APCH (FAS) + RF legs
- MOC increased 100%
- GPA 5°
- MAS towards Lake Brienz and turn back to IAF
- MACG 5%

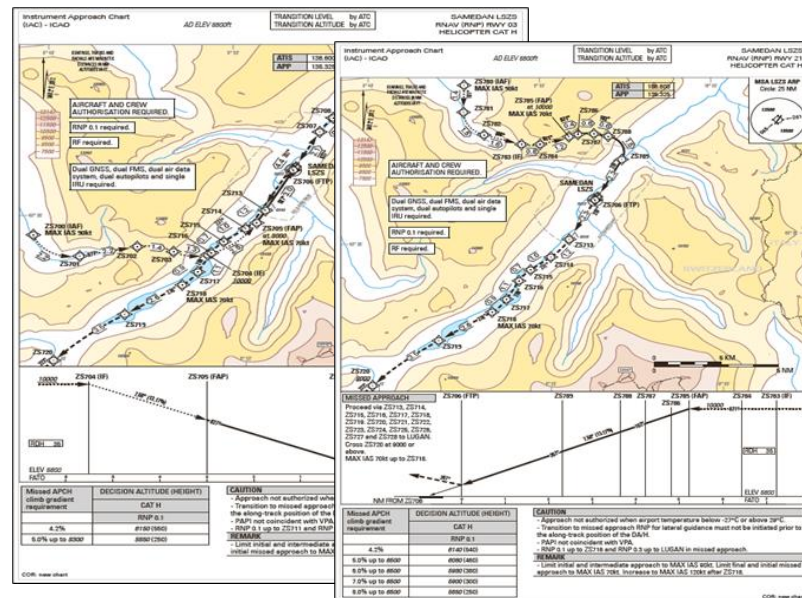
OCA/H	MA Climb Gradient	H
LPV	5.0 %	2820 / 950
LNAV	5.0 %	3400 / 1540



# LESU PinS RNP-AR 0.3



## LSZS PinS RNP-AR 0.1





# Interlaken Hospital (LSHK)

## Approach Minima

APCH Type	OCA(H) (ft)
LNAV	3400 (1540) with MACG 5%
LPV	2820 (950) with MACG 5%
LPV FAA	2221 (347)
RNP AR 0.3	2770 (893) with MACG 7%
RNP AR 0.2	2260 (383) with MACG 7%
RNP AR 0.15	2230 (353)
RNP AR 0.1	2220 (343)

# Chicken or egg situation

- RNP-AR IFP design criteria exist for aeroplanes
- No PANS OPS criteria for RNP-AR departures
- Helicopter RNP-AR and helicopter PinS RNP-AR procedures design criteria do not exist yet
- As no helicopter RNP-AR procedures exist, because the criteria are not available, OEMs will not produce RNP-AR approved helicopters.

# ARIOS (Advanced Rotorcraft IFR Operations in Switzerland)

- Develop procedural criteria for helicopter RNP-AR approach procedures.
- Acceptance of the procedural criteria by SFCOA for the ARIOS project.
- Establishment of the helicopter RNP-AR procedures in Samedan and Interlaken.
- Verification and evaluation of the flight accuracy of the procedures under normal and abnormal conditions.
- Preparation of the required documentation (OM/TM) for a helicopter RNP-AR OPS approval.

# Flight Trials





## Location Samedan Airport LSZS

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N 46° 32' 06"

E 09° 53' 06"

5602ft MSL





# LSZS CAT-H RNP-AR 0.1 DEP RWY 03

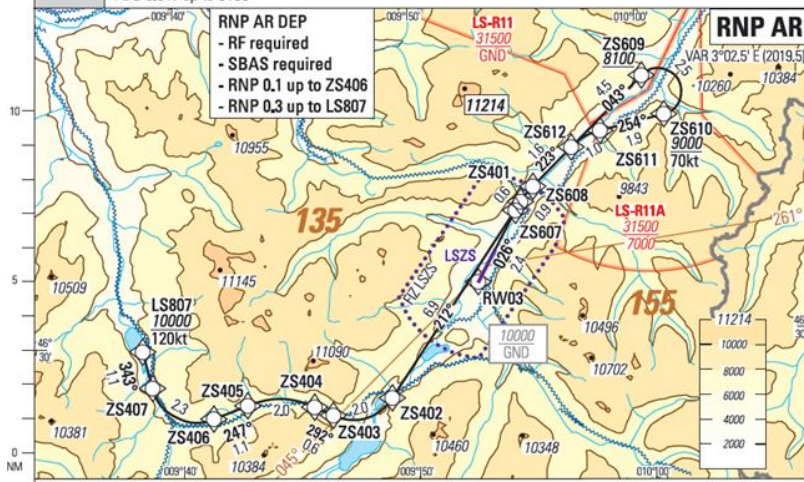


26.10.2020 10-1

Samedan - LSZS  
SID RWY 03 - RNP AR  
CAT H

SAM ATIS 136.600	SAM AFIS 135.325	ZRH DELTA 119.225				<b>LS801N</b>
INITIAL DEP CRS <b>026°</b>	ZS609 <b>8100</b>	ZS610 <b>9000</b>	LS807 <b>10000</b>	ARP ELEV <b>5602</b>		QNH/WX LSZS

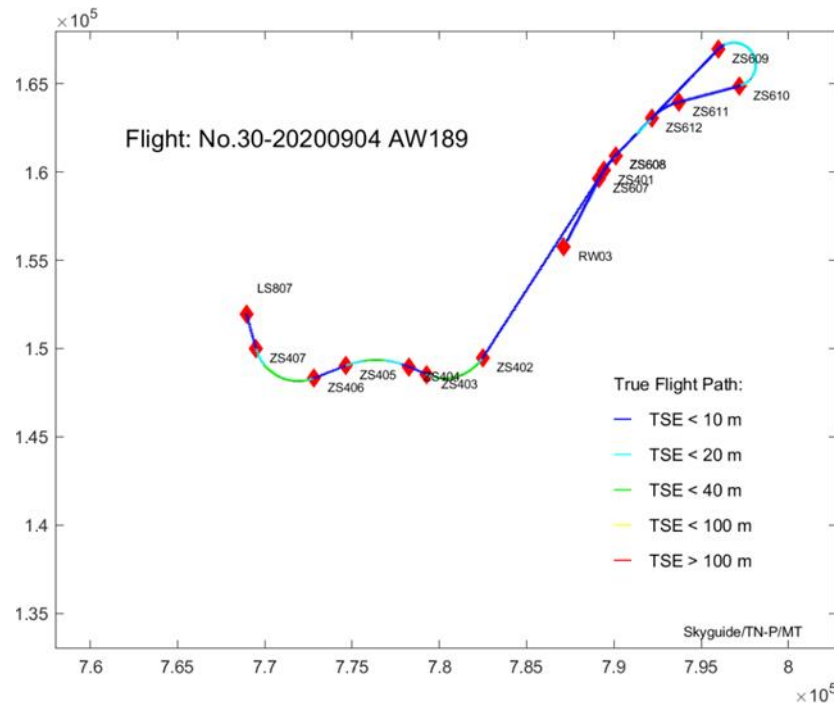
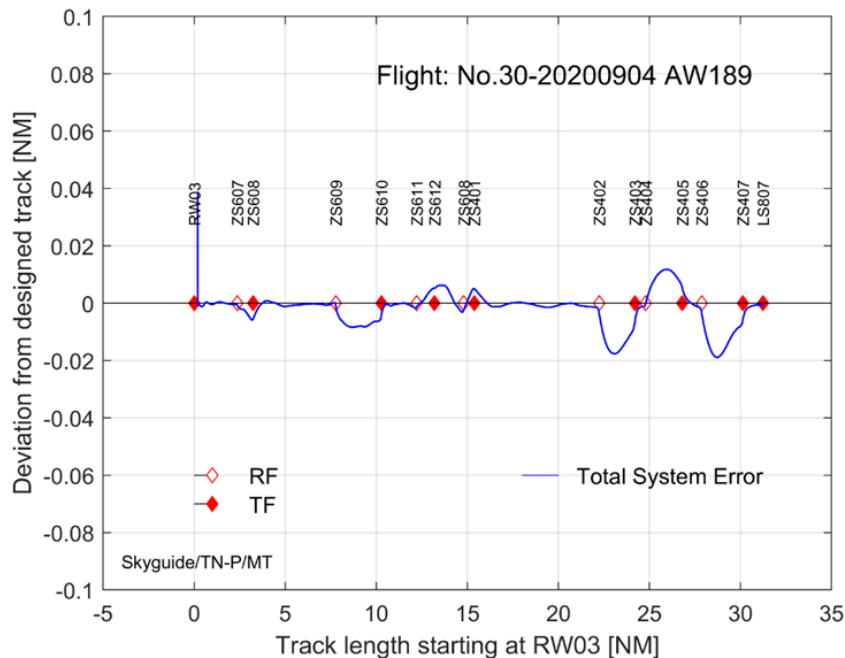
**LS807 1N** Proceed via ZS607, ZS608, ZS609, ZS610 (MAX IAS 70 kt), ZS611, ZS612, ZS608, ZS401, ZS402, ZS403, ZS404, ZS405, ZS406, ZS407 to LS807 (MAX IAS 120 kt).  
Cross ZS609 at **8100** or above, ZS610 at **9000** or above, LS807 at **10000** or above.  
PDG 5.9% up to **9100**



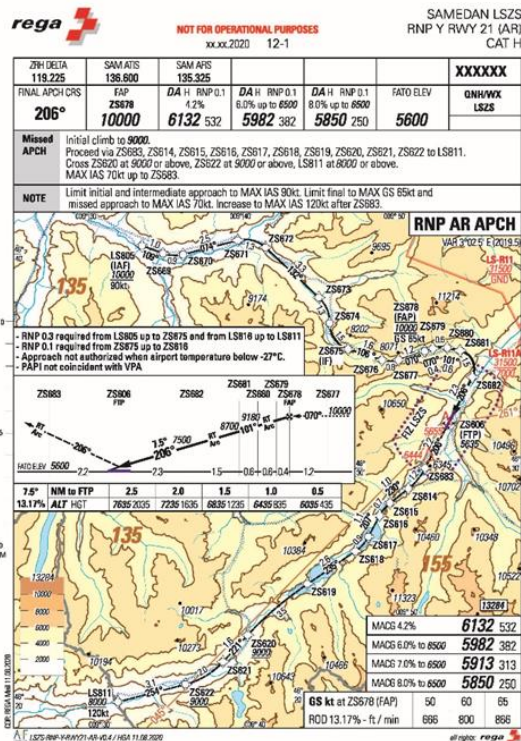


# TSE LSZS

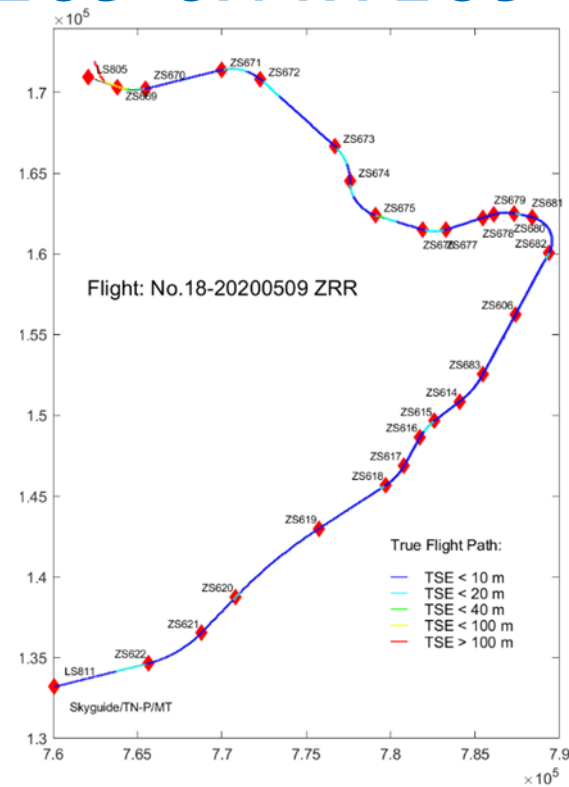
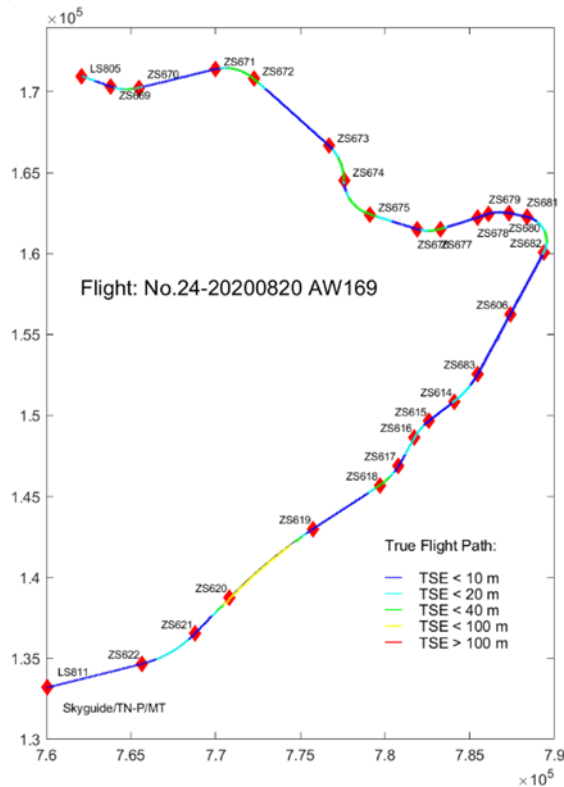
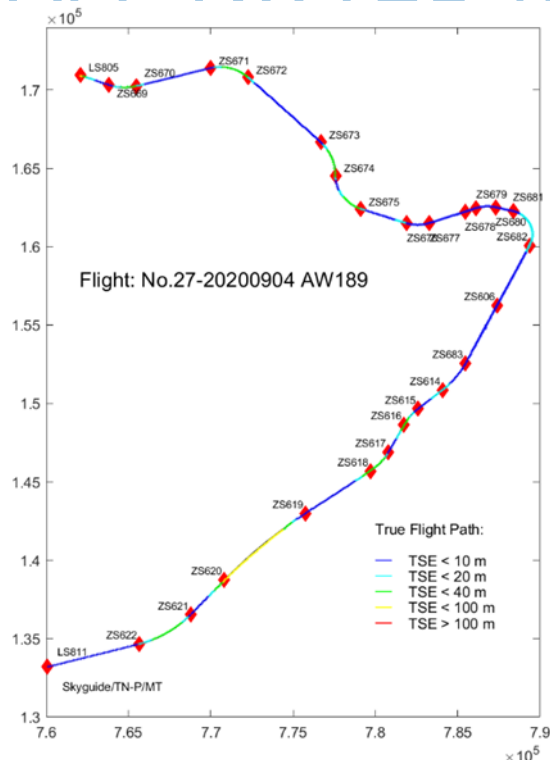
## RNP-AR 0.1 DEP RWY 03 AW189



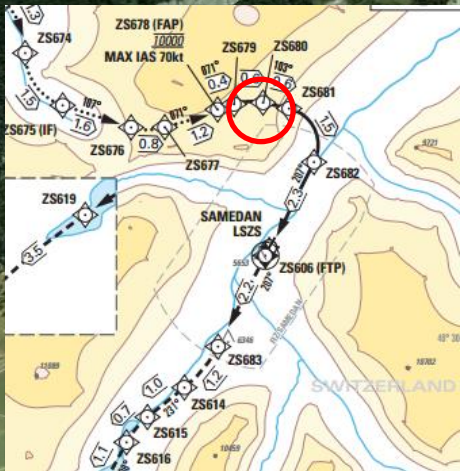
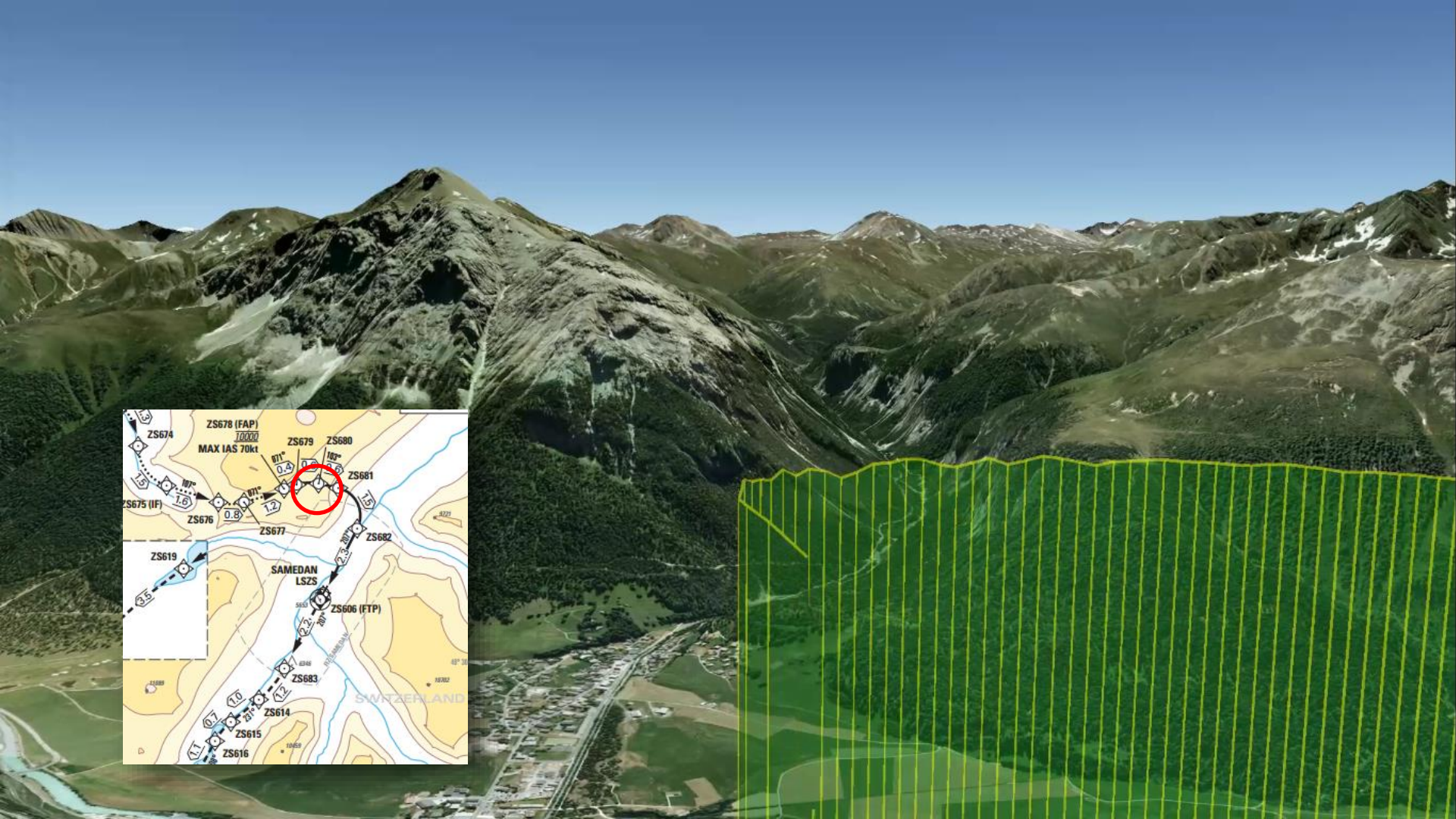
# LSZS CAT-H RNP-AR 0.1 APP RWY



# TSE comparison LSZS RNP-AR 0.1 APP RWY21 with AW189, AW169 & AW109



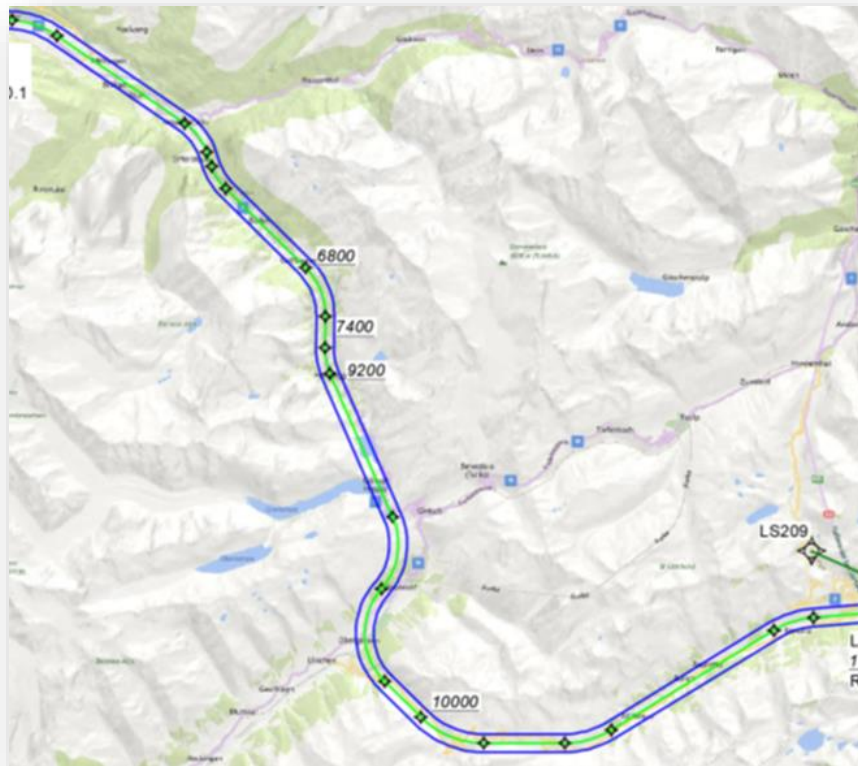








# Fixed Radius Transition (FRT)



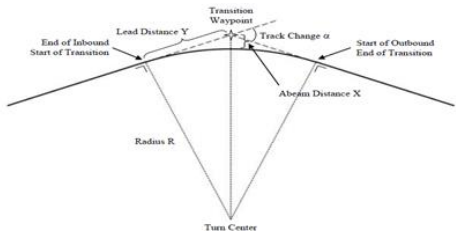
- The fixed radius transition (FRT) was intended to be used in en-route procedures above FL195
- Why not use them for helicopter LFN routes?
- Skyguide provided a coding of the LFN airway KY258 using FRTs
- The Leonardo and Genesys FMS are capable to perform FRT as requested



# RF and FRT-legs

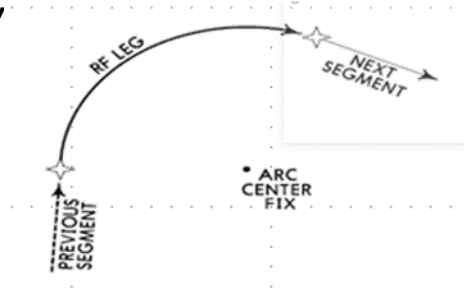
## Radius-to-Fix leg (RF-leg)

- In terminal environment only due to use of path terminators (ARINC 424 standards)
- Intended for obstacle clearance purposes
- 2 Waypoints (start and end of turn) as well as an arc center
- **Only one-directional**
- Can entail altitudes and speeds at start and end of turn

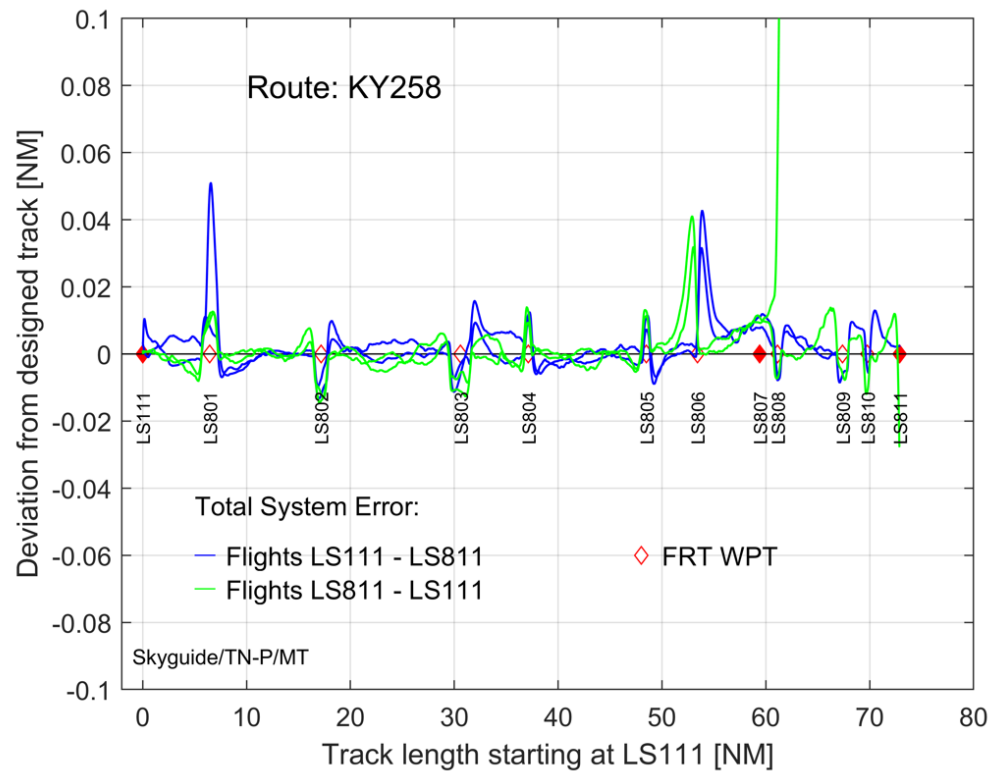
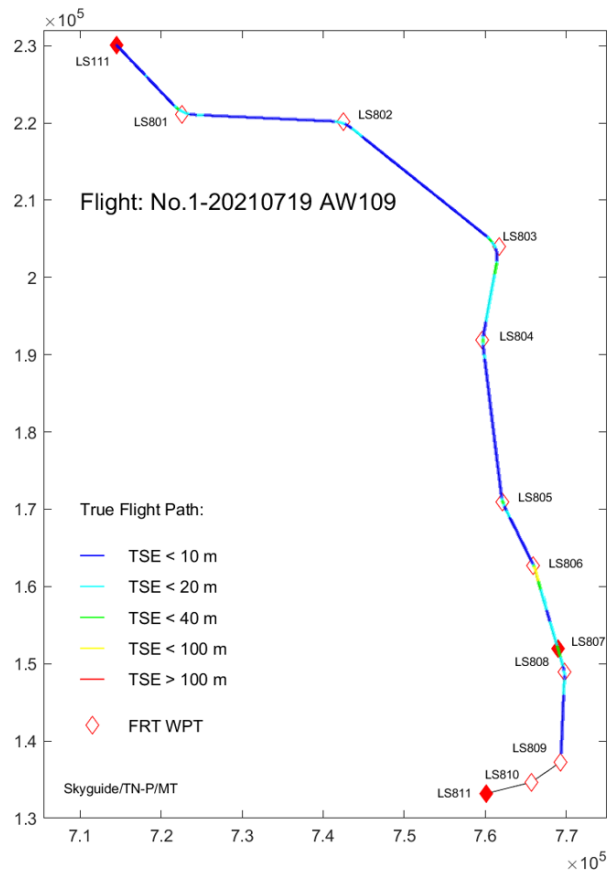


## Fixed Radius Transition (FRT)

- In en-route environment, where no path-terminators (like RF) can be used, intended for separation purposes by ensuring repeatable precise en-route turns without differences in turn-anticipation due to individual aircraft & avionics
- Obstacle clearance benefits can be "harvested"
- 1 waypoint



# FRT flight trial



# FRT – open questions

IFP protection concept to be defined (not yet clear within IFPP)

How to manage the interface between two routes in case of prescribed FRT as

- FRT is always applicable if prescribed for one WPT and
- FRTs can only be constructed by RNP systems up to a maximum turn angle of 90°

Charting/publication unclear

- It is an additional functionality for RNP, so how to ensure that all users are FRT-capable and how to restrict the use of FRT routes
- No standard for publication (yet)
- PBN manual only attributes FRT to RNP 4, RNP 2 and A-RNP -> RNP 0.3 for helicopters not (yet?) included

Discrepancy between

- ARINC 424 standard (FRT freely selectable with a 0.1 NM resolution);
- PBN manual (only 2 fixed values for FRTs; 22.5 NM and 15 NM)

# RNP-AR OPS Approval

- Establish RNP-AR and PinS RNP-AR IFP criteria
- SFOCA accept ARIOS IFP criteria
- ATC CONOPS (70%)
- Flight validation AW109
- GPS EGNOS Performance Assessment
- Meteo Study Airport LSZS
- AW109 RNP-AR 0.3 Approach C of A
- AW109 FFS RNP-AR 0.3 Approach
- SPA OMA & OMD RNP-AR SFOCA

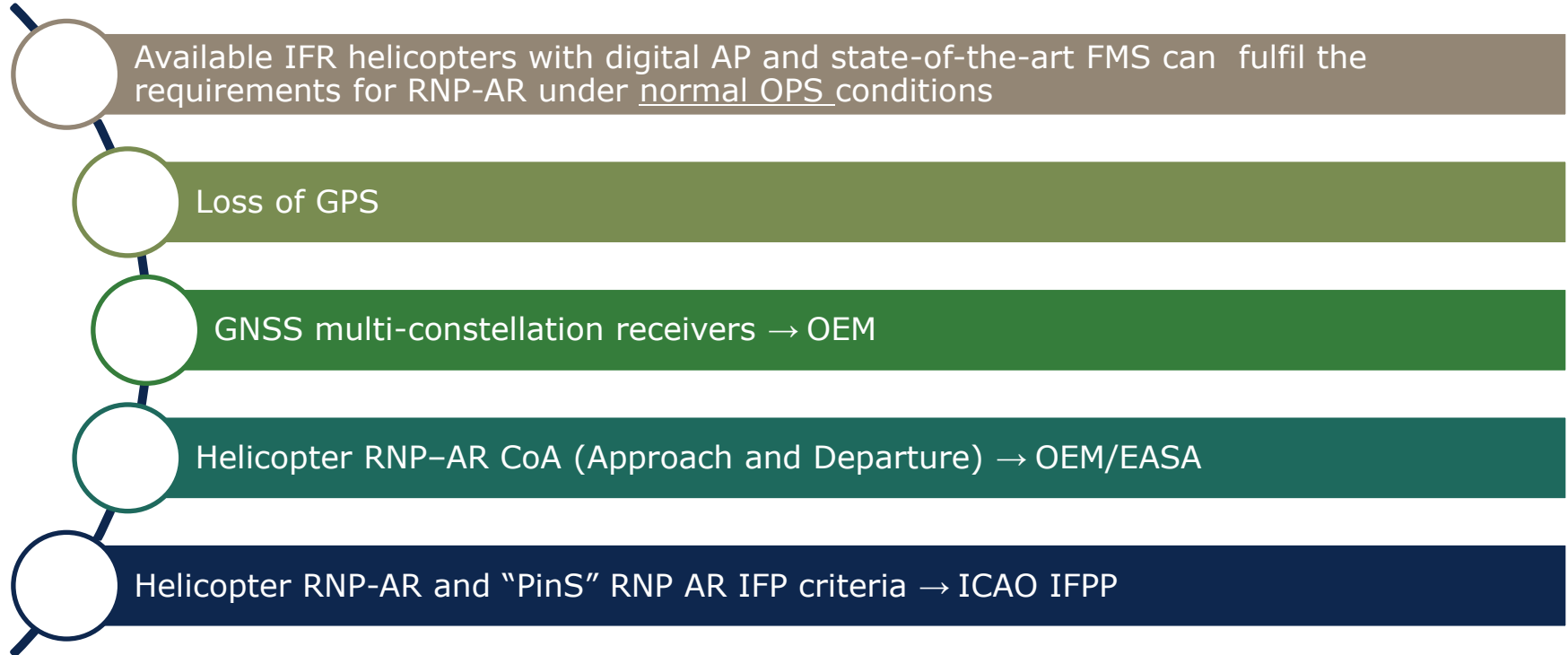


# ARIOS activities 2022

- RFM including AW109 RNP-AR 0.3 DEP and MAS
- Rega AOC SPA for Helicopter RNP-AR
- AW109 FOSA RNP-AR 0.3 DEP
- AW169 RNP-AR 0.1 / FRT “GPS outage”



# Summary







**Thank you for your kind attention**