B1 - Demonstration Report

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Aegean, Airbus ProSky; Air France; DCAC (Department of Civil Aviation Cyprus) ; DSNA (Direction des Services de la Navigation Aérienne); easyJet ; Emirates ; HCAA (Hellenic Civil Aviation Authority) ; NAV Portugal ; Novair, TAP Portugal, Air Corsica	

Abstract

This document illustrates the Demonstration Report for the RISE (RNP Implementation Synchronized in Europe) Project, highlighting the purpose and execution of the demonstrations exercises, assessment and methodology of collected data, and the obtained results.
More than 500 demonstration flights were achieved to Madeira, Nice, Ajaccio, Corfu, Iraklion, Mykonos, Santorini, Paphos and Larnaca, using the newly developed PBN procedures.
The results of the project highlight the benefits linked to the use of those procedures in terms of accessibility, safety enhancement, trajectory repeatability, avoidance of sensitive zones, track miles and fuel consumption reduction. Those results clearly

illustrate stakeholder interest and support in current PBN implementation plan in Europe, and pave the way to large deployment of PCP AF#1.

Authoring & Approval

Prepared By – *Authors of the document.*		
Name & Company	Position & Title	Date
[redacted] TAP Portugal		3 Oct 2016
[redacted] Air France		3 Oct 2016
[redacted] / Novair		3 Oct 2016
[redacted] Aegean		3 Oct 2016
[redacted] Emirates		4 Oct 2016
[redacted] / easyJet UK easyJet Switzerland		4 Oct 2016 4 Oct 2016
[redacted] / Air Corsica		29 Sept 2016
[redacted] / DSNA		30 Sept 2016
[redacted] DCAC		4 Oct 2016
[redacted] HCAA		30 Sept 2016
[redacted] NAV Portugal		30 Sept 2016
[redacted] / Airbus ProSky		29 Sept 2016

Reviewed By – *Reviewers internal to the project.*		
Name & Company	Position & Title	Date
[redacted] TAP Portugal		3 Oct 2016
[redacted] Air France		3 Oct 2016
[redacted] Novair		3 Oct 2016
[redacted] / DSNA		4 Oct 2016
[redacted] DCAC		4 Oct 2016
[redacted] HCAA		30 Sept 2016
[redacted] NAV Portugal		30 Sept 2016

Reviewed By – *Other SESAR projects, Airspace Users, staff association, military, Industrial Support, other organisations.*		
Name & Company	Position & Title	Date
[redacted] NATS		4 Oct 2016

Approved for submission to the SJU By - *Representatives of the company involved in the project.*		
Name & Company	Position & Title	Date
[redacted] Airbus ProSky		29 Sept 2016

Rejected By - *Representatives of the company involved in the project.*		
Name & Company	Position & Title	Date

Rational for rejection
None.

Document History

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00.02.00	29 Sept 2016	VALIDATED	See above	Includes comments raised by the SJU in the assessment report dated 23rd Sept 2016, and by EASA/SJU by email dated 29th Sept 2016.

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Executive summary

The RISE project stands for “RNP Implementation Synchronized in Europe”.

This project was led by a Consortium formed between:

- Airbus ProSky,
- Four ANSPs: DCAC (Cyprus Department of Civil Aviation), DSNA (Direction des Services de la Navigation Aérienne), HCAA (Hellenic Civil Aviation Authority), NAV Portugal,
- Three Airlines: Air France, TAP Portugal, Novair.

Also, additional airlines (called “participant airlines” or “participating airlines” in this document), without being a consortium member, participated to RISE project (participation to meetings and/or participation to the trials):

- easyJet, Emirates, Aegean Airlines, Air Corsica, SAS, Air Berlin, Edelweiss, Rossiya Airlines, Austrian Airlines, Etihad.

The project’s objective was to demonstrate the benefits of SESAR solutions (solution #62 “Enhanced Terminal Airspace for RNP-based Operations”, and solution #9 “Enhanced terminal operations with automatic RNP transition to ILS/GLS”) in real life environment, focusing on lot 2 (Solutions targeting improvements in particular, but not necessarily limited to, a small/medium size airport) and specifically addressing Precision Arrival and Departure Procedures focus area. The project’s objectives per airport were numerous and adapted to each airport: improve access to airport (for example by lowering the decision height), enhance safety by replacing existing circle to land procedures and defining fully managed procedures, define fully repeatable procedures avoiding non-authorized penetration of airspace, reduce track miles and fuel consumption.

The RISE initiative included design and validation of new specific approach trajectories to the following airports:

- RNP AR and RNAV Visual procedures to Nice runways 22L and 22R,
- RNP AR procedures to Ajaccio runway 20,
- RNP AR procedures to Madeira runways 05 and 23,
- RNP AR procedures to Horta runways 10 and 28,
- RNP1 to ILS and RNAV Visual procedures to Paphos runway 29,
- RNP1 to ILS and RNAV Visual procedures to Larnaca runway 22,
- RNP AR procedures to Mykonos runway 16 and RNP APCH procedure to Mykonos runway 34,
- RNP AR procedures to Santorini runways 16 and 34 and RNP APCH procedure to Santorini runway 16.

The project scope also included training or briefing of local ATC personnel and one demonstration flight in Iraklion (RNP APCH to runway 27) and Corfu (RNP APCH to runway 35), where PBN procedures have already been developed (not part of RISE project).

Also, the project allowed gathering live data from most operators. In addition, Radar or ADS-B Tracking data were also collected to demonstrate repeatability of the procedures.

The results of the project highlight the benefits linked to the use of those procedures in terms of accessibility, safety enhancement, trajectory repeatability, avoidance of sensitive zones, track miles and fuel consumption reduction. Those results clearly illustrate stakeholder interest and support in current PBN implementation plan in Europe and pave the way to large deployment of PCP AF#1.

Finally, the RISE initiative addressed issues concerning the future approval and publication of these types of procedures as State Authorities and Regulators, even though not all identified as members, fully cooperated in the project.

1 Introduction

1.1 Purpose of the document

This document provides the Demonstration report for the RISE project (Large Scale Demonstration project 02.08). It describes the results of demonstration exercises defined in RISE Demonstration Plan version 00.00.05 dated 6th of August 2015, and how they have been conducted.

1.2 Intended readership

The RISE integrated flight trials demonstration report is primarily intended to the Consortium Members and Participating Airlines of the project.

In addition this document may also be of interest, but not limited to, the SESAR OFA leaders, and the audience detailed in paragraph 7.2 of the Demonstration Plan (ref [3]) and reminded here below:

- Associations and their members, Industry:
  - IATA: Air Transport Association
  - AEA: Association of European Airlines
  - EBAA: European Business Aviation Association
  - ELFAA: European Low Fares Airline Association
  - IACA: International Air Carrier Association
  - IAOPA: International Aircraft Owners and Pilots Association Europe
  - CANSO: Civil Air Navigation Services Organization
  - ACI: Airports council international
  - IFATCA: International Federation of Air Traffic Controller's Associations
  - ATCEUC: Air Traffic Controllers European Union Coordination
  - Avionics and aircraft manufacturers
- Institutional decision-makers
  - CAA- Civil Aviation Authorities
  - EASA- European Aviation Safety Agency
  - ICAO- International Civil Aviation Organization
  - EUROCAE- European Organization for Civil Aviation Equipment
  - Representatives of the European Commission (DG MOVE, DG ENV)

1.3 Structure of the document

The document is divided in the following sections:

- Section 1: Introduction;
- Section 2: Presents how this project and the planned demonstration activities are related with the SESAR program;
- Section 3: Explains the project organization, deliverables and risk management methodology
- Section 4: Provides an overview of the exercise executions;
- Section 5: Illustrates the exercise results per type of procedure, and project's conclusion;
- Section 6: Gives the exercises reports per airport;

- Section 7: Summarizes the project's communication activities;
- Section 8: Presents next steps, overall lessons learn and recommendations that can be useful for other similar projects; and future approval and publication of PBN procedures;
- Section 9: Provides the list of applicable and reference documents.

1.4 Glossary of terms

N/A

1.5 Acronyms and Terminology

Term	Definition
ACC	Area Control Centre
AIP	Aeronautical Information Publication
ANSP	Air Navigation Service Provider
APS	Airbus ProSky
ARR	Arrival
ATC	Air Traffic Control
ATCo	Air Traffic Controller
ATM	Air Traffic Management
ATS	Air Traffic Services
CAA	Civil Aviation Authority
CAT	Category
CDO	Continuous Descent Operations
CTR	Control Zone
DSNA	Direction des Services de la Navigation Aérienne
DEG	Degree
DEP	Departure
DFDR	Digital Flight Data Recorder
DTG	Distance To Go
E-ATMS	European Air Traffic Management System
E-OCVM	European Operational Concept Validation Methodology
EGPWS	Enhanced Ground Proximity Warning System

Term	Definition
FDP	Flight Data Processor
FDR	Flight Data Recorder
FIR	Flight Information Region
FL	Flight Level
FMS	Flight Management System
FPL	Flight Plan
GNSS	Global Navigation Satellite Systems
HCAA	Hellenic Civil Aviation Authority
IAF	Initial Approach Fix
ICAO	International Civil Aviation Organisation
ILS	Instrument Landing System
INAC, I.P.	Portuguese Aviation Authority (Instituto Nacional da Aviação Civil)
KPA	Key Performance Area
KPI	Key Performance Indicator
LCLK	Larnaca ICAO code
LCPH	Paphos ICAO code
LCTR	Locator
LFKJ	Ajaccio ICAO code
LFMN	Nice ICAO code
LGIR	Iraklion ICAO code
LGKR	Corfu ICAO code
LGMK	Mykonos ICAO code
LGSR	Santorini ICAO code
LoA	Letter of Agreement
LPHR	Horta ICAO code
LPMA	Madeira ICAO code
MSL	Mean Sea Level

Term	Definition
OACC	Oceanic Area Control Centre
OFA	Operational Focus Area
PBN	Performance Based Navigation
P-RNAV	Precision RNAV
QAR	Quick Access Recorder
RNAV	Area Navigation
RNP	Required Navigation Performance
RNP AR	Required Navigation Performance with Authorization Required
RT	Radio Telephony
RWY	Runway
SESAR	Single European Sky ATM Research
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
STAR	Standard Arrival Route
SW	Software
TMA	Terminal Area
TOD	Top of Descent
TWR	Tower
WP	Work Package

2 Context of the Demonstrations

2.1 Scope of the demonstration and complementarity with the SESAR Programme

The scope of the RISE project was to design, validate, train/brief the air traffic controllers and perform flight trials of RNP AR, RNP APCH, RNP1 to ILS and RNAV Visual procedures to Nice, Ajaccio, Madeira, Horta (all activities excepts flight trials for Horta), Mykonos, Santorini, Paphos and Larnaca airports. The project also included training of the air traffic controllers and one flight in Corfu and Iraklion. The project's objectives per airport were numerous and adapted to each airport: improve access to airport (for example by lowering the decision height), enhance safety by replacing existing circle to land procedures and defining fully managed procedures, define fully repeatable procedures avoiding non-authorized penetration of airspace, reduce track miles and fuel consumption.

The below tables give an overview on the conducted exercises:

Demonstration Exercise ID and Title	**EXE-02.08-D-001 : RNP AR and RNAV Visual Operations at LFMN (Nice)**
Leading organization	DSNA, Air France, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. • Airport accessibility, • Safety, • Environment.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator - Revenue flight **Output:** - Procedures charts - Simulator reports - Flight data and questionnaires analysis and comments/recommendations
Number of trials	21 flights conducted by Air France

Demonstration Exercise ID and Title	**EXE-02.08-D-002 : RNP AR Operations at LFKJ (Ajaccio)**
Leading organization	DSNA, Air Corsica, Air France, easyJet, Airbus ProSky

Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. • Airport accessibility, • Safety, • Environment.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator - Revenue flight **Output:** - Procedures charts - Simulator reports - Flight data and questionnaires analysis and comments/recommendations
Number of trials	49(*) flights conducted by Air France 13(*) flights conducted by easyJet 160(*) flights conducted by Air Corsica

(*) The above mentioned numbers have been provided by the airlines. The number of flight trials monitored by Ajaccio Air Traffic Controllers is the following:

32 flights conducted by Air France
6 flights conducted by Easyjet
8 flights conducted by Air Corsica
The difference as compared to the number reported by Ajaccio ATC is partially due to the fact that flights have been flown as visual approaches procedures and that some flights did not use the RISE trials phraseology.

Demonstration Exercise ID and Title	EXE-02.08-D-003 : RNP1 to ILS and RNAV Visual Operations at LCPH (Paphos)
Leading organization	DCAC, easyJet, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. • Safety, • Environment, • Track miles reduction, • Fuel savings and CO2 emission reduction.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator - Revenue flight **Output:** - Procedures charts - Simulator reports - Flight data and questionnaires analysis and comments/recommendations
Number of trials	32 flights conducted by easyJet

Demonstration Exercise ID and Title	EXE-02.08-D-004 : RNP1 to ILS and RNAV Visual Operations at LCLK (Larnaca)
Leading organization	Aegean, easyJet, Emirates, DCAC, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. • Safety, • Environment, • Track miles reduction, • Fuel savings and CO2 emission reduction.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities

	- Full Flight Simulator - Revenue flight **Output:** - Procedures charts - Simulator reports - Flight data and questionnaires analysis and comments/recommendations
Number of trials	3 flights conducted by easyJet 11 flights conducted by Aegean 28 flights conducted by Emirates 2 flight conducted by Edelweiss 10 flights conducted by Rossiya Airlines 1 flight conducted by Austrian Airlines 3 flights conducted by Etihad

Demonstration Exercise ID and Title	**EXE-02.08-D-005 : RNP AR and RNP APCH Operations at LGMK (Mykonos)**
Leading organization	Aegean, easyJet, HCAA, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. • Airport accessibility, • Safety, • Track miles reduction, • Fuel savings and CO2 emission reduction.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator - Revenue flight **Output:** - Procedures charts - Simulator reports - Flight data and questionnaires analysis and comments/recommendations
Number of trials	16 flights conducted by Aegean 32 flight conducted by easyJet

(*) The above mentioned number has been provided by HCAA. The number of flight trials reported by easyJet is 25 flights for easyJet. The difference is due to the difficulty to sometimes get pilot's feedback/questionnaires

Demonstration Exercise ID and Title	EXE-02.08-D-006 : RNP AR Operations at LGSR (Santorini)
Leading organization	Novair, easyJet, Aegean, HCAA, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. • Airport accessibility, • Safety, • Track miles reduction, • Fuel savings and CO2 emission reduction.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator - Revenue flight **Output:** - Procedures charts - Simulator reports - Flight data and questionnaires analysis and comments/recommendations
Number of trials	17 flights conducted by Novair 30 flights conducted by easyJet 22 flights conducted by Aegean

Demonstration Exercise ID and Title	EXE-02.08-D-007 : RNP APCH Operations at LGIR (Iraklion)
Leading organization	Novair, HCAA
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Revenue flight **Output:** - Operator and Air Traffic Controllers feedback

	- Simulator report
Number of trials	2 demonstration flights conducted by Novair

Demonstration Exercise ID and Title	**EXE-02.08-D-008 : RNP APCH Operations at LGKR (Corfu)**
Leading organization	Novair, HCAA
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Revenue flight **Output:** - Operator and Air Traffic Controllers feedback - Simulator Report
Number of trials	2 demonstration flights conducted by Novair

Demonstration Exercise ID and Title	**EXE-02.08-D-009 : RNP AR Operations at LPMA (Madeira)**
Leading organization	TAP Portugal, NAV Portugal, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. • Airport accessibility, • Safety.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator - Revenue flight **Output:** - Procedures charts - Simulator reports

	- Flight data and questionnaires analysis and comments/recommendations
Number of trials	42 flights conducted by TAP Portugal 16 flight conducted by SAS 1 flight conducted by Air Berlin

Demonstration Exercise ID and Title	**EXE-02.08-D-010 : RNP AR Operations at LPHR (Horta)**
Leading organization	TAP Portugal, NAV Portugal, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. • Airport accessibility, • Safety.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator **Output:** - Procedures charts - Simulator reports
Number of trials	0 *(see section 4.3 for rationale)*

3 Programme management

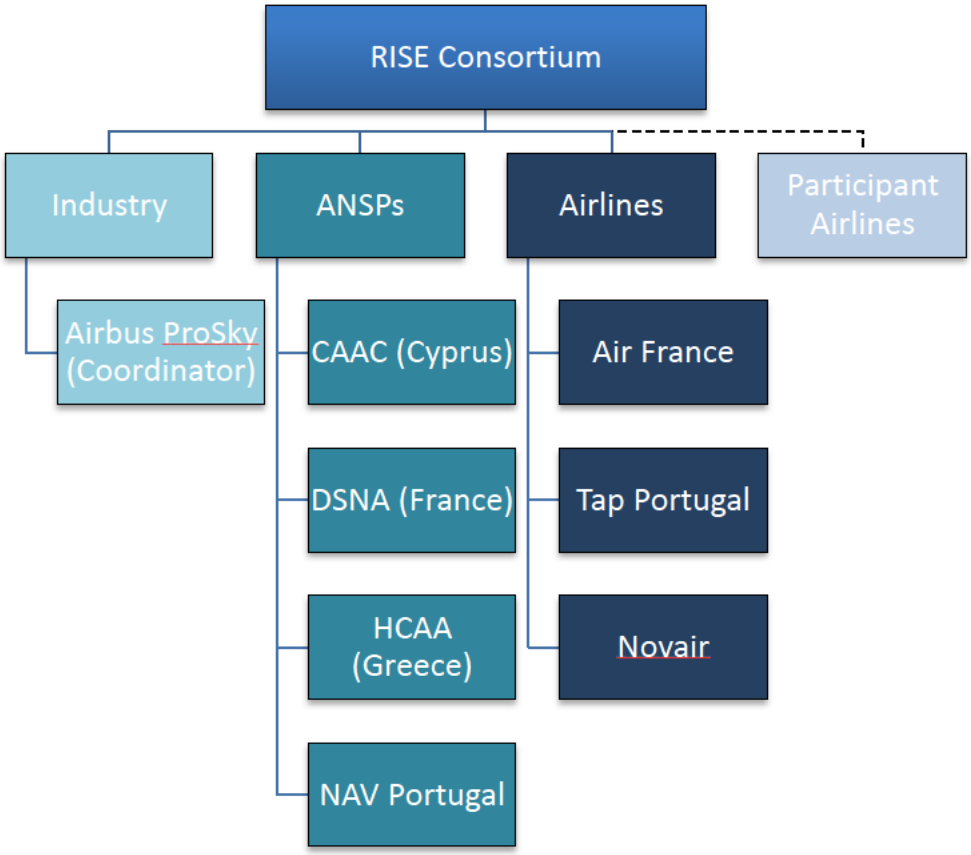
3.1 Organisation

The Consortium of the RISE project was composed by Airbus ProSky (project leader), four European ANSPs (DCAC for Cyprus, DSNA for France, HCAA for Greece and NAV Portugal) and three commercial airlines (Air France, Novair and TAP Portugal).

Also, additional airlines (called "participant airlines" or "participating airlines" in this document), without being a consortium member, participated to RISE project (participation to meetings and/or participation to the trials):

- easyJet, Emirates, Aegean Airlines, Air Corsica, SAS, Air Berlin, Edelweiss, Rossiya Airlines, Austrian Airlines, Etihad.

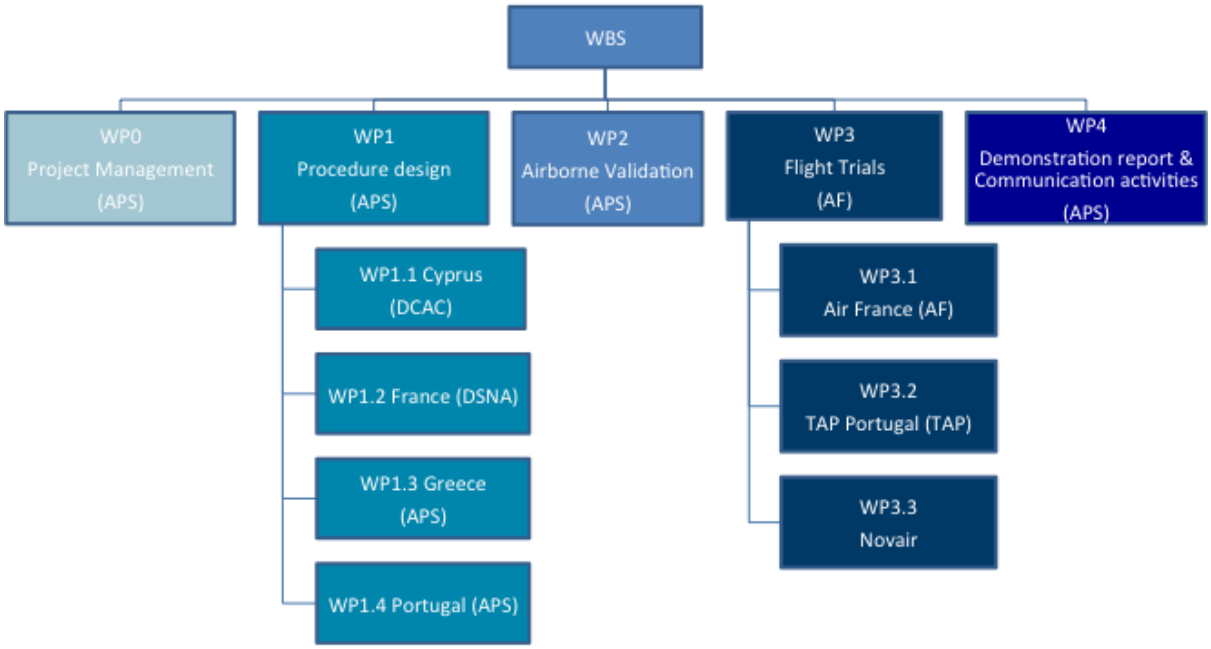
The below figure shows an overview of the project organization:



Even though not part of the Consortium, National Supervisory Authorities/Regulators were involved in the RISE project from the start of the procedure development.

3.2 Work Breakdown Structure

The project was split into 5 work packages:



WP0 (Project Management) concentrated on the overall management and coordination activities of the project, most importantly interfacing with the SJU on behalf of the Consortium Members. Control of the project deadlines, milestones and accomplishments, budget actions, risk management, communications activities and deliverables submission is included as part of this WP.

✓ Airbus ProSky, as project coordinator, led WP0.

WP1 (Procedure design) addressed the design of the flight procedures, the environmental and safety assessments, and the training of the air traffic controllers. The deliverables of this work package include procedure technical reports, procedures coding tables and charts, safety studies (when applicable), environmental studies (when applicable), air traffic controllers training or briefing materials.

✓ The DCAC, in charge of the design of the procedures in Cyprus led WP1.1. The DSNA, in charge of the design of the procedures in France led WP1.2. Airbus ProSky, in charge of the design of the procedures in Greece and Portugal led WP1.3 and 1.4.

✓ Airbus ProSky led WP1.

WP2 (Airborne validation) encompassed the full flight simulator tests, ensuring that the designed procedures are flyable under agreed parameters. The deliverables of this work package are the simulator validation test results.

✓ Airbus Prosky led WP2

WP3 (Flight trials) addressed evaluation of the procedures in revenue flight, as well as flight data analysis. In this phase the Consortium members and participant airlines accomplished more than 500 demonstration flights to the selected airports. The deliverable of this work package are flight crews and air traffic controllers report, reports resulting from the flight data monitoring outputs and radar/ADS-B

tracks obtained from the flights, plus other statistical information that could be obtained during the conduct of these operations.

- ✓ Each airline led the trials to the airports they were operating to.
- ✓ Air France led WP6.

WP4 (Demonstration Report and Communication Activities) was dedicated to the Awareness & Dissemination activities also outlined in the Communications Plan described in Section 7 of this document.

- ✓ Airbus Prosky led WP4.

3.3 Deliverables

The RISE Kick Off meeting took place on the 30th of September 2014 (making the official project T0).

The following formal deliverables have been delivered to the SJU:

Deliverable name	Date
Demonstration Plan (A1) V00.00.01 ***(deliverable code: D01)***	**13th November 2014**
Demonstration Plan (A1) V00.00.02 ***(deliverable code: D01)***	**19th December 2014** **D01 version, accepted with "no reservation"**
Demonstration Plan (A1) V00.00.03 ***(deliverable code: D02)***	**29th May 2015**
Demonstration Plan (A1) V00.00.04 ***(deliverable code: D02)***	**10th July 2015**
Demonstration Plan (A1) V00.00.05 **FINAL VERSION** ***(deliverable code: D02)***	**19th August 2015** **D02 (final) version, accepted with "no reservation".**
Demonstration Report (B1) V00.00.00	**This document**

3.4 Risk Management

Airbus ProSky carried out a continuous monitoring of the risks, as well as of those arising during the project. They were provided and updated regularly on RISE SJU extranet, and highlighted in the SJU Quarterly Reports.

All risks have been closed.

4 Execution of Demonstration Exercises

4.1 Exercises Preparation

The preparation activities included all those necessary to prepare the design, assessment, validation and implementation of the RNP procedures. These included:

- Gathering initial needs from all stakeholders:
- Determining the operational needs, TMA and environmental considerations to propose optimal solutions and design of optimized RNP flight paths;
- Assessing ATCos constraints and needs to define the desired solution that would fit with local traffic management strategies;
- Assessing the local regulations to agree on acceptable regulatory baselines with the local authorities prior to approval and full implementation of the procedure upon project completion (despite approval not being part of RISE project);
- Assessing local requirements and constraints and thus ensuring that the planned procedures could be easily implemented in the airport environment (i.e.: obstacles, noise-sensitive areas, airspace constraints, traffic complexity, etc).
- Agreeing with the operators what kind of flight data should be considered/captured during flights completed using the conventional procedures applicable to the airport, and those completed using the RNP AR, RNP APCH, RNP1 to ILS and RNAV Visual procedures during the demonstration phase of the project; About how the relevant output flight data should be recorded and stored; and then, about how the resultant data should be processed so that an appropriate comparison of relevant parameters could be easily extracted and presented.

4.2 Exercises Execution

In order to have a wide picture of the activities that needed to be completed before, during and after the demonstration flights, it is necessary to understand the step by step process of the procedure design and associated activities. The intended way in which data has been captured to meet the objectives of the project are explained within each exercise section.

The procedure design process was composed of the conceptual design and the detailed design. When tasked to design procedures, a conceptual design was performed for each airport taking into account the environmental constraints together with the ANSP's and operator's requirements. Items such as the aircraft models, speeds, ATC procedures, AIP information, and operational constraints were all factors taken into consideration during the conceptual design. These design(s) were then presented and discussed during the Kick-Off Meeting. A Kick-Off Meeting for each airport was organized between November 2014 and February 2015.

After presentations and discussions between the interested parties, the conceptual design, project objectives, project planning, applicable regulations were summarized and included in a Project Specifications document (one for each airport), that was validated formally by all stakeholders prior to the start of the detailed design.

The execution activities started at the Kick Off Meetings and continued after the approval of the project specification.

During the detailed design of the procedures, the project managers and procedure designers ensured that the intended trajectories took into consideration all constraints identified in the conceptual design, and that the paths were flyable. Each flight leg of the procedure was checked to ensure that the aircraft was capable of adhering to the different constraints (altitude, speeds, and turn radius). If there were significant changes between the conceptual design and the detailed design, changes had to be approved by all stakeholders.

Each RNP AR, RNP APCH, RNP1 to ILS and RNAV visual instrument procedure was thoroughly evaluated in a representative simulator to verify the fly-ability of the newly designed instrument

procedure. During this evaluation, the effect of the aircraft performance had to be taken into consideration and evaluated in variable conditions such as normal or rare wind and temperature conditions. As necessary, wind and/or temperature limitations might have had to be defined in addition to the temperature limitation, which might have been mandated by the design criteria of the designed procedures.

Also, depending on the airport, safety studies and/or environmental studies have been conducted.

A detailed design review meeting was set by all involved parties for each airport to freeze the final design, and produce final version of the technical report, coding, charts, safety studies and environmental studies (whenever applicable).
Once all the procedures had been accepted by all involved parties and submitted to the Authorities or Regulator for approval for the purpose of flight trials, the Air Traffic Controllers were trained or briefed on PBN operations.

The above described set of activities has been conducted for Nice, Ajaccio, Paphos, Laranca, Mykonos, Santorini, Horta and Madeira airports.
For the particular case of Corfu and Iraklion for which the design and validation of the procedures was not part of RISE project, only training of the ATCos by Airbus Prosky and a flight demonstration by Novair, with the HCAA on board, have been conducted
For the particular case of Horta, all activities except the flight trials have been conducted.

The scope of activities conducted in RISE project is in line with the RISE Demonstration Plan.

The first demonstration/trial flights were performed in May 2015 for Corfu and Iraklion, followed by Santorini in September 2015, Madeira in October 2015, Nice in December 2015, Larnaca and Mykonos in February 2016, Paphos in March 2016, Ajaccio in April 2016.
Flight trials data analysis (operators and ATC questionnaires, flight data recording analysis) were performed during and after the trials phases.

The below table summarizes for each Exercice the start and end dates for the execution and flight data analysis.

Exercise ID	Exercise Title	Actual Exercise execution start date (*)	Actual Exercise end date
EXE-02.08-D-001	RNP AR and RNAV Visual Operations at LFMN (Nice)	Nov 2014 (Feb 2015)	March 2016
EXE-02.08-D-002	RNP AR Operations at LFKJ (Ajaccio)	Feb 2015 (April 2015)	Aug 2016
EXE-02.08-D-003	RNP1 to ILS and RNAV Visual Operations at LCPH (Paphos)	Feb 2015 (June 2015)	July 2016
EXE-02.08-D-004	RNP1 to ILS and RNAV Visual Operations at LCLK (Larnaca)	Feb 2015 (June 2015)	July 2016
EXE-02.08-D-005	RNP AR and RNP APCH Operations at LGMK (Mykonos)	Nov 2014 (June 2015)	Aug 2016

Exercise ID	Exercise Title	Actual Exercise execution start date (*)	Actual Exercise end date
EXE-02.08-D-006	RNP AR Operations at LGSR (Santorini)	Nov 2014 (April 2015)	Sept 2016
EXE-02.08-D-007	RNP APCH Operations at LGIR (Iraklion)	Nov 2014	May 2015
EXE-02.08-D-008	RNP APCH Operations at LGKR (Corfu)	Nov 2014	May 2015
EXE-02.08-D-009	RNP AR Operations at LPMA (Madeira)	Nov 2014 (April 2015)	May 2016
EXE-02.08-D-010	RNP AR Operations at LPHR (Horta)	Feb 2015 (April 2015)	February 2016

(*) Both KOM and project specification approval dates are indicated. Project specification approval date is provided underneath in parenthesis.

4.3 Deviations from the planned activities

As compared to the activities planned in Demonstration Plan V00.00.05, the following items have been added or cancelled:

- Part of Work Packages 1 & 2 (procedure design and airborne validation):
  - An additional RNP APCH procedure has been designed and validated in Santorini Runway 16, in addition to the RNP AR one. This has been requested by operators and air traffic controllers during the Detailed Design Review in September 2015.
  - Environmental studies in Mykonos and Santorini have not been conducted, because they were not required by HCAA, neither for the purpose of RISE trials nor for publication.

This change has been coordinated and agreed with the SJU through Change Request Ref 2329.

In addition, no flight trial has been conducted to Horta, as explained in the Demonstration Plan (and agreed with the SJU at that time) and covered in Change Request Ref 2317.

5 Exercises Results

5.1 Summary of Exercises Results

Exercise ID	Demonstration Objective Tittle	Demonstration Objective ID	Success Criterion	Exercise Results	Demonstration Objective Status
Nice RNP AR and RNAV Visual procedures, and **Ajaccio** RNP AR procedures					
EXE-02.08-D-001 EXE-02.08-D-002	Assess lateral/vertical RNP AR / RNAV Visual approach tracks in Nice and RNP AR in Ajaccio	OBJ-02.08-01	Fly ability deemed satisfactory Positive or no impact on safety Positive or no impact on airport capacity	See 6.1.3.1.1.1 and 6.2.3.1.1.1	OK
EXE-02.08-D-001	Improve access to Nice airport by reducing minima	OBJ-02.08-02	Newly published minima < 500ft Increased number of flights that could land using the new procedure and cannot do so in current operations.	See 6.1.3.1.1.2	OK
	Design of approach procedure avoiding Nice, Villefranche-sur-Mer and Cap Ferrat.	OBJ-02.08-03	Tracks not overflying Nice, Villefranche-sur-Mer and Cap Ferrat.	See 6.1.3.1.1.3	OK
EXE-02.08-D-002	Design of approach procedure avoiding the city of Ajaccio	OBJ-02.08-04	Tracks not overflying the city of Ajaccio	See 6.2.3.1.1.3	OK
EXE-02.08-D-001 EXE-02.08-D-002	Flight trials execution in Nice and Ajaccio	OBJ-02.08-05	More than 40 flights trials performed (in total, Nice and Ajaccio) and data analysed	21+222 (or 46 (*)) flights conducted	OK
EXE-02.08-D-001 EXE-02.08-D-002	Assess track miles savings, fuel savings and CO_2 emissions reduction on RNP AR / RNAV Visual approaches in Nice and RNP AR in Ajaccio.	OBJ-02.08-14	Track miles and fuel savings / CO2 emissions analysis conducted	See 6.1.3.1.1.4 and 6.2.3.1.1.4	OK

Exercise ID	Demonstration Objective Tittle	Demonstration Objective ID	Success Criterion	Exercise Results	Demonstration Objective Status
Paphos RNP1 to ILS and RNAV Visual procedures, and **Larnaca** RNP1 to ILS and RNAV Visual procedures					
EXE-02.08-D003 EXE-02.08-D004	Assess lateral/vertical RNP1 to ILS and RNAV Visual approach tracks in Paphos and Larnaca.	OBJ-02.08-10	Fly ability deemed satisfactory	See 6.3.3.1.1.1 and 6.4.3.1.1.1	OK
EXE-02.08-D003 EXE-02.08-D004	Design of optimized approach procedure avoiding the unauthorized airspaces in Larnaca and Paphos.	OBJ-02.08-11	Tracks not overflying the unauthorized airspaces.	See 6.3.3.1.1.2 and 6.4.3.1.1.2	OK
EXE-02.08-D003 EXE-02.08-D004	Assess track miles savings and/or fuel savings and CO_2 emissions reduction on RNP1 to ILS and RNAV Visual approaches in Paphos and Larnaca.	OBJ-02.08-12	Track miles and/or fuel savings / CO2 emissions analysis conducted	See 6.3.3.1.1.3 and 6.4.3.1.1.3	OK
	Flight trials execution in Paphos and Larnaca	OBJ-02.08-13	More than 40 flights trials performed (in total, Paphos and Larnaca) and data analysed	32+58 flights conducted	OK
Mykonos RNP APCH and RNP AR procedures, and **Santorini** RNP AR procedures					
EXE-02.08-D005 EXE-02.08-D006	Assess lateral/vertical RNP AR or RNP APCH tracks in Mykonos and Santorini.	OBJ-02.08-06	Fly ability deemed satisfactory	See 6.5.3.1.1.1 and 6.6.3.1.1.1	OK
	Improve access to Mykonos and Santorini airports by reducing minima	OBJ-02.08-07	Published DH for RNP AR procedures Mykonos < 600ft Published DH Santorini RNP AR < 400ft - 500ft	See 6.5.3.1.1.2 and 6.6.3.1.1.2	OK
	Assess track miles savings and/or fuel savings and CO_2 emissions reduction utilizing RNP AR / RNP APCH approaches	OBJ-02.08-08	Track miles and/or fuel savings / CO2 emissions analysis conducted	See 6.5.3.1.1.3 and 6.6.3.1.1.3	OK

Exercise ID	Demonstration Objective Tittle	Demonstration Objective ID	Success Criterion	Exercise Results	Demonstration Objective Status
	Flight trials execution in Mykonos and Santorini.	OBJ-02.08-09	More than 40 flights trials performed (in total, Mykonos and Santorini) and data analysed	48 (or 41) + 69 flights conducted	OK
Corfu RNP APCH procedures, and **Iraklion** RNP APCH procedures					
EXE-02.08-D007 EXE-02.08-D008	Flight trial execution in Corfu and Iraklion	OBJ-02.08-16	1 flight trials conducted in Corfu and 1 in Iraklion	2+2 Flights conducted	OK
Madeira RNP AR procedures, and **Horta** RNP AR procedures					
EXE-02.08-D009	Assess lateral/vertical RNP AR tracks in Madeira and Horta.	OBJ-02.08-17	Fly ability deemed satisfactory	See 6.9.3.1.1.1 and 6.10.3.1.1.1	OK
EXE-02.08-D010	Improve access to Madeira and Horta airports by reducing minima	OBJ-02.08-18	Published DH Madeira AR 0.1 < 600ft Published DH Horta AR 0.1 < 500ft	See 6.9.3.1.1.2 and 6.10.3.1.1.2	OK
EXE-02.08-D009	Flight trials execution in Madeira.	OBJ-02.08-19	More than 40 flights trials performed in Madeira and data analysed	59 flight conducted	OK
All airports					
All	Provide useful material to contribute to RNP AR, RNP APCH, RNP1 to ILS and RNAV Visual development in Europe.	OBJ-02.08-15	Release of the Demonstration Report including relevant information.	Demo Report released	OK

Table 1: Summary of Demonstration Exercises Results

(*) Difference between figures reported by operators and by Air Traffic Controllers. Explanations are provided in section 6 for each airport, whenever applicable.

5.2 Choice of metrics and indicators

Refer to paragraph 5.3.1 that gives the list of KPAs, success criterion and metrics.

5.3 Summary of Assumptions

The assumptions are defined in the Demonstration Plan.

5.3.1 Results per KPA

Objective ID	KPA (key SESAR Programme concepts and technical enablers)	Success Criterion / Expected Benefit
OBJ-02.08-01 OBJ-02.08-10 OBJ-02.08-06 OBJ-02.08-17	Safety	Procedures fly able Positive or no impact on safety
OBJ-02.08-14 OBJ-02.08-12 OBJ-02.08-08	Efficiency	No target defined. Objective was to assess the differences
OBJ-02.08-02 OBJ-02.08-07 OBJ-02.08-18	Airport accessibility	Published DH < values defined in table 1 (targeted values are different from one airport to the other). Increase of the number of flightsTable 1: Summary of Demonstration Exercises Results
OBJ-02.08-03 OBJ-02.08-04 OBJ-02.08-11	Environment	Procedures avoiding sensitive zones, as defined in table 1 (zones are different from one airport to the other)

The below table summarizes the metrics used for the purpose of this project for each KPA. The methodology and/or metrics used are in line with the SJU Performance framework, described in these documents:

- SESAR Safety Reference Material (WP 16.06.01)
- Environmental impact assessment as part of the global SESAR validation approach (WP 16.06.03)
- SESAR Human Performance Reference Material – Guidance (WP 16.06.05)

KPA	Metric	Data Type
Safety	Operational feasibility	Qualitative
	Operators' workload	Qualitative
	Deviation to the defined trajectory	Quantitative
Efficiency	Delta fuel burn (*)	Quantitative
	Normalised fuel burn (*)	Quantitative
	Track miles savings	Quantitative
Airport accessibility	Approach minima	Quantitative
	Number of additional flights	Quantitative

Environment	Track repeatability	Qualitative
	Delta area of the 65 dB LAMax	Quantitative

(*) Depending on the airport and data / tools available for the study, one or the other method has been used.

The below tables give an overview of the exercises results, per type of procedure (RNP AR, RNP APCH, RNP1 to ILS, RNAV Visual), for all airports:

RNP AR procedures	
KPA	**Result of the demonstration**
Safety	KPA applicable to: Nice, Ajaccio, Mykonos, Santorini, Madeira, Horta
	Positive impact on safety reported by all operators and ANSPs: - Procedures are defined down to the runway threshold - Use of the aircraft automation leads to accurate path tracking, with a reduction in cockpit workload. *Deviations to the defined trajectory of much less than 0.1NM (order of magnitude between 0 and 0.02NM) demonstrated with flight data recordings in Madeira, Nice and Ajaccio.* *ADS-B tracks, when available, allowed qualitatively confirming repeatability of the procedures* - More stabilized approaches, especially in terms of IAS and Vertical Speed (thus reduction of risk of runway excursion, go-around…). *Flight data recordings in Santorini allowed demonstrating that the RNP AR approaches are flown with a stable and quite low IAS and a stable vertical speed during the descent.* - In a procedural flying environment, the fixed path/speed nature of the procedures might provide a more ordered ATC environment with the possibility for reduced RT (Radio Telephony) loading.
Airport accessibility	KPA applicable to: Nice, Ajaccio, Mykonos, Santorini, Madeira, Horta
	For all designed procedures, **RNP AR approach minima are lower than the published procedures minima**. **The impact in terms of number of additional aircraft that could land / number of diversions that could be avoided**, is different from one airport to the other as it depends on the local meteorological conditions, traffic: - No or negligible impact in Santorini, Madeira and Mykonos RWY34 - Positive impact in (assumptions are detailed in the relevant paragraphs): • Nice (around +42 flights/year, 46% reduction in the number of weather related diversions for Air France)

	• Ajaccio (100% reduction in the number of weather related diversion for Air France, at least 2 diversions could have been avoided during the 2 months trials period for easyJet), • Mykonos RWY16 (more than 20 flights / year) • Horta (around +15 flights/ year)
Efficiency	KPA applicable to: Nice, Ajaccio, Mykonos, Santorini
	Depending on the airport, and to the reference scenario, there is **little or positive impact on efficiency**. - There are no savings in Nice (compared to published RNAV (GNSS) procedure). It is believed (no data analysed) that there is no or little savings due to the lateral trajectory in Santorini/Mykonos if compared to a visual approach procedure as lateral trajectories are pretty similar in terms of track miles. *In Santorini, qualitative fuel analysis conducted by Novair allowed demonstrating positive impact on efficiency due to the optimization of the vertical profile, but no quantitative assessment was possible due to the limited number of flights.* - There are significant savings in Ajaccio (compared to the published Visual Prescribed Tracks procedure), in Mykonos RWY16 if compared to the published procedures (used in bad weather conditions). *In Ajaccio, fuel analysis conducted by Air France and easyJet allowed demonstrating benefits of around 80 to 140kg per approach.*
Environment	KPA applicable to: Nice, Ajaccio
	Data recorded during the flight trials (tracks) allowed demonstrating **repeatability of the RNP AR procedures** (see "Safety" item above). **Sensitive zones** are **avoided** (meaning that the track and its protection area do not overfly the zone). *In Nice and Ajaccio, noise study conducted by DSNA allowed estimating the difference in terms of number of affected people:* - *In Nice, there is a slight decrease in the number of people affected as compared to the VOR procedure* - *In Ajaccio, a similar number of impacted people as compared to the existing visual approach procedures from the North West would be affected by the new RNP AR procedure. Significantly less people (approximately 22700 people less) as compared to the existing published VPT procedure would be affected by the new RNP AR procedure.*

RNAV Visual procedures	
KPA	**Result of the demonstration**
	All KPAs applicable to: Nice, Paphos, Larnaca
Safety	**Positive impact on safety reported by operators and ANSPs**:

	- Significantly increases the likelihood of a stabilized approach - When recommended by the operator's internal policy, use of the aircraft automation leads to accurate horizontal and vertical path tracking, with a reduction in cockpit workload. - In a procedural flying environment, the fixed path/speed nature of the procedures might provide a more ordered ATC environment with the possibility for reduced RT (Radio Telephony) loading. - Depending on the airport (e.g. Larnaca), it eliminates the need for requesting a non-coded visual approach in order to cut track miles, reducing significantly pilots' workload and hand-flying manoeuvres This positive impact is particularly emphasized for airlines not having customized "RNAV aid to visual procedures" coded in their NDB already.
Efficiency	Conclusions differ from one airport to the other. - **Negative impact on efficiency in Nice**: *In Nice, Air France analysis showed + 30kg fuel burnt per flight and + 50 seconds flight time per flight, compared to a visual approach track.* - **Significant positive impact in Paphos and Larnaca** in terms of efficiency *In Larnaca, Emirates flight data analysis showed no measurable difference for the arrivals from SOBOS, and around 90kg of fuel savings per approach from BONEK.* *Globally track mileages as compared to the existing published procedures are significantly reduced: 6.7 NM shorter in average in Larnaca, and 13 NM shorter in average in Paphos.* Also, the ATC of Paphos and Larnaca emphasized that the new designed procedure allowed better timing and sequencing of the arrivals, thus benefits for airlines in terms of flight time (confirmed by some airlines)
Environment	Data recorded during the flight trials (a/c flight data or ADS-B data) allowed demonstrating **repeatability of the RNAV Visual procedures**. For all airports, **sensitive zones** are **avoided**.

RNP1 to ILS procedures	
KPA	**Result of the demonstration**
	<u>All KPAs applicable to:</u> Paphos, Larnaca
Safety	**Positive impact on safety reported by operators and ANSPs:** - More stabilized approaches - Use of the aircraft automation leads to accurate horizontal and vertical path tracking, with a reduction in cockpit workload. - In a procedural flying environment, the fixed path/speed nature of the procedures might provide a more ordered ATC environment with the possibility for reduced RT loading.

	- Depending on the airport (e.g. Larnaca), it eliminates the need for requesting visual approach in order to cut track miles, reducing significantly pilots' workload and hand-flying manoeuvres
Efficiency	**Significant positive impact** in terms of efficiency *Globally track mileages as compared to the existing published procedures are significantly reduced: 1.9 NM shorter in average in Larnaca, and 17 NM shorter in average in Paphos.* Also, the ATC of Paphos and Larnaca emphasized that the new designed procedure allowed better timing and sequencing of the arrivals. thus benefits for airlines in terms of flight time (confirmed by some airlines)
Environment	Data recorded during the flight trials (ADS-B data) allowed demonstrating **repeatability of the RNP AR procedures**. For all airports, **sensitive zones** are **avoided**.

RNP APCH procedures	
	All KPAs applicable to: Mykonos RWY34, Santorini RWY16
KPA	**Result of the demonstration**
Safety	**Positive impact on safety reported by operators and ANSPs**: Same conclusions and details than in the "RNP AR procedures" table above.
Airport accessibility	Published minima lower in Mykonos, and higher in Santorini, as compared to the published procedure. There is no negative or positive impact on the number of aircraft that could land there, as the weather conditions are always good when these runways are in service.
Efficiency	**No benefit** for these airports.

5.3.2 Impact on Safety, Capacity and Human Factors

Refer to paragraph 5.3.1.

5.3.3 Description of assessment methodology

The assessment has been conducted as described in RISE Demonstration Plan.

5.3.4 Results impacting regulation and standardisation initiatives

5.3.4.1 Background information about regulatory aspects

The intent of the paragraph is to clarify the RISE project assumptions, the role of the National Supervisory Authorities in this project, and introduce the next paragraph about deviation to the existing ICAO recommendations.

- It is reminded that the purpose of the RISE project is to demonstrate the benefits of PBN procedures in terms of safety, efficiency, airport accessibility and environment. Description of the project objectives per exercise is described in paragraph 5.1.

  The purpose of the flight trials conducted by the airlines, in cooperation with the Air Traffic Controllers, was to collect crews / ATCos feedback and aircraft flight data recordings in order to fulfil this objective.

  It was not within the objectives of the trial flights to validate the designed PBN procedures.

  Validation of the procedures (fly ability assessment) has been conducted on Full Flight Simulator, equipped with the minimum set of equipment required for the designed procedures, and qualified pilots (e.g. all RNP AR procedures have been validated on Full Flight Simulator certified for RNP AR, and by RNP AR qualified pilots).

- The National Supervisory Authorities of France, Cyprus, Portugal and Greece have been involved in the RISE project from the Kick-Off-Meeting. They set up the requirements and authorized the use of the procedures and the airlines prior to the start of the trials phase.

  Also refer to paragraph 5.3.4.5. about this topic.

- In terms of procedure design, the procedures have been developed as per the existing ICAO recommendations (ICAO DOC 8168 vol.2 and DOC 9905).

  However, for the RNP AR procedures, due to the challenging environment, the procedure designers sometimes had to deviate from the ICAO DOC 9905 recommendations.

  Reasons for deviating from these recommendations and mitigation means which have been proposed for each particular airport are detailed in paragraphs 6.1.2.2.1, 6.2.2.2.1, 6.5.2.2.1, 6.6.2.2.1, 6.9.2.2.1, 6.10.2.2.1.

  Also paragraph 5.3.4.2 provides a summary of the deviations and recommendations.

5.3.4.2 Update of ICAO DOC 9905 procedure design criteria

For some or all the procedures developed in the frame of the RISE projects, procedure designers had to deviate from the following ICAO DOC 9905 (Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual) recommendations, due to the terrain environment:

a. Distance between the FROP (Final Roll Out Point) and the OCA/H

Requirement for straight segment prior to OCH

4.5.13 Procedures that incorporate an RF leg in the final segment shall establish the aircraft at a final approach roll-out point (FROP) aligned with the runway centreline prior to the greater of:

a) 150 m (492 ft) above LTP elevation,

SI units: $D_{150} = \frac{150 - RDH}{\tan(VPA)}$

Non-SI units: $D_{492} = \frac{492 - RDH}{\tan(VPA)}$

b) a minimum distance before OCA/H is calculated as in 4.5.14 (see Figures 4-15 and 4-16).

4.5.14 TAS based on the IAS for the fastest aircraft category for which the procedure is designed at ISA + 15° C at aerodrome elevation, plus a 15-kt tailwind for a time of:

a) 15 seconds where the missed approach is based on RNP 1.0 or greater:

SI units: $D_{15sec} = \frac{HATh - RDH}{\tan(VPA)} + (V_{TAS} + 27.78) * 4.167$

Non-SI units: $D_{15sec} = \frac{HATh - RDH}{\tan(VPA)} + (V_{TAS} + 15) * 25.317$

b) 50 seconds where the missed approach RNP is less than 1.0 or where the missed approach is based on RNP APCH:

SI units: $D_{50sec} = \frac{HATh - RDH}{\tan(VPA)} + (V_{TAS} + 27.78) * 13.89$

Non-SI units: $D_{50sec} = \frac{HATh - RDH}{\tan(VPA)} + (V_{TAS} + 15) * 84.39$

Note.— The HATh is the height above threshold of the OCH or DH, as appropriate.

Extract of ICAO DOC 9905

This ICAO recommendation should be updated taking into account the IFPP/11 report dated 2012 providing further clarification on the rationale for this recommendation, and the fact that AMC 20-26 requires that, for missed approach less than RNP1 aircraft shall remain in LNAV upon initiating a go-around or, for missed approaches of RNP 0.3 or greater this may be mitigated by adequate crew training.

b. Bank angle limitation in RF legs, limited to 20° in approach and 15° in missed approach

This ICAO recommendation should be updated to take into account most modern aircraft capabilities.

In addition, the ICAO DOC 9905 indicates that the use of other tailwind gradients based on location's meteorological history is possible (rather than using the ICAO winds, which are usually very conservative), for calculating the bank angles, which may greatly help. However, historical data are not always available, and there is no methodology defined in the ICAO document on how to determine such data.

There should be guidelines on how to determine statistical meteorological data, and usage of statistical metrological data should be used to a much greater extent in procedure design, that requires some kind of European Data base for this in the long run.

c. VSS (Visual Segment Surface) shall not be penetrated by obstacles, for RNP AR procedures

This ICAO recommendation should be clarified, in particular to explain why it is different from the ICAO DOC 8168 recommendation.

These deviations have been accepted by the Regulators for the purpose of flight trials.

Work is on-going at ICAO/IFPP level to clarify/modify the above items. It might need to be shared at European level as well, if deemed relevant.

5.3.4.3 RNAV Visual CONOPS and procedure design criteria

At the time of this project, no standard and no regulation did exist to cover Visual RNAV procedures development. In particular, there was no defined Concept of Operation, and no procedure design criteria. The set of procedure design criteria used for the procedures developed in France and in Cyprus was therefore different. The work done in RISE project about RNAV Visual has been brought up by DSNA and Air France at ICAO level to feed in the ICAO definition of RNAV Visual. See document in Appendix S.

Works are still on-going at ICAO level and they should solve this lack of existing recommendations. It might need to be shared at European level as well, if deemed relevant.

5.3.4.4 Runway certification requirements

The EASA regulation has been updated, refer to EASA Opinion Letter Ref 03/2016 dated 8.3.2016.

The objective of this Opinion letter is to “maintain and, for specific types of runways (non-instrument and non-precision), enhance the high level of safety. It facilitates performance-based navigation approach operations with vertical guidance to be applied at non-precision approach runways, and instrument approach operations to be associated with non-instrument runways without the need in both cases to upgrade runway infrastructure”.

The Opinion Letter clarifies the “non-precision runway” definition. Nevertheless, some interpretation is still needed concerning IFR procedure on “non-instrument approach” runway: definition of the point beyond which the approach may continue in visual conditions is not clearly defined, and thus might be interpreted by Authorities as not being possible. This should be clarified in order to facilitate implementation of PBN procedures on ”non-instrument” runways.

> ‘(34) “non-instrument runway” means a runway intended for the operation of aircraft using visual approach procedures or an instrument approach procedure to a point beyond which the approach may continue in visual meteorological conditions.’

Extract of EASA Opinion Letter Ref 03/2016 dated 8.3.2016.

5.3.4.5 Operational requirements for flight trials exercise

There is no regulatory framework today to cover requirements for the purpose of flight trials in VMC conditions, in particular regarding procedure acceptance, conduction of trials and airline operational requirements. For this project, the regulators had to adapt their processes and lighten requirements as compared to what would have been requested for publication and flights in IMC conditions in order to allow trials to be conducted. A regulatory framework adapted to this type of exercise would have been welcome.

Also, some airlines pointed out that the regulatory value of such trial flights should be studied (especially depending on the aircraft equipment and/or approvals).

5.4 Analysis of Exercises Results

A summary of qualitative and quantitative results per type of procedure is provided in 5.3.1.

5.4.1 Unexpected Behaviours/Results

There were no unexpected behaviours / results.

5.5 Confidence in Results of Demonstration Exercises

5.5.1 Quality of Demonstration Exercises Results

There was no specific issue concerning the quality of the results achieved in this Exercise.

5.5.2 Significance of Demonstration Exercises Results

The Demonstration results are deemed significant. The operational realism of the Demonstration Exercice could have been affected by the fact that:

- The trials have been conducted in VMC conditions. However, the procedures used by the flight crew were as if these flights were IMC.
- For RNP AR procedures, the aircraft was not always certified for RNP AR operations; however the aircraft was equipped with the minimum equipment required for this type of operations. In other words, the aircraft was equipped with the minimum pre-requisites in terms of avionics (FMS, ADIRU, EIS, MMR, TAWS, …) to fly RNP AR 0.3 procedures, but was not always certified (the airline was not able to demonstrate RNP AR capability as usually stated in the AFM page).

  Note: all operators had their aircraft not certified for RNP AR operations (and no RNP AR operational approval by their state of registration), except Novair, SAS and Emirates.

  Reminder: The purpose of RISE trials was to demonstrate the benefits of PBN procedures through flight trials in VMC conditions by collecting crew / ATCos feedback and aircraft data recording. For this purpose, the results of the trials phase are deemed significant.

  It was not within the objectives of the trial flights to validate the designed PBN procedures (procedure validation has been conducted on Full Flight Simulator) nor to use the trials for RNP AR operational approval purpose

5.5.3 Conclusions and recommendations

The following recommendations have been made:

a) <u>Visual RNAV procedures</u>

Different points of view have been raised by operators and ANSPs, regarding <u>publication of the procedures</u>: some States plan to publish the procedures in the AIP, while others States recommend waiting for the definition of ICAO criteria before publishing any RNAV Visual procedures in the AIP.

On the operators' side:

- Some prefer that standardized ICAO recommendations are provided before such type of procedure is published in order to allow common operational procedures (SOP, charting policy, …) thus avoiding safety events coming from pilot's misunderstanding.

- Some others are pushing to have these procedures in the AIP, and even, to publish designed RNP AR procedures as Visual RNAV procedures so that they can be used in VMC conditions in order to enhance safety (due to the fixed path nature of the procedures, reduced workload…)

From an operational perspective, operators recommend that the use of automation (Flight Director/autopilot) when flying this type of procedure is left at each airline's discretion, based on their internal safety study and SOPs.

Finally, operators highlighted that use of RNAV Visual procedures should be left at pilot's discretion, and not imposed ("free" visual approach procedures should remain an option when traffic and local conditions permit. Indeed, some operators highlighted that it supports basic pilot skills practice, practice which is recognized on the industry as a key factor for safety). On some ANSPs' side, it is emphasized that benefit of RNAV Visual is actually to have all aircraft flying the same path (enhance timing and sequencing), so will tend to favour this type of procedure.

b) RNP AR procedures

Operators recommend that full advantage of the RNP AR capability (in terms of design flexibility) is taken so that efficient trajectories (from a track miles / fuel perspective) are defined, while properly addressing local constraints and mixed traffic operations. RNP AR procedures defined as overlays of existing procedures bring little benefit in terms of fuel efficiency. This directly impacts the business case for RNP AR.

Also, it should be possible to use RNP AR procedures regularly and not only in remote conditions (e.g. bad weather conditions).

Finally, some operators recommend that the designed RNP AR procedures are also published as RNAV Visual procedure (when weather conditions permit that use), so that they can be used by non RNP AR approved operators in visual conditions. Each airline would then decide if they allow their pilots to fly it or not (based on internal safety assessment).
Some ANSPs, in line with what is described in item a) above, are not in favour of this as it would lead to implement RNAV Visual procedures defined with RNP AR criteria, while today no standardized RNAV Visual concept and design criteria exist (once available, criteria could eventually be very different from RNP AR ones). The risk without a harmonized concept, thus no common operational procedures (SOP, charting policy,…) is to increase safety events coming from pilot's misunderstanding.

c) PBN procedures in general

More generally, operators encourage publication of the designed PBN procedures in a timely manner (and development of such type of procedures on other airports when needed), and encourage the use of PBN procedures.

Operators recommend that full advantage of the PBN capability (in terms of design flexibility) is taken so that efficient trajectories (from a track miles / fuel perspective) are defined. PBN procedures defined as overlay of existing procedures brings little benefits in terms of fuel efficiency, and thus directly impact airline's business case.

Finally, it is recommended that the regulatory items listed in sections 5.3.4.1 (update of ICAO DOC 9905) and 5.3.4.4 (clarification of "non-instrument" runway definition) are clarified or modified in order to facilitate implementation of PBN procedures. Updates of ICAO DOC 9905 items are currently being worked at ICAO level, but it might need to be shared at European level as well, if deemed relevant. Clarification on "non-instrument" runway definition shall be solved at European level as it is provided in EASA Opinion letter Ref 03/2016 dated 8.3.2016.

Solving of these regulatory items directly impacts the approval & publication of PBN procedures by local Authorities, and therefore airlines business case.

Note: some procedure design recommendations have also been made for some of the airports, which are not traced here in the general conclusions as they are very specific to each airport, but are put in the conclusions of each Exercise.

6 Demonstration Exercises reports

6.1 Demonstration Exercise #1 Report

6.1.1 Exercise Scope

This first demonstration exercise covers RNP AR and RNAV Visual approaches demonstrations into RWY 22L and 22R of Nice airport.

Demonstration Exercise ID and Title	EXE-02.08-D-001 : RNP AR and RNAV Visual Operations at LFMN (Nice)
Leading organization	DSNA, Air France, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. • Airport accessibility, • Safety, • Environment.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator - Revenue flight **Output:** - Procedures charts - Simulator reports - Flight data and questionnaires analysis and comments/recommendations
Number of trials	21 flights conducted by Air France

6.1.2 Conduct of Demonstration Exercise EXE-02.08-001

6.1.2.1 Exercise Preparation

The preparation activities include all those necessary to prepare the design, assessment, validation and evaluation of the RNP procedures.

The output of the Exercise Preparation phase is the Project Specification document, signed by all stakeholders, that summarizes the project scope and objectives, data to be followed for the design of the procedures and conceptual design of the procedures.

Nice project specification has been approved by all stakeholders in February 2015.

6.1.2.2 Exercise execution

The following activities have been performed in the Exercise execution for Nice RNP AR and RNAV Visual procedures:

Exercise execution activity	Included in the scope for Nice airport?	Timeline
Procedure design	YES	Feb to June 2015
Procedures simulator validation	YES	
Safety study	YES	
Environmental study	YES	
ATC training or briefing	YES	October 2015
Flight trials & data analysis	YES	December 2015 to March 2016 Total number of flights: 21

6.1.2.2.1 Procedures design

Both RNP AR and RNAV Visual procedures have been designed for Nice runway 22R and 22L.

The final procedures approach charts are shown in Appendix A.

The RNP AR procedures design main highlights are:

- The RNP AR procedures are an overlay of the existing published RNAV (GNSS) approach procedures and VPT (Visual Prescribed Track) trajectories. This was a request from the air traffic controllers
- The procedure is designed with a FPA (Flight Path Angle) of 3.1°, which is a compromise between the operators request to use the lowest FPA as possible in order to allow proper energy management especially for larger aircraft, and operational / regulator requirement that the flight crews should never see 3 red lights on the PAPI. In addition, VPA 3.1° is the maximum

recommended VPA for a CAT D aircraft, as per ICAO procedure design recommendations. As the actual vertical path depends on the temperature, minimum temperatures have been defined for operation. For the flight trials the PAPI was set to 3.5° (unchanged as compared to current operations) and the minimum temperature allowed allowing not getting 3 red lights on the PAPI was +7°C. For the purpose of publication, requirements from the DSAC are not confirmed yet, neither decision on PAPI slope: should the PAPI be lowered to 3.3° (which is the minimum angle allowing the PAPI surfaces not being penetrated by obstacles), the minimum temperature for operating the RNP AR procedures would be lowered to -10°C.

- Design of the procedures has been done in accordance with ICAO 9905 document. However, two deviations have been highlighted during the design phase:

  a. The ICAO 9905 Document paragraph 4.5.13 (“requirement for straight segment prior to OCA”) recommends that the procedures that incorporate an RF leg in the final segment shall establish the aircraft at Final Roll Out Point (FROP) aligned with the runway centreline prior to a minimum distance before OCA/H for a time of 50 seconds.

     In Nice, due to the terrain constraint, it was not possible to meet this recommendation, and the distance between the FROP and OCA/H for runway 22L and 22R is respectively 9,1 seconds and 4 seconds.

     This deviation to ICAO 9905 recommendation has been mitigated thanks to IFPP/11 report dated 2012. This report provides further clarification on the rationale for this recommendation, and the fact that AMC 20-26 requires that, for missed approach less than RNP1 aircraft shall remain in LNAV upon initiating a go-around or, for missed approaches of RNP 0.3 or greater this may be mitigated by adequate crew training.

     It was recommended that this deviation to ICAO should be highlighted to operators and covered in the FOSA (Flight Crew Operational Safety Assessment).

  b. The ICAO 9905 Document paragraph 4.6.18 recommends using a specific formula for DMAS (Distance Missed Approach Segment) RNP Maximum length of RNP<1. As this deviation is covered in a subsequent Amendment of DOC 9905, this is no longer considered as a deviation.

     The DSAC (French Surveillance Authority) has been involved in the discussion all along the RISE project. They accepted these deviations for RISE trials.

     In parallel, DSNA and DSAC have developed RNP AR procedure design criteria document that will be used for approvals and publication of RNP AR procedures in France. This document is based on the ICAO 9905 document, and French specific requirements.

The Visual RNAV procedures design main highlights are:

- No Visual RNAV procedure design criteria have currently been published by the ICAO. Even if not supported by IFALPA, Visual RNAV procedures have however been defined worldwide, either considered as airline tailored procedures, or procedures published by the States.

  In France, criteria used for this project are based on VPT (Visual Prescribed Track) ones.

- As shown in the approach chart, the Visual RNAV procedure is composed of an IMC segment, from FERAT to MN01V, then followed by the visual segment. The airport must be in sight at MN01V latest point to continue the procedure. If not, a missed approach shall be initiated (left turn, as shown on the chart).

6.1.2.2.2 Procedures simulator validation

All the designed procedures have been tested on Airbus A320 Full Flight Simulator equipped with the minimum equipment required for RNP AR operations.

It has been demonstrated that the designed procedures are fly able. In particular:

a. Flight plans are correctly displayed on ND and MCDU
b. No TAWS warning or caution alerts are triggered along the designed paths
c. Experienced cross track errors are within acceptable limits
d. Experienced bank angles are within acceptable limits
e. Procedures are manageable from an energy management point of view.

6.1.2.2.3 Safety study

A safety study has been conducted by DSNA for RISE trials, for both the RNP AR and RNAV Visual procedures.

In addition, a generic RNAV Visual safety study has been developed by DSNA, in collaboration with stakeholders involved in the RISE project.

For both studies, the methodology used was based first on the provision of a generic document (one for each type of approach) gathering standard expected hazards (hazards identified and studied from an ATC perspective). Then two one day brainstorming sessions gathering all stakeholders were conducted to discuss and enhance the initial documents. The output were both the safety study documents for the particular situation of Nice environment as well as the enhancement of the generic initial document for each type of procedure.

The safety study conducted for the RNP AR procedure in Nice allowed all stakeholders to exchange especially regarding the on-board performances and limitations for this type of the procedure. A lot was learned by ATCOs on the limitations associated with this type of procedure, as well as the benefits.

For the RNAV Visual, a supplementary brainstorming session was also conducted to understand and consolidate the concept (as this concept was not yet known at ICAO level). This step was a preliminary step to perform the safety analysis of the associated hazards. A Visual RNAV concept document was issued. This work was used at ICAO Flight Ops panel level to produce the ICAO concept for Visual RNAV. A generic safety assessment document was created for RNAV Visual approach based on the operational concept.

The RNAV Visual CONOPS document prepared by DSNA is provided in Appendix S.

Both concept and safety brainstorming sessions for Visual RNAV were very fruitful since all RISE partners and stakeholders exchanged and contributed altogether as well as individually to introduce both types of trajectories in the complex ATM environment of Nice

Also, Air France has conducted a safety study (hazards identified and studied from a cockpit perspective) prior to performing RISE trials in order to demonstrate that the RISE flights can be safely conducted, and validate trials operational conditions.

6.1.2.2.4 Environmental study

An environmental study has been conducted in order to compare the noise impact of the new designed procedures, as compared to the existing procedures.

The below figures show the footprint comparisons, between the new RNP AR procedure, and a) the VOR B mean track procedure b) the RNAV (GNSS) mean track procedure.

Fig 7 bis: 65 dB LAmax noise footprints A320, VOR-B mean track and RNP-AR nominal trajectory

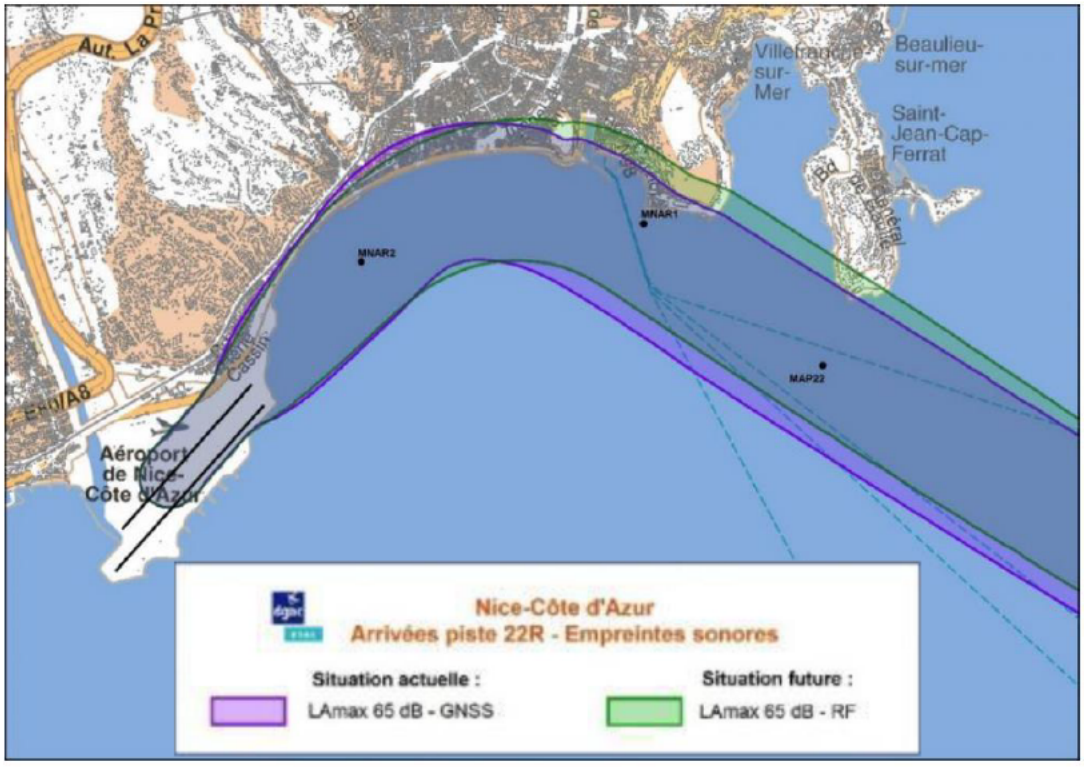


Fig 6: 65 dB LAmax noise footprints A320, GNSS and RNP-AR procedures

Note: RNP-AR and Visual RNAV procedures have slightly different profiles (final slopes are respectively 3.1° and 3.3 °) but in terms of impact, the difference appears barely perceptible: noise footprints of the two new procedures are virtually identical.

The following table presents a comparison of the impacted population counts, according to the procedures used by an Airbus A320 on approach, knowing that the procedure most in use today (prior to the implementation if RNP AR) is the VOR B procedure.

	Population currently affected (LAmax 65 dB)	Number of people affected by RNP-AR future procedure (LAmax 65 dB)	population variation
GNSS procedure	39059	39904	+845
VOR B procedure	47418		-7514

Conclusion is that the introduction of these new RNP AR and Visual RNAV procedures leads to a slight increase in the number of people impacted by comparison with the use of current RNAV (GNSS) approach, but leads to a substantial decrease of people affected by comparison with the use of the current VOR-Bravo approach which is the procedure the most in use.

In addition, the RNP AR and Visual RNAV procedure, contrary to the existing VOR-Bravo and RNAV (GNSS) trajectories, are fully repeatable and defined down to the runway threshold. This should allow for much less dispersion in the final part of the approach paths.

6.1.2.2.5 Operational staff briefing

ATC

The Air Traffic Controllers of Nice have been briefed prior to the start of RISE trials: it included a briefing, publication of an Operational Note and a “memo” on control position.

Pilots:

A safety assessment was conducted by Air France for Nice RISE trials. The outcomes of those safety assessments for Pilot training were:

- In Nice, only pilots based in Nice were eligible for the trials. Therefore training could be done via computer based training and technical notes.

6.1.2.2.6 Flight trials & data analysis

General

Air France and Nice Air Traffic Controllers ran:

- 11 RNP AR flight trials were conducted on runway 22R: 8 flight questionnaires were filled by crew. No flight trials occurred on runway 22L for the RNP AR trials, however it is believed by experts that conclusions on 22R are applicable to 22L
- 9 RNAV Visual flight trials were conducted on runway 22L and 1 on runway 22R: 8 flight questionnaires were filled by crew.

AF pilots reported no flight trial that ATC couldn't accommodate.

Procedure	Nb of requests	Nb of clearances	Nb of satisfactory approaches
		Clearance rate (%)	Satisfactory approaches rate (%)
RNP AR RWY 22R	11	11	11
		100%	100%
RNP AR RWY 22L	0	N/A	N/A
		N/A	N/A
Visual RNAV RWY 22R	1	1	1
		100%	100%
Visual RNAV RWY 22L	9	9	9
		100%	100%
Total Nice airport	21	21	21
		100%	100%

Trial conditions

Prior to conducting the trials, Air France and Nice ATC agreed on the operational conditions for the trial:

- Flights under visual approach clearance
- Designated phraseology was put into place
- Weather conditions to ask the RISE approaches:
  - Minimum ceiling: 3500ft / minimum visibility 10Km.
  - Temperature > 6°C (resp. -10°C for the RNAV Visual) : This condition guarantee a usable PAPI information (lowest temperature for 3 red and 1 white).
- ATC could refuse trial because of traffic pressure
- Both captain and co-pilot had to be volunteers

Results per KPA are provided in paragraph 6.1.3.

6.1.2.3 Deviation from the planned activities

All activities planned have been conducted.

6.1.3 Exercise Results

6.1.3.1 Summary of Exercise Results

Refer to paragraph 5.1

6.1.3.1.1 Results per KPA

6.1.3.1.1.1 Safety

The procedures have been assessed during the flight trials period, by Air France and Nice Air Traffic Controllers.

The Air Traffic Controllers of Nice did not report any safety problem, for both RNP AR and Visual RNAV procedures.

Air France conclusions are:

Regarding the RNP AR procedures (RWY 22R),

Pre-trial Analysis:

Common benefit of RNP AR and RNP APCH procedures (VNAV) in NCE	Additional benefit brought by RNP AR in NCE
Lateral/vertical guidance	Lateral/vertical guidance available until the aircraft is much closer to the runway Auto Pilot disconnection after aligned with runway axis.
Coded Go-around available for both procedures but with the VNAV approach, Mapt is 9,5NM from runway threshold because of obstacles	Coded go-around from threshold thanks to design option to have RNP 0,3 and RF Leg go-around procedure
	Fully coded and managed trajectory

All safety enhancements brought by RNP AR are believed to reduce un-stabilized approaches.

Note: In Nice, to ease the energy management on the trajectory, it was decided to design RNP AR with a vertical path of 3,1° instead of 3,5° of the current VPT (Visual Prescribed Tracks) trajectory following the RNP APCH. This is seen as an important improvement from a safety point of view but it is not relative to RNP AR technology. In a short term, safety benefit coming from lower vertical path (3.1° versus 3.5°) could be made by redesigning existing procedures and lowering the PAPI slope to 3.3° (lowest possible angle with existing obstacles). This would be already a positive outcome from RISE trial.

Post-trial Analysis:

a) Qualitative Feedbacks:

No Air Safety Report was filed by Air France pilots concerning the RISE procedure.

On RISE questionnaires, Air France pilots assessed positively the procedure fly-ability and safety.

1. No issue with energy management was reported.
2. No issue with the final alignment to the runway was reported. However, from pilot comments, we can note that they found unusual to have a final turn so close to the runway (for an instrument approach).
3. No unexpected behaviour of managed speed.
4. Reported max Roll degree was between 9 and 15°
5. No EGPWS alerts were reported

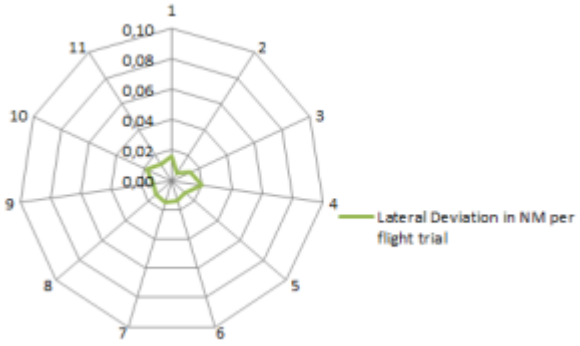
Comment n°2 is completely normal as RF Leg after FAF is the innovation brought by RNP AR.

b) Quantitative Feedbacks:

Study from Air France safety ad hoc services confirmed all information reported by participating pilots and showed no flight safety event (study based on safety indicators using flight data recorder – as un-stabilized approaches).

To study the precision of flight navigation, Air France compared position of reference points (published latitude and longitude for FAF and MNAR2; calculation for “mid of final turn”) with the position reported by the aircraft (from flight data recorders).

As shown on the following figures, adherence to the trajectories is under 0,1NM of precision.



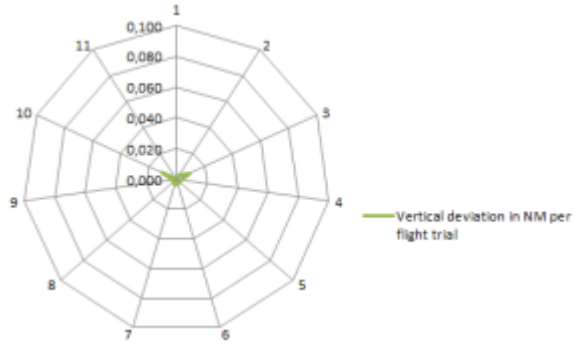


Figure 1 Lateral and vertical deviation at FA20

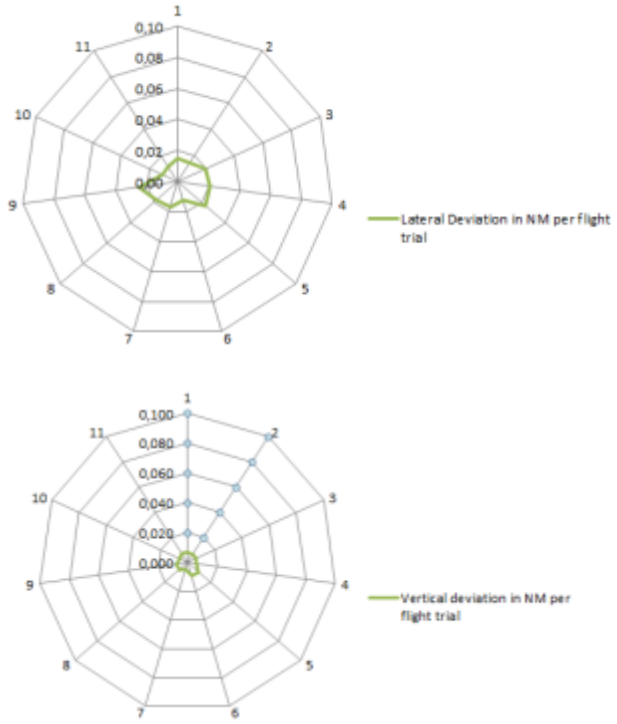


Figure 2 Lateral and vertical deviation at mid-way of final turn

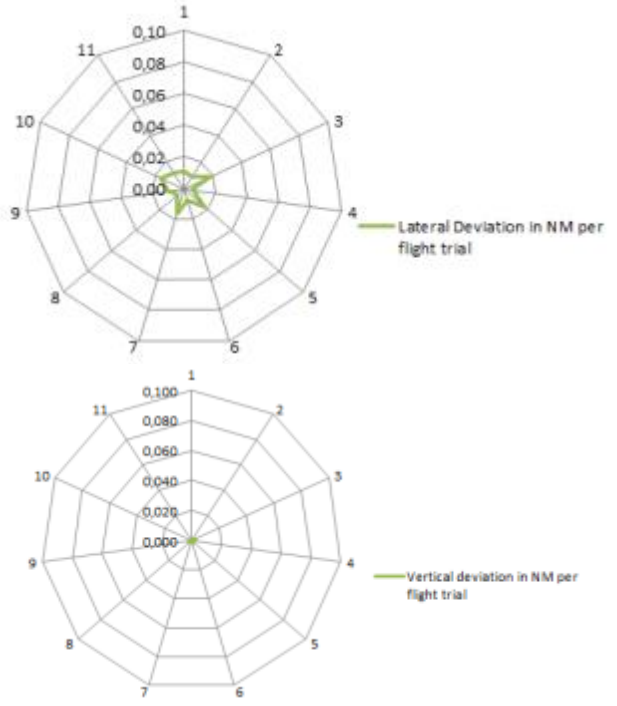


Figure 3 Lateral and vertical deviation at MNAR2

Regarding the Visual RNAV procedures (RWY 22R/22L),

Pre-trial Analysis:

RNAV Visual is foreseen to improve safety as it provides guidance (especially VDEV information) believed to reduce un-stabilized approaches. This benefit is already achieved today by airlines – as Air France- that have a homemade "RNAV aid to visual approaches".
However, the fact that RNAV Visual is published by authorities avoid airliners to customise their own RNAV support, bringing better awareness of the situation between controllers and pilots with shared and unique trajectory.

Post-trial Analysis:

a) Qualitative Feedbacks:

No Air Safety Report was filed by AF pilots concerning the RISE procedure.

On RISE questionnaires, AF pilots assessed positively the procedure fly-ability and safety.

- No issue with energy management was reported
- No issue with the final alignment to the runway was reported
- No unexpected behaviour of managed speed
- Roll degree was between 5° and 12°
- No EGPWS alerts was reported

b) Quantitative Feedbacks :

Study from Air France safety ad hoc services confirmed all information reported by participating pilots and showed no flight safety event (study based on safety indicators using flight data recorder – as un-stabilized approaches).

6.1.3.1.1.2 Airport accessibility

The below table compares published procedures minima and new RNP AR procedures minima, for a CAT C aircraft. In addition, thanks to the available weather and number of flights statistics, DSNA has estimated the duration per year where the airport would have been accessible thanks to the new RNP AR procedure and while they could not today.

No comparison is shown for the new RNAV Visual procedure as its objective was not to improve airport accessibility.

	VOR B MDH	RNP APCH MDH	New RNP AR DH	Benefit (ft)	Estimated nb of additional flights
Nice 22R	1490ft	1250ft	380ft	-1110ft (compared to VOR) -870ft (compared to RNP APCH)	(*)

Nice 22L			320 ft	-1170ft (compared to VOR) -930ft (compared to RNP APCH)	(*)

(*) The following estimates have been provided by DSNA and Air France:

a) DSNA analyzed the past 5 years weather data to provide the duration where RNP AR would have allowed access to Nice airport, while it was not possible with the current procedures.

Number of hours per year where the weather conditions were:

- worse than the conditions necessary to implement RNAV (GNSS) procedure

- better than the conditions necessary to implement RNP-AR22, and runway 22 was in service :

2015 : 2h58'

2014 : 12h12'

2013 : 2h18'

2012 : 0

2011 : 0h12'

The maximum clearance rate at Nice airport in bad weather condition is 12 flights/hour.

In the last 5 years, 211 flights would have been able to access Nice with the RNP AR published, and the aircraft and aircrew capable of flying the procedure, meaning an average of 42 additional flights per year.

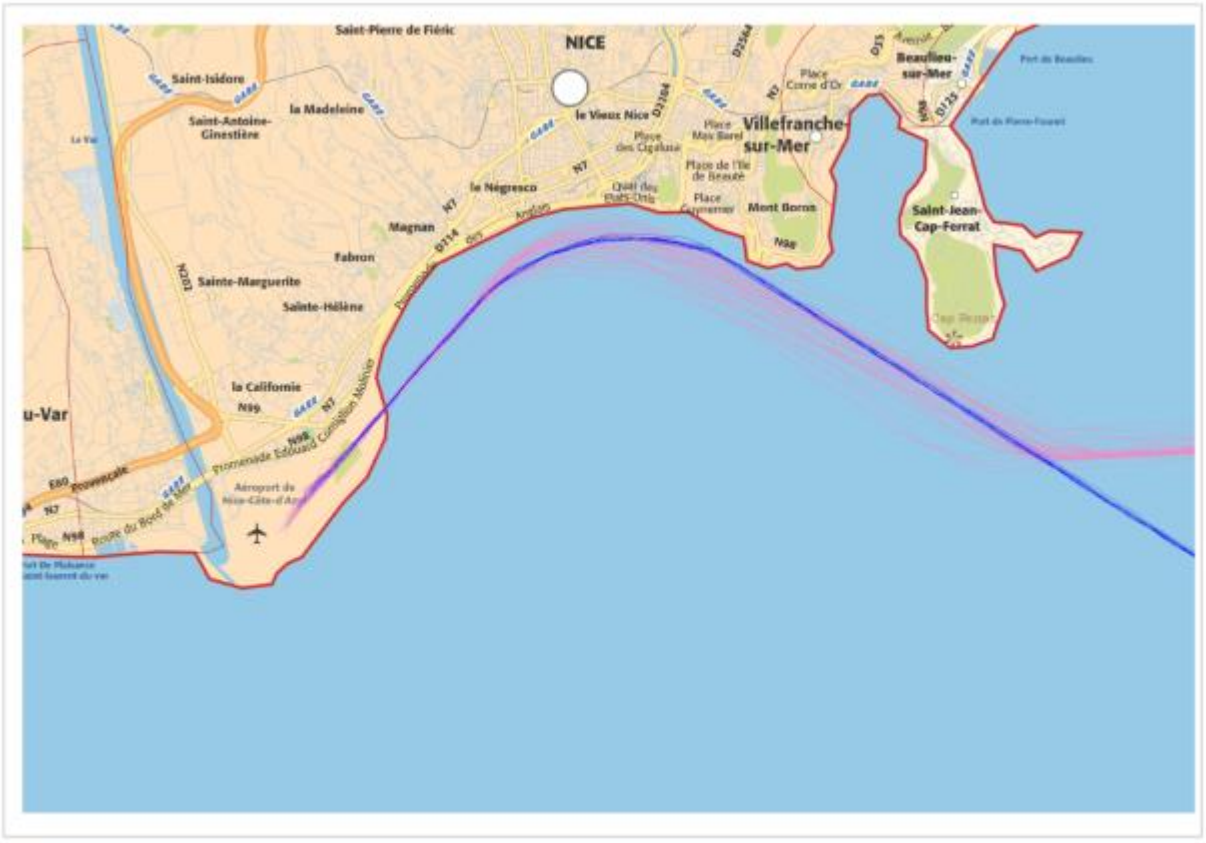
b) In addition, Air France estimates that, thanks to the new RNP AR procedures, Air France weather diversions and cancellations for Nice will be reduced by 46% (figure coming from October 2013 to October 2014 data). Hypothesis being that the whole Air France fleet would be certified to fly RNP AR procedures.

The implementation of RNP AR procedures in Nice runway 22L/R greatly improves airport accessibility.

6.1.3.1.1.3 Environment

As shown on the approach charts (Appendix A), the designed procedures avoid Nice, Villefranche sur Mer and Cap Ferrat, which perfectly answers to the objective.

In addition, the flight trials demonstrated that the procedure are fully repeatable down to the runway threshold, and it allows for much less dispersion in the final part of the approach paths, as compared to the existing procedures, as shown in the radar tracks images below.



RNP AR trajectories

VOR B trajectories

Finally, DSNA has conducted an environmental study, refer to paragraph 6.1.2.2.4.

6.1.3.1.1.4 Efficiency

Air France conducted a fuel efficiency study. The conclusions are:

Regarding the RNP AR procedures,

Pre-trial Analysis:

If published, RNP AR will be used as follows:

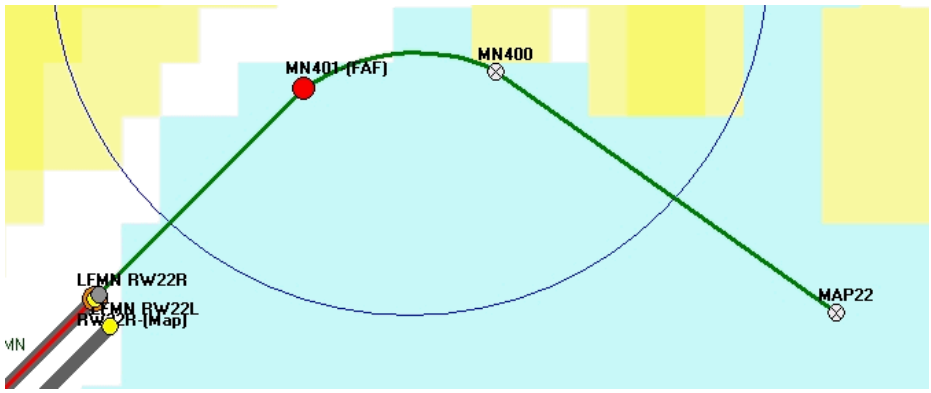
1. VOR approach is normally in use;
2. When the VOR approach does no longer permit landing, RNP APCH approach will be in use;
3. When the RNP APCH is no longer sufficient, the RNP AR approach will be in use.

Therefore, RNP AR in Nice is seen as an enhancement of RNP APCH publication.

In the following table are gathered a comparison of those procedures for NCE, from a flight efficiency point of view only

Common benefit of RNP AR and RNP APCH procedures (VNAV)	Additional benefit brought by RNP AR
Same published lateral trajectory	Final turn done with Auto Pilot thanks to lower minima
Possibility to shorten the procedure thanks to a direct to NANAX ⇨ Fuel and Time savings compared to publication	Reduced protection volume of trajectory with RNP 0,3 and RF Leg for the final segment as well as go-around. It allows the Mapt to be at runway threshold. Therefore final segment can be coded until the runway threshold. Thank to that: ⇨ Pilots can visualise procedure on PFD – especially the final turn ⇨ Pilots can follow VDEV indication to smooth CDFA vertical profile till the runway (VDEV still active after minima)

Both procedures have been flown in flight simulator in order to have the same operational input (same weight, same weather conditions). Even though additional guidance is given to pilot with RNP AR, fuel savings couldn't be demonstrated. Indeed, on final segment of any procedures, Pilot actions to configure aircraft for landing has a major influence on fuel consumption.



Therefore for Air France, when weather condition permits use of RNP APCH or VOR Approach, there is no improvement from an efficiency point of view. RNP AR makes the difference only when weather is below the RNP APCH minima (diversion cost savings).

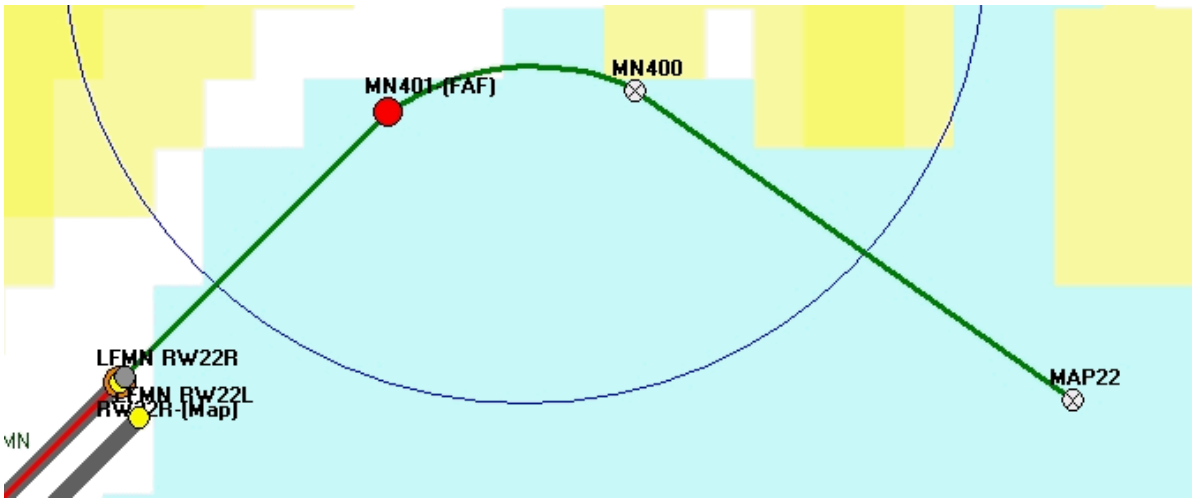
<u>Regarding the Visual RNAV procedures (RWY 22R),</u>

<u>Pre-trial Analysis:</u>

In Nice, RNAV Visual is understood as a support for visual approach for crew that are not familiar with the environment or for pilots that would like additional guidance (especially VDEV information). It could replace current airline homemade coding.

Note: Air France has in place an in-house "RNAV Aid for visual approach". It is a customized coding of trajectory between Mapt and runway threshold.

In Air France, the following custom coding is available (same vertical path for both trajectories).



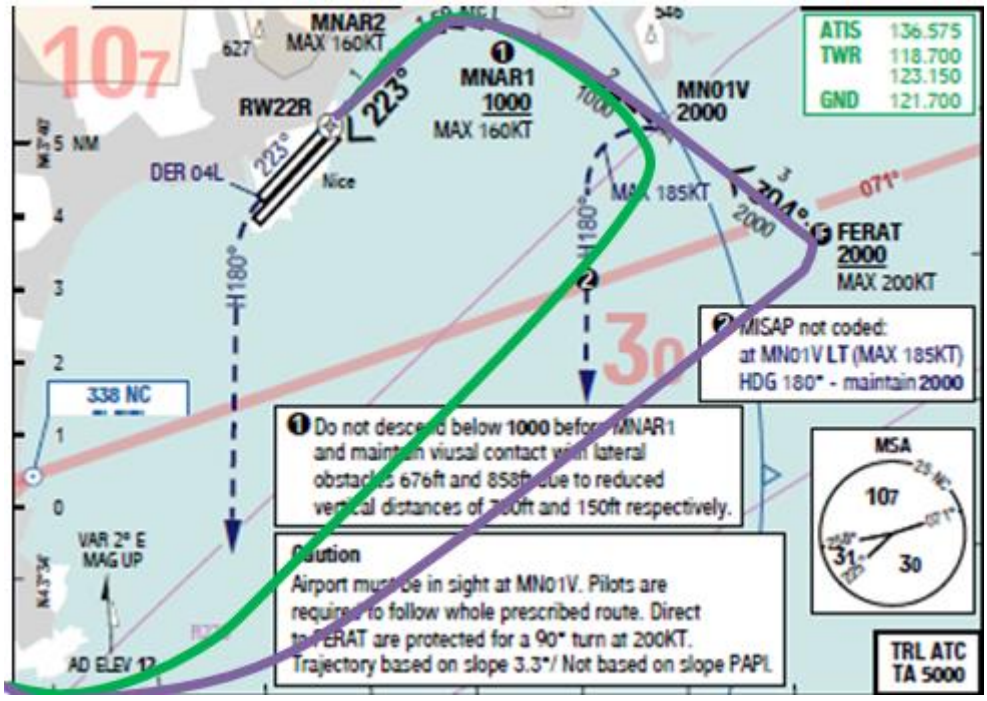
Note: AF has home based crews in Nice who know well the area and then fly mostly visual approaches.

For RISE analysis and comparison purpose, Air France considered two cases:

- **Comparison with visual approaches**:

  Hypothesis:

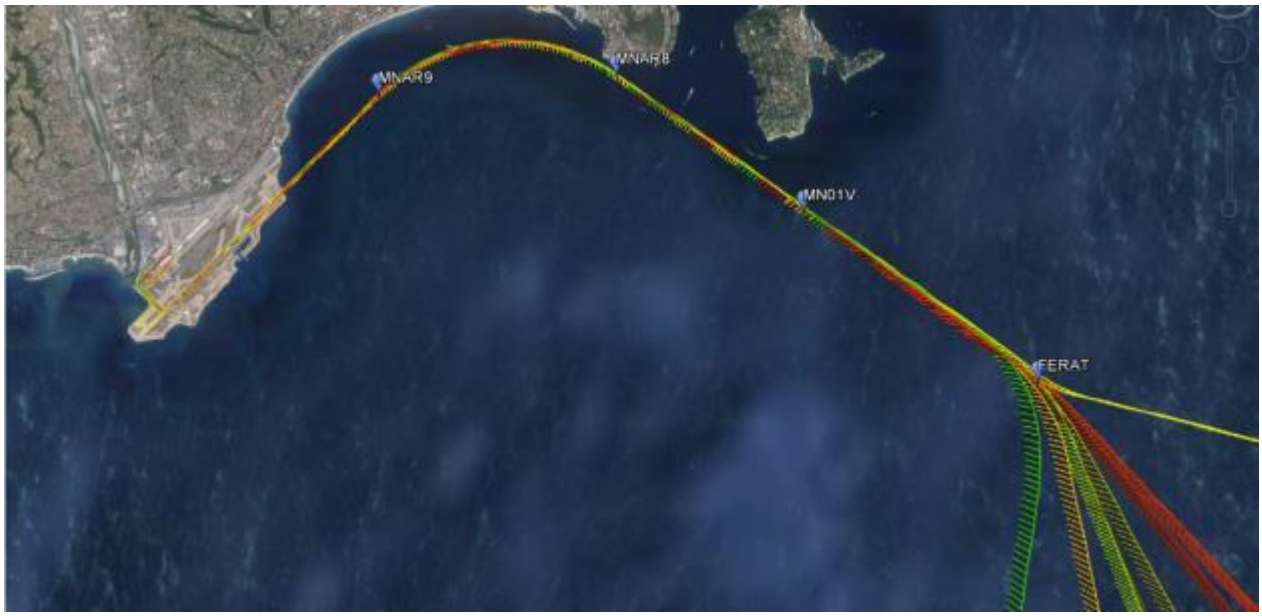
  A mean.average visual approach has been defined, which is not the most optimized visual approach, in order to be more realistic.
  Air France considered that the discrepancies on trajectory till “FERAT axis” are similar for visual approaches and for RNAV visual. They are not linked to the procedures but to the surrounding traffic.
  For the study, Air France therefore considered that there is no conflicting traffic.
  Calculation has been done in PEP (Airbus Performance tool) for a A320 aircraft of 60 tons at Alt 2000ft, speed 200kt and flap 1.



In average, trajectories using the RNAV Visual are 3NM longer at low Flight level (Alt: 2000ft) and low speed (max 200kt) which implies 50 s of additional flight time and 30 kg of additional fuel consumption compared to the average visual approach trajectory.

- **Comparison with current Air France RNAV Aid for visual approach**: The RISE trajectory is equivalent.

Post-trial Analysis:



As shown on this figure, Visual RNAV trajectories were flown as expected.

Air France pilots did not report any additional constraints from ATC, except minor comments:

- 3 pilots reported speed reduction before FERAT (from 180kt to 160kt). Those are explained by operational context (avoidance departure traffics, runway change because of wind).

Those speed reduction requests had an impact on fuel consumption as to meet with those speed crews have to extend additional drags (flaps or landing gear). So, in order to maintain flight vertical path, aircraft will have to use additional thrust. This couldn't be further studied as Air France cannot use flight data information for fuel study.

6.1.3.1.2 Results impacting regulation and standardisation initiatives

The following topics have been discussed and a need for updating the existing regulatory and standardisation initiatives has been identified in the following areas:

1. Visual RNAV (or RNAV Visual) procedures: at the time of this project, no standard and no regulation did exist to cover Visual RNAV procedures. In particular, there was no defined Concept of Operation, and no procedure design criteria. The French DSNA and DSAC (Surveillance Authority) chose to define with the stakeholders involved in RISE project a concept of operation, and to use a set of criteria previously used for the development of Visual RNAV procedure in Bordeaux.

2. ICAO DOC 9905: due to the terrain environment in Nice, the procedure designers had to deviate from 1 ICAO recommendation: distance between the FROP (Final Roll Out Point) and the OCA/H.

   Refer to paragraph 6.1.2.2.1 for details, and Nice RNP AR procedures technical report.

3. Runway certification: This topic is now closed and has been discussed during the project. The regulation has been updated, refer to EASA Opinion Letter Ref 03/2016 dated 8.3.2016.

6.1.3.1.3 Unexpected Behaviours/Results

There was no unexpected behaviour/result.

6.1.3.1.4 Quality of Demonstration Results

There was no specific issue concerning the quality of the results achieved in this Exercise.

6.1.3.1.5 Significance of Demonstration Results

The Demonstration results are deemed significant. The operational realism of the Demonstration Exercice could have been affected by:

As compared to real RNP AR operations:

- The trials have been conducted in VMC conditions. However, the procedures used by the flight crew were as if these flights were IMC.
- The aircraft was not certified for RNP AR operations; however the aircraft was equipped with the minimum equipment required for this type of operations.

6.1.4 Conclusions and recommendations

6.1.4.1 Conclusions

All objectives were achieved. Conclusions are sum up in the following tables:

KPA	**RNP AR in Nice benefits**
Safety	High improvement with fully coded and managed trajectory till runway threshold (plus go-around trajectory) Navigation precision is under 0,1 NM Automatic Pilot disconnection after aligned with runway axis
Airport accessibility	Decrease in minima (see paragraph 6.1.3.1.1.2)
Environment	Slight decrease in the number of people affected as compared to the VOR procedure (see paragraph 6.1.3.1.1.3)
Efficiency	No savings from trajectory optimization or additional guidance compared to RNP APCH

KPA	**RNAV Visual in Nice benefits**

Safety	For airlines having customized “RNAV aid to visual approaches”: With Official publication of RNAV Visual, a better awareness of situation between airlines and controllers will be achieved For airlines not having customized “RNAV aid to visual approaches: Additional guidance => reduction of un-stabilized approaches
Environment	Slight decrease in the number of people affected as compared to the VOR procedure (see paragraph 6.1.3.1.1.3)
Efficiency	Compared to visual approaches, RNAV Visual in NCE would lead to a degradation of flight efficiency. ⇨ Additional 30kg of fuel burnt per flight and 50s of flight time per flight Compared to current AF RNAV Aid: Same as current situation

Finally, a short term positive outcome of RISE Trial for safety could be made by redesigning current procedures and lowering the PAPI slope to 3.3° (lowest possible angle with existing obstacles).

The Exercise results were as expected and confirmed the need to implement RNP AR procedure to Nice RWY 22L and 22R, in order to enhance safety and improve airport accessibility.

DSNA objective is to carry on the work in order to publish the RNP AR when possible (2017/2018).

DSNA is using the experience gained through this project to help the definition of a mature concept of operation for Visual RNAV operation at international level.

6.1.4.2 Recommendations

The Exercise highlighted a need to update regulatory documents and standards, as detailed in paragraph 6.1.3.1.2.

Regarding the Visual RNAV procedures, and based on Nice experience as well as on other airports, Air France recommends:

- To let the RNAV Visual be « a tool » for pilots that feel the need to use it (not familiar with the environment; because of company policy)
- Not to publish this procedure before the definition of international, harmonized and shared ICAO criteria
- To let automatic pilot use to airline decision based on safety study and Standard Operating Procedures (SOP) (RNAV Visual SOP to be distinguished to RNP AR SOP).

Regarding RNP AR procedures in Nice, Air France position is:

- On one hand, Nice flight trials confirmed the operational benefits in terms of safety and accessibility of the RNP AR procedure.
- On the other hand, no flight efficiency could be achieved in Nice because of the complexity of trajectory optimization in constrained airspace with busy and mixed traffic (RNP AR procedure is an overlay of existing designs). Trajectory optimization is an issue on many airports and it impacts directly the business case of RNP procedures in general, of RNP AR in particular.

  For airliners, further studies should be done in order to define solutions where:

  - Trajectories can be optimized using fully the advantages of RNP (not an overlay of existing procedures)

- Operational conditions to use those trajectories can be defined taking into account ATC constraints (traffic density, traffic mix) and Airline needs (Pilots familiar with the procedure by using it regularly). Linked to an arrival management tool could be studied in order to produce innovative solutions to manage mixed traffic.

6.2 Demonstration Exercise #2 Report

6.2.1 Exercise Scope

This demonstration exercise covers RNP AR approaches demonstrations into RWY 20 of Ajaccio airport.

Demonstration Exercise ID and Title	EXE-02.08-D-002 : RNP AR Operations at LFKJ (Ajaccio)
Leading organization	DSNA, Air France, easyJet, Air Corsica, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. • Airport accessibility, • Safety, • Environment
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator - Revenue flight **Output:** - Procedures charts - Simulator reports - Flight data and questionnaires analysis and comments/recommendations
Number of trials	49(*) flights conducted by Air France 13(*) flights conducted by easyJet 160(*) flights conducted by Air Corsica

(*) The above mentioned numbers have been provided by participating airlines. The number of flight trials monitored by AJA ATC is the following:

32 flights conducted by Air France
6 flights conducted by Easyjet
8 flights conducted by Air Corsica.
The difference as compared to the number reported by Ajaccio ATC is partially due to the fact that flights have been flown as visual approaches procedures and that some flights did not use the RISE trials phraseology.

6.2.2 Conduct of Demonstration Exercise EXE-02.08-002

6.2.2.1 Exercise Preparation

The preparation activities include all those necessary to prepare the design, assessment, validation and implementation of the RNP procedures.

The output of the Exercise Preparation phase is the Project Specification document, signed by all stakeholders, that summarizes the project scope and objectives, data to be used for the design of the procedures and conceptual design of the procedures.

Ajaccio project specification has been approved by all stakeholders in April 2015.

6.2.2.2 Exercise execution

The following activities have been performed in the Exercise execution for Ajaccio RNP AR procedures:

Exercise execution activity	Included in the scope for Ajaccio airport?	Timeline
Procedure design	YES	April to December 2015
Procedures simulator validation	YES	
Safety study	YES	
Environmental study	YES	
ATC training or briefing	YES	March 2015
Flight trials & data analysis	YES	April 2016 to August 2016 Total number of flights: 222(*)

(*) The above mentioned numbers have been provided by participating airlines. The number of flight trials reported by AJA ATC is 46 flights. The difference as compared to the number reported by Ajaccio ATC is partially due to the fact that flights have been flown as visual approaches procedures and that some flights did not use the RISE trials phraseology.

6.2.2.2.1 Procedures design

RNP AR procedures have been designed to Ajaccio runway 20.

The final procedures approach chart is shown in Appendix B.

The RNP AR procedures design main highlights are:

- The RNP AR procedure from the Northern IAF is similar to the procedure flown today as visual procedure by Air France, easyJet and Air Corsica (known as “approche par le col”).

- The procedure is designed with a FPA (Flight Path Angle) of 3.5°, which is a compromise between the operators request to use the lowest FPA as possible in order to allow proper energy management, and operational / regulator requirement that the flight crews should never see 3 red lights on the PAPI (which is set to 3.7° due to the challenging terrain and osbtacles in the airport area). As the actual vertical path depends on the temperature, a minimum temperature of -9°C has been defined for operation (which is very improbable in Ajaccio).
- Design of the procedures has been done in accordance with ICAO 9905 document. However, three deviations have been highlighted during the design phase:
    a. The ICAO 9905 Document paragraph 4.5.13 recommends that the procedures that incorporate an RF leg in the final segment shall establish the aircraft at Final Roll Out Point (FROP) aligned with the runway centreline prior to a minimum distance before OCA/H for a time of 50 seconds.

       In Ajaccio, due to the terrain constraint, it was not possible to meet this recommendation, and the OCA/H is located slightly before the FROP.

       This deviation to ICAO 9905 recommendation has been mitigated thanks to IFPP/11 report dated 2012 providing further clarification on the rationale for this recommendation, and the fact that AMC 20-26 requires that, for missed approach less than RNP1 aircraft shall remain in LNAV upon initiating a go-around or, for missed approaches of RNP 0.3 or greater this may be mitigated by adequate crew training.

       It was recommended that this deviation to ICAO should be highlighted to operators and covered in the FOSA (Flight Crew Operational Safety Assessment).

    b. The ICAO 9905 Document paragraph 4.6.18 recommends using a specific formula for DMAS RNP Maximum length of RNP<1. As this deviation is covered in a subsequent Amendment of DOC 9905, this is no longer considered as a deviation.

    c. The ICAO 9905 Document recommends that the bank angles in RF legs are limited to 20° in approach and 15° in missed approach (considering ICAO wind table). Using ICAO winds at the beginning of the final RF, calculated bank angle was 23.4°. This deviation has been mitigated thanks to actual wind statistics in Ajaccio (rather than using the ICAO winds), which allow to decrease this bank angle to a theoretical 19.7°.

       It was recommended that this deviation to ICAO should be highlighted to operators and covered in the FOSA (Flight Crew Operational Safety Assessment).

       The DSAC (French Surveillance Authority) has been involved in the discussion all along the RISE project. They accepted these deviations for RISE trials.

       In parallel, DSNA and DSAC have developed RNP AR procedure design criteria document that will be used for approvals and publication of RNP AR procedures in France. This document is based on the ICAO 9905 document, and French specific requirements.

- Finally, while the ICAO 9905 recommends that no obstacle penetrate the VSS (Visual Segment Surface) for RNP AR procedures, the study conducted by DSNA highlighted a couple of obstacles penetrating the VSS in Ajaccio RWY 20.

    This deviation is deemed not acceptable by DSAC (Surveillance Authority), and French RNP AR criteria will not accept any VSS penetration for RNP AR procedure so it is a showstopper for a potential publication. Thus, the obstacles should be removed prior to publication of the procedures or maybe new VSS criteria, discussed at IFPP, could be applied and trees should be out of the OCS part of VSS.

6.2.2.2.2 Procedures simulator validation

The designed procedures have been tested on Airbus A320 Full Flight Simulator equipped with the minimum equipment required for RNP AR operations.

It has been demonstrated that the designed procedures are fly able. In particular:

a. Flight plans are correctly displayed on ND and MCDU
b. No TAWS warning or caution alerts are triggered along the designed paths
c. Experienced cross track errors are within acceptable limits
d. Experienced bank angles are within acceptable limits
e. Procedures are manageable from an energy management point of view.

6.2.2.2.3 Safety study

A safety study was conducted by DSNA for the RISE trials concerning RNP AR procedures:

For the study, the methodology used was first based on a generic document outlining standard expected hazards (hazards identified and studied from ATC perspective).

After that, a brainstorming session was conducted with all stakeholders to discuss and to improve the initial documents.

The outcome was both the safety study documents for the unique environment of Ajaccio, as well as the improvement of the initial documents for the RNP-AR procedure.

The safety study conducted for the RNP AR procedure in Ajaccio allowed all stakeholders to exchange information especially that regarding on-board performance and limitations for this type of procedure.

A great deal was learned by ATCOs on the limitations associated with this type of procedure, as well as the benefits.

In addition, Air France has conducted a safety study (hazards identified and studied from a cockpit perspective) prior to performing RISE trials in order to demonstrate that the RISE flights can be safely conducted, and validate trials operational conditions.

6.2.2.2.4 Environmental study

An environmental study has been conducted in order to compare the noise impact of the new designed procedures, as compared to the existing procedures.

It has been demonstrated that:

- A similar number of impacted people as compared to the existing visual approach procedures from the North West would be affected by the new RNP AR procedure.
- Significantly less people (approximately 22700 people less) as compared to the existing published VPT procedure would be affected by the new RNP AR procedure.

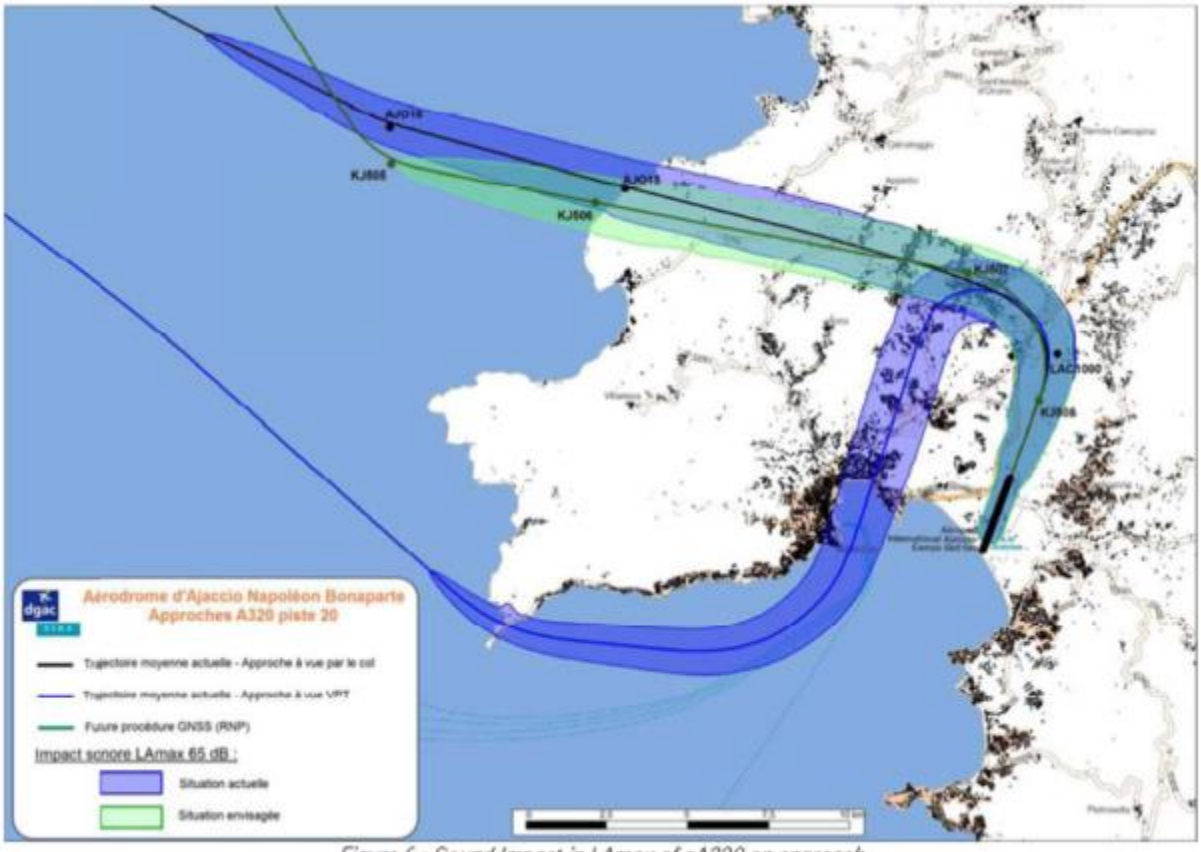


Figure 6 : Sound Impact in LAmax of aA320 on approach

6.2.2.2.5 Operational staff briefing

Air Traffic Controllers

The Air Traffic Controllers of Ajaccio have been briefed prior to the start of RISE trials.

All the documentation (Operational Note, “memo”, AIC, protocol agreement, etc) were available on control position.

Flight crews

A safety assessment was conducted by Air France for Ajaccio RISE trials. The outcomes of those safety assessments for Pilot training were:

- Among the AJA qualified pilots, only experienced Pilots with recent flying experience to AJA were eligible for the flights. Moreover, RNP AR is very similar to current AF RNAV aid for visual approach. Therefore, It was decided that training could be done via computer based training and technical notes. Number of involved pilots was limited in order to keep close contact with them and to allow them to gain experience on the flight trial.

6.2.2.2.6 Flight trials & data analysis

According to participating airlines, 222 flights have been conducted by Air France, EasyJet and Air Corsica.

However, only 47 of them have been formally recorded by Ajaccio Air Traffic Controller (46 cleared).

The difference as compared to the number reported by Ajaccio ATC is partially due to the fact that flights have been flown as visual approaches procedures and that some flights did not use the RISE trials phraseology. Conclusions raised by the operators are based on the total number of flights they flew.

Statistic information is provided in the below table:

Procedure	Nb of requests	Nb of clearances	Nb of satisfactory approaches
		Clearance rate (%)	Satisfactory approaches rate (%)
RNP AR RWY 20	47	46	46
		98%	100%
Total Ajaccio airport	47	46	46
		98%	100%

Trial conditions

Prior to conducting the trials, Air France and Ajaccio ATC agreed on the operational conditions for the trial:

- Flights under visual approach clearance
- Designated phraseology was put into place
- Weather conditions to ask the RISE approaches:
  - Ceiling: 4000ft / visibility 10Km.
  - No clouds on the trajectory under 4000ft
  - Temperature > -9°C. This condition guarantees usable PAPI information (lowest temperature for 3 red and 1 white).
- ATC could refuse trial because of traffic pressure
- Both Captain and first officer had to be volunteers

Results are provided in paragraph 6.2.3.

6.2.2.3 Deviation from the planned activities

All activities planned have been conducted.

6.2.3 Exercise Results

6.2.3.1 Summary of Exercise Results

Refer to paragraph 5.1

6.2.3.1.1 Results per KPA

6.2.3.1.1.1 Safety

The procedures have been assessed during the flight trials period, by Air Corsica, easyJet, Air France and Ajaccio Air Traffic Controllers.

DSNA conclusions:

The air traffic controllers of Ajaccio airport did not report any safety concern when the RNP AR was performed.

Air France conclusions:

Pre-trial Analysis:

Currently, only procedures available on runway 20 are circling to land and visual approaches. Ajaccio is a category C airport, surrounded by many obstacles. PAPI on runway 20 is set at 3,7°. In addition, high temperature and strong winds are usually in Ajaccio making the landing challenging in particular from an energy management point of view.

Introduction of an RNP AR for the runway 20 is believed to increase safety (reducing un-stabilized approaches) as it would be used instead of the circling to land. The main improvements are that:

1. Lateral and vertical guidance are available till the runway threshold
2. Go-around procedure is fully coded and is facing the sea (free of obstacles). Procedure flight path is of 3.5°: This is an important improvement as, with Ajaccio's temperature, aircraft are very often above ISA leading to steep path procedure.

It is to be noted that, if the procedures are used on regular basis and not only when the weather is bad, there is a strong VFR activity at the beginning of the trajectory (between KJ506 and FA20). However, this risk is the same as today in VMC condition with the visual approach going through the same path. If used in degraded conditions, VFR activities will be less important (risk has not been rated higher then).

Post-trial Analysis:

a) Qualitative Feedbacks:

No Air Safety Report was filed by Air France pilots concerning the RISE procedure.

On RISE questionnaires, Air France pilots assessed positively the procedure fly-ability and safety.

1. No issue with energy management was reported. However, they highlighted the importance to anticipate the descent with Marseille ACC to be able to manage properly the approach.

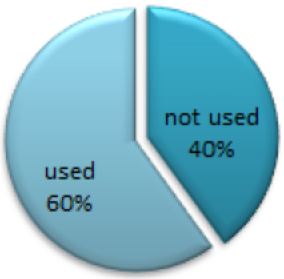
2. No issue with the final alignment to the runway was reported. As for Nice, Pilots noted that the final segment is very short for an instrument approach. This comment is completely normal as RF Leg after FAF is the innovation brought by RNP AR.

3. Reported max Roll degree was between 8° and 20°

4. No EGPWS alerts were reported

5. On the questionnaires, specific questions were asked to pilots about the trees penetrating the VSS. Those questions were:

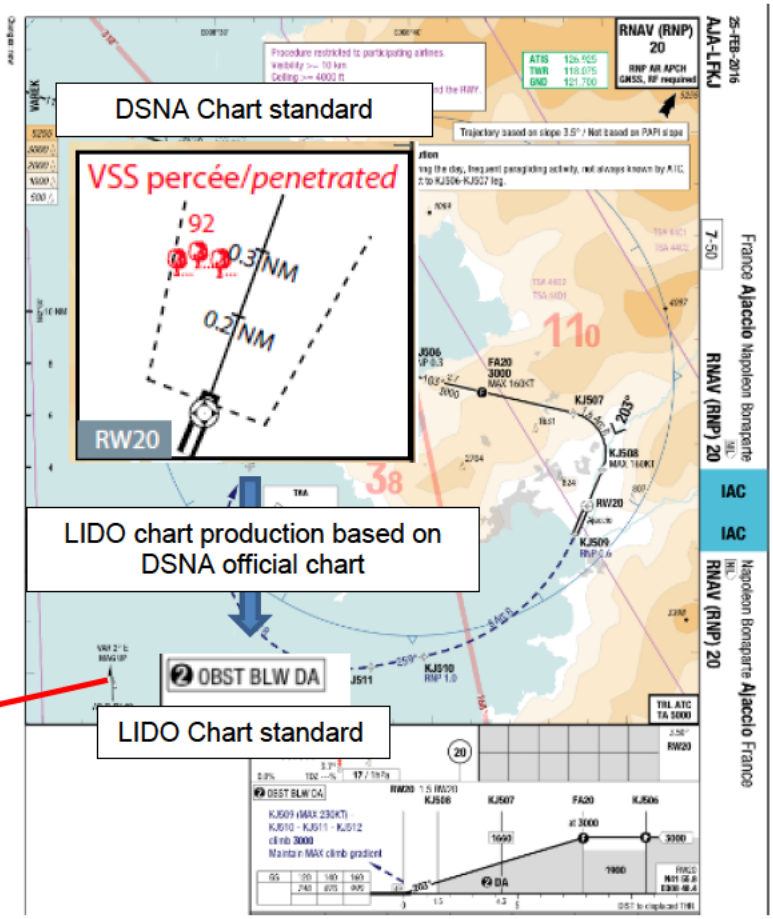
   i. How do you take into account the new chart information of penetrated VSS? (Note to the reader: penetrated VSS information is required on chart only since 2016)



Majority of pilots used the information. However, in their comments, they explained that they could use the information because they already know the airport environment.

Pilot that did not use the information explained that they didn't understand to which obstacles the chart referred to and therefore the information had no interest to raise awareness.

Those comments from Pilots can be easily supported. As shown below, in LIDO chart standard, obstacles are "only" mentioned without any details.

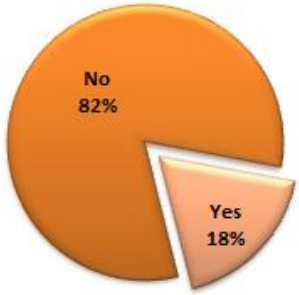


ii. Once on visual segment, did you identify the concerned trees?

Major comments by pilots were:

- Trees were identified because Pilots are specially qualified on the airport and so have a good operational knowledge of the environment
- Even if trees were identified in final segment, they couldn't tell for sure which of those trees were concerned by the chart mention "obstacles below DA".
- In the trial flying conditions, trees were not evaluated as a threat for the flight safety

iii. Do you think some actions should be taken concerning those trees to allow night/IMC operations?



As shown on the graph, most pilots didn't feel that those trees in final were an issue for night/IMC operations

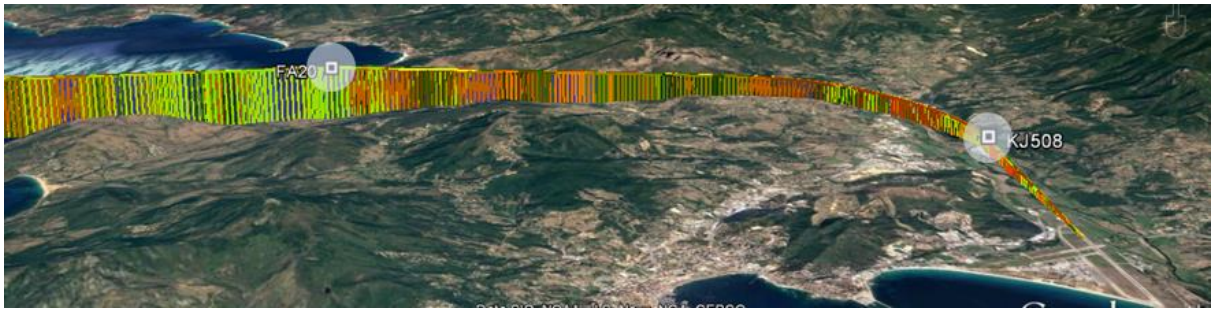
Better charting and potential electric lightning could be an important improvement on that matter.

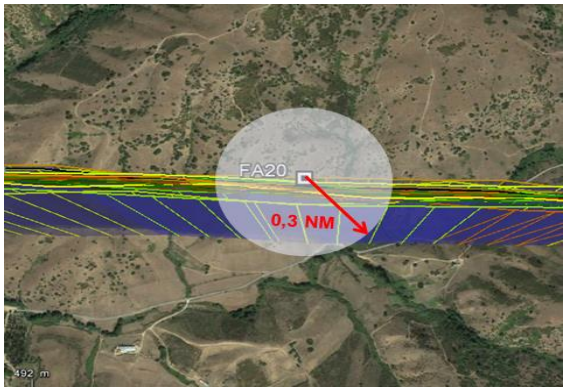
b) Quantitative Feedbacks:

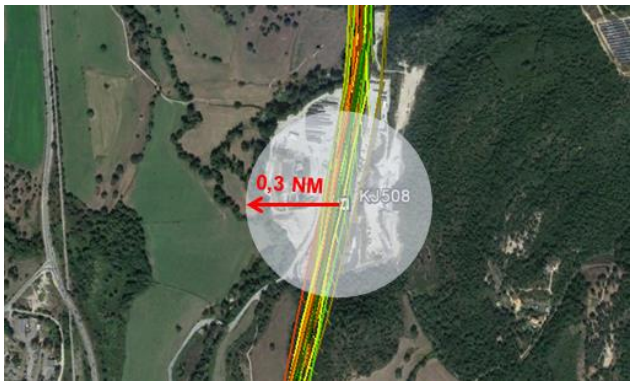
Study from Air France safety ad hoc services confirmed all information reported by participating pilots and showed no flight safety event (study based on safety indicators using flight data recorder – as un-stabilized approaches).

To study the precision of flight navigation, Air France compared position of reference points (published latitude and longitude for FAF and KJ508) with the position reported by the aircraft (from flight data recorders).

As shown on the following figures, adherence to the trajectories is way under the requested 0,3NM of precision.







Air Corsica conclusions:

Air Corsica reported good fly ability of the procedure and positive impact on safety.

EasyJet conclusions:

The RISE RNP AR 20 approach is easy to fly. It is a safety improvement compared to the VPT A or B circling procedure.

FDM analysis has shown that the maximum bank angle record during the final RF leg is 15.5° (RF leg started at max IAS 160 kts). On average when RF leg flown at F speed in CONF2 or CONF3, recorded bank angle recorded were below 14.5°

The minimum Radio Altimeter height during the approach before the final segment was recorded at 830ft close to waypoint KJ507.

No GPWS alerts triggered (while some alerts are sometimes triggered when flying the existing VPT procedure).

No FDM RED events triggered

For all flights, autopilot was kept until reaching proposed DA.

Out of 13 flights, 3 have reported a “low” PAPI indication 3 red light/1 white light, all other flights were on PAPI (2 reds/2 white) at minimum on vertical RNP AR profile (3.5° for a PAPI 3.7°)

Minor or no pilot input required below minimum for the hand flown part

The trees penetrating the VSS have not been reported as a factor by all pilots who have conducted the approach.

6.2.3.1.1.2 Airport accessibility

The below table compares published procedures minima and new RNP AR procedures minima, for a CAT C aircraft.

The implementation of RNP AR procedures in Ajaccio runway 20 greatly improves the published minima. However, this was not a key objective for this airport, as the weather conditions are usually not limiting.

	VPA A / VPT B MDA	**New RNP AR DA**	**Benefit (ft)**	**Estimated nb of additional flights**
Ajaccio 20	4000ft / 2030ft	630ft	-3370ft / -1400ft	(*)

(*) Runway 02 being the preferred runway, it can be in-service with wind conditions favourable to the usage of runway 20, thus leading to some diversion when the limits are reached. With the RNP-AR on runway 20, this situation would not occur (if all users are equipped), and the accessibility would be improved. As an example:

a) During the trial period, easyJet experienced 2 days where landing on RWY20 was not possible using currently published VPT approaches but which would most likely have been possible if use of RNP AR 20 with proposed minima would have been possible

b) Air France estimates that, thanks to the new RNP AR procedures, all weather diversions in Ajaccio could have been avoided (all diversion in the period of October 2013 to October 2014 data have been because of minima). Hypothesis being that the whole Air France fleet would be certified to fly RNP AR procedures.

6.2.3.1.1.3 Environment

As shown on the approach charts (Appendix B) the designed procedures avoid the city of Ajaccio, which perfectly answers to the objective.

In addition, the flight trials demonstrated that the procedures are fully repeatable down to the runway threshold, and it allows for much less dispersion in the final part of the approach paths, as compared to the existing procedures.

Finally, DSNA has conducted an environmental study, refer to paragraph **Error! Reference source not found.**.

6.2.3.1.1.4 Efficiency

Air France and easyJet conducted a fuel study. Conclusions are provided below.

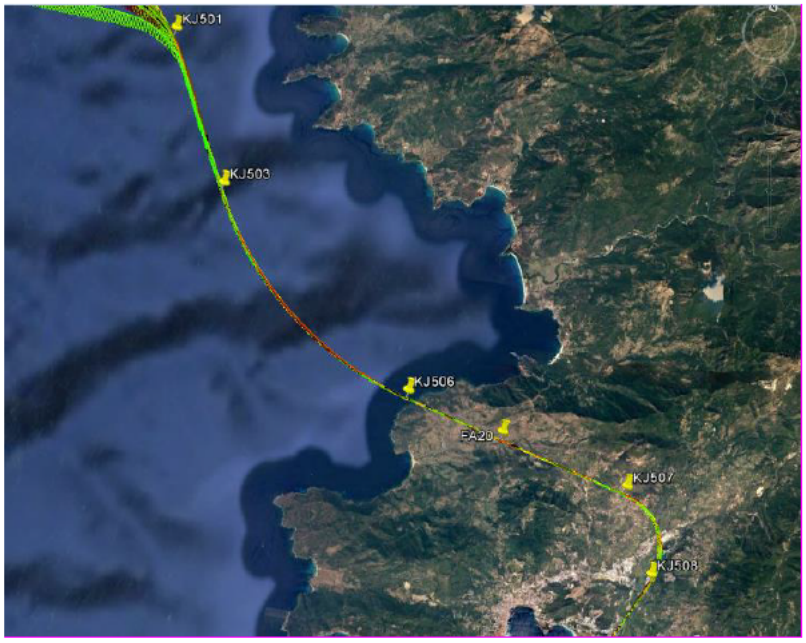
Air France analysis:

Pre-trial Analysis:

Reference trajectory for the baseline is Circling B20. A mean approach has been defined based on actual flown trajectory.

In average, 10NM can be saved per flight thanks to the RNP AR trajectory compared to the circling B20. In terms of fuel, this represents 85 kg ie 42% of savings compared to the current fuel necessary to cover the circling B20 approach (Fuel coverage coming from LIDO data).

Post-trial Analysis:



As shown on this figure, Visual RNAV trajectories were flown as expected. So the savings are confirmed.

easyJet analysis:

easyJet made a comparison of fuel burn from VAREK to Landing RWY 20, comparing the RNP AR fuel data and VPT A via IS. Fuel savings range between 80 and 140 kgs.

easyJet also measured fuel used from KJ506 to landing via RNP AR range [94kg-135kg]. This difference in fuel burn depends on several factors (Gross weight/Wind) but mainly on the configuration (FLAPS and LDG GEAR). easyJet trial pilots tend to be conservative in configuration when doing the approach for the 1st time while pilot with "more" experience on this approach have achieved better fuel burn (energy management does not cause any issue on this approach).

6.2.3.1.2 Results impacting regulation and standardisation initiatives

The following topics have been discussed and a need for updating the existing regulatory and standardisation initiatives has been identified in the following areas:

1. ICAO DOC 9905: due to the terrain environment in Ajaccio, the procedure designers had to deviate from 2 ICAO recommendations: a) distance between the FROP (Final Roll Out Point) and the OCA/H, and b) bank angles in the RF legs
2. Runway certification: This topic is now closed and has been discussed during the project. The regulation has been updated, refer to EASA Opinion Letter Ref 03/2016 dated 8.3.2016. Nevertheless, some interpretation is still needed concerning IFR procedure on non-fully IFR runway end.

6.2.3.1.3 Unexpected Behaviours/Results

There was no unexpected behaviour/result.

6.2.3.1.4 Quality of Demonstration Results

There was no specific issue concerning the quality of the results achieved in this Exercise.

6.2.3.1.5 Significance of Demonstration Results

The Demonstration results are deemed quite significant. The operational realism of the Demonstration Exercice could have been affected by:

As compared to real RNP AR operations:

- The trials have been conducted in VMC conditions. However, the procedures used by the flight crew were as if these flights were IMC.
- The aircraft was not certified for RNP AR operations; however the aircraft was equipped with the minimum equipment required for this type of operations.

6.2.4 Conclusions and recommendations

6.2.4.1 Conclusions

The Exercise results were as expected and confirmed the benefits that could bring the implementation of a RNP AR procedure to Ajaccio RWY 20:

- Enhancement of safety by proposing a fully managed and repeatable procedure (replacing the existing circle to land procedure).
- Fuel savings thanks to a shorter trajectory: 80 kg up to 140 kg of fuel consumption reduction have been assessed, representing 25% to 50% of fuel reduction on the approach to Ajaccio
- Enhance airport accessibility and thus reduce the number of diversions and cancellations due to bad weather conditions.

The design of the approach is good (obstacle clearance/energy management) and easy to fly.

One major issue for the publication of the procedure has been identified, which is the fact that some obstacles penetrate the VSS (Visual Segment Surface). The DSNA and DSAC are coordinating with the airport administrator to get these obstacles (trees) removed.

In addition, Ajaccio airport will have to be certified by EASA. In particular, Runway 20 will have to be approved for non-precision approach procedures before RNP AR can be published. Deviations to the new EASA regulation have been identified (e.g. terrain – that cannot be removed - penetrating the protection surfaces), and might be a showstopper for publication of the procedures.

DSNA objective is to carry on the work in order to publish the RNP AR when possible (2017/2018).

6.2.4.2 Recommendations

The Exercise highlighted a need to update regulatory documents and standards, as detailed in paragraph 6.2.3.1.2.

6.3 Demonstration Exercise #3 Report

6.3.1 Exercise Scope

This demonstration exercise covers RNP1 to ILS and RNAV Visual approaches demonstrations into RWY 29 of Paphos airport.

Demonstration Exercise ID and Title	EXE-02.08-D-003 : RNP1 to ILS and RNAV Visual Operations at LCPH (Paphos)
Leading organization	DCAC, easyJet, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. • Safety, • Environment, • Track miles reduction, • Fuel savings and CO2 emission reduction.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator - Revenue flight **Output:** - Procedures charts - Simulator reports - Flight data and questionnaires analysis and comments/recommendations
Number of trials	32 flights conducted by easyJet

6.3.2 Conduct of Demonstration Exercise EXE-02.08-003

6.3.2.1 Exercise Preparation

The preparation activities include all those necessary to prepare the design, assessment, validation and implementation of the procedures.

The output of the Exercise Preparation phase is the Project Specification document, signed by all stakeholders, that summarizes the project scope and objectives, data to be used for the design of the procedures and conceptual design of the procedures.

Paphos project specification has been approved by all stakeholders in June 2015.

6.3.2.2 Exercise execution

The following activities have been performed in the Exercise execution for Paphos RNP1 to ILS and RNAV Visual procedures:

Exercise execution activity	Included in the scope for Paphos airport?	Timeline
Procedure design	YES	June 2015 to December 2015
Procedures simulator validation	YES	
Safety study	YES	
Environmental study	NO	
ATC training or briefing	YES	January 2016
Flight trials & data analysis	YES	February 2016 to July 2016 Total number of flights: 32

6.3.2.2.1 Procedures design

RNP1 to ILS and RNAV Visual procedures have been designed to Paphos runway 29.

The final procedures approach charts are shown in Appendix C.

The RNP1 to ILS procedures design main highlight is:

- It is the approach where the initial approach segment is defined by an RNP1 route, using RNP systems for track guidance. The RNP route is terminated at IF. The IF is located on the LOC course and the inbound intermediate segment is defined by the LOC. After the IF the pilot will follow the ILS for landing. The aircraft is protected from obstacles throughout the procedure.
- The procedures have been designed so that the aircraft will level off before the FAP, whatever the temperature in order to allow for proper interception of the G/S.
- Missed approach segment has been designed with RNP1.

The RNAV Visual procedures design main highlights are:

- As no RNAV Visual procedure criteria exists, the DCAC chose to use RNAV1 procedure design criteria for the approach and missed approach paths, except for the final visual leg (no protection design area defined for this final visual leg).
- In general, the initial approach segment is defined by an RNAV1 route, using RNAV systems for track guidance. The RNAV route is terminated at VAP (Visual Approach Point) which is

located at the start of the final leg, or any other identified point from where the pilot will continue its approach visually with reference to ground (obstacles) and having the airport in sight all times.

- The aircraft is protected from all obstacles until the VAP (Visual Approach Point). In order to descend lower than the altitude of the VAP, the pilot has to have the aerodrome and ground visual at all times and has the responsibility to avoid any obstacles (visual part of the procedure)

6.3.2.2.2 Procedures simulator validation

The designed procedures have been tested on Airbus A320 Full Flight Simulator.

It has been demonstrated that the designed procedures are fly able. In particular:

a. Flight plans are correctly displayed on ND and MCDU
b. No TAWS warning or caution alerts are triggered along the designed paths
c. Experienced cross track errors are within acceptable limits
d. Experienced bank angles are within acceptable limits
e. Procedures are manageable from an energy management point of view.

6.3.2.2.3 Safety study

A safety study has been conducted for RISE trials, for both RNAV Visual and RNP1 to ILS procedures.

The study has been conducted in the context of official publication of all procedures. The approval in the frame of RISE trials has been granted by the NSA.

6.3.2.2.4 ATC training

The Air Traffic Controllers of Paphos have been briefed prior to the start of RISE trials.

Classroom training has been conducted by DCAC: it included general information on GNSS Systems and specific information related to the RISE trials.

6.3.2.2.5 Flight crew briefing

Emirates has developed a crew briefing to support the trials phase, which is provided in Appendix N.

EasyJet provided Flight Crew with a Notice to Crew (NTC) that provided an overview of the RISE project, and a NTC that detailed the specific conditions related to the trials at Paphos. Refer to Appendix P.

6.3.2.2.6 Flight trials & data analysis

32 flights have been conducted by easyJet on A320 aircraft type.

Procedure	Nb of requests	Nb of clearances	Nb of satisfactory approaches
		Clearance rate (%)	Satisfactory approaches rate (%)
	NIL		

RNP1 to ILS 29 via ESERI			
RNP1 to ILS 29 via GENOS	NIL		
RNP1 to ILS 29 via GIPRO	NIL		
RNP1 to ILS 29 via NORDI	NIL		
RNP1 to ILS 29 via TOBAL	22	22	22
		100%	100%
Total RNP1 to ILS	22	22	22
		100%	100%
RNAV Visual 29 via ESERI	NIL		
RNAV Visual 29 via GENOS	NIL		
RNAV Visual 29 via TOBAL	10	10	10
		100%	100%
Total RNAV Visual	10	10	10
		100%	100%
Total Paphos airport	32	32	32
		100%	100%

Results are provided in paragraph 6.1.3.

6.3.2.3 Deviation from the planned activities

All activities planned have been conducted.

6.3.3 Exercise Results

6.3.3.1 Summary of Exercise Results

Refer to paragraph 5.1

6.3.3.1.1 Results per KPA

6.3.3.1.1.1 Safety

The procedures have been assessed during the flight trials period, by easyJet and Paphos Air Traffic Controllers.

The controllers' feedback was very positive since the flight paths are fully repeatable which allows for better timing and sequencing of the arrivals. It also provides an alternate to the conventional navigation and less worries about entering uncontrolled/unauthorised airspace.

Easyjet states that no Air Safety Reports (ASRs) were received in relation to these procedures, in line with the reporting detailed in the NTC.

No adverse comment was reported or raised by Flight Crew conducting the Flight Trials.

EasyJet believe that the key driver for the introduction of these procedures is safety. The benefits primarily accrue from the following:

- Maximum use of the aircraft automation, leading to accurate horizontal and vertical path tracking, in a multitude of meteorological conditions, with a commensurate reduction in cockpit workload.
- The above significantly increases the likelihood of a stabilised approach which is a key prerequisite for the avoidance of landing incidents/accidents and the reduction of missed approaches.
- In a procedural flying environment, the fixed path/speed nature of the procedures, provide a more ordered ATC environment with the possibility for reduced RT loading.

In addition, EasyJet provided a sample of ACARS reports related to Paphos (LCPH, PFO) PBN procedures:

Tail	Arr	Freetext
G-EZPH	PFO	- HI. PERFORMED RNAV VISUAL R29 PFO GEZPH EZY51RG - APPR ARMED AT PH966. FINAL APP ENGAGED AT PH965 AND REMAINED UNTIL AP DISCONNECT AFTER PH96
G-EZUR	PFO	- ILS 29 P COMPLETED SATIS
G-EZOP	PFO	- RNAV-V 29. ALL WORKED WELL WITH NO ISSUES FLT 2133
G-EZOI	PFO	- SUCCESSFUL RNAV VISUAL APP RWY 29 PFO

G-EZUG	PF O	- PFO/ILS29P SUCCESSFUL EXPERIENCED SLIGHT DIFF ON SPD CONTROL DUE TO TAILWND. A/C REMAINED ON THE INNER SIDE OF RF LEG.
G-EZOO	PF O	- 1 SUCCESSFUL RNAV VISUAL RWY 29 PFO
G-EZOO	PF O	- RNAV TO VISUAL 29 PFO COMPLETED SUCCESSFULLY
G-EZWK	PF O	- FLEW RNAV VISUAL 29 INTO PFO. PROCEDURE AND PROFILE WORKS WELL.
G-EZWF	PF O	- HELLO. FOR INFO RNAV VISUAL APPROACH FLOWN INTO PFO RWY 29. SUCCESSFUL APPROACH THANKS

6.3.3.1.1.2 Environment

As shown on the approach charts (Appendix C) the designed procedures avoid the British military controlled Akrotiri airport, and the city of Paphos, which perfectly answers to the objective.

In addition, the flight trials demonstrated that the procedure are fully repeatable down to the runway threshold, and it allows for much less dispersion in the critical part of the approach paths (close to the unauthorized airspace), as compared to the existing procedures. See Appendix L.

6.3.3.1.1.3 Efficiency

A track miles analysis comparison has been done, comparing the new designed procedures with the published VOR to ILS procedure, results are provided in the below table:

Paphos RWY 29 – Track miles comparison new procedures (RNP1 to ILS) versus published procedure (VOR to ILS)	
Procedure	Difference in NM with the published VOR to ILS procedure
RNP1 to ILS via ESERI	-22 NM
RNP1 to ILS via GENOS	0 NM
RNP1 to ILS via GIPRO	-32 NM
RNP1 to ILS via NORDI	-35 NM
RNP1 to ILS via TOBAL	+ 2NM
Average RNP1 to ILS	*New procedures 17NM shorter*
RNAV Visual via ESERI	-28 NM
RNAV Visual via GENOS	-7 NM
RNAV Visual via TOBAL	-4 NM

Average RNAV Visual	*New procedures 13NM shorter*

Due to lack of access to FDM data, no specific analysis on benefits was conducted by easyJet

6.3.3.1.2 Results impacting regulation and standardisation initiatives

The following topics have been discussed and a need for updating the existing regulatory and standardisation initiatives has been identified in the following area:

1. Visual RNAV (or RNAV Visual) procedures: at the time of this project, no standard and no regulation did exist to cover Visual RNAV procedures. In particular, there was no defined Concept of Operation, and no procedure design criteria. The DCAC chose to use its internally defined criteria.

6.3.3.1.3 Unexpected Behaviours/Results

There was no unexpected behaviour/result.

6.3.3.1.4 Quality of Demonstration Results

There was no specific issue concerning the quality of the results achieved in this Exercise.

6.3.3.1.5 Significance of Demonstration Results

The results are deemed significant of the real operations.

easyJet comment:

Based upon our involvement in the RISE project and procedure construction, and our experience of other PBN procedures in our operational environment, we are not surprised by the success of the demonstration results. Please note that all demonstration flights were performed by line Flight Crew who only had access to the briefing material contained herein.

6.3.4 Conclusions and recommendations

6.3.4.1 Conclusions

The Exercise results were as expected and confirmed the need to implement RNP1 to ILS and RNAV Visual procedures to Paphos RWY 29, main objective being to propose shorter trajectories thus reduce fuel consumption, and define trajectories avoiding penetration of unauthorized airspaces.

The DCAC is in the process of getting the procedures approved by the Regulator, for publication of the procedures end of 2016 / beginning of 2017.

easyJet reports are in line with the objectives of the implementation, ensuring that both procedures provide ordered and safe approaches.

6.3.4.2 Recommendations

The Exercise highlighted a need to update regulatory documents and standards, as detailed in paragraph 6.3.3.1.2.

In addition, easyJet made the following recommendations:

- Ensure that the procedures are published in a timely manner.
- Encourage the use of the procedures, to the benefit of all airspace users.
- Keep abreast of PBN developments and incorporate, where appropriate, within existing procedures.

6.4 Demonstration Exercise #4 Report

6.4.1 Exercise Scope

This demonstration exercise covers RNP1 to ILS and RNAV Visual approaches demonstrations into RWY 22 of Larnaca airport.

Demonstration Exercise ID and Title	EXE-02.08-D-004 : RNP1 to ILS and RNAV Visual Operations at LCLK (Larnaca)
Leading organization	Aegean, easyJet, Emirates, DCAC, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. • Safety, • Environment, • Track miles reduction, • Fuel savings and CO2 emission reduction.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator - Revenue flight **Output:** - Procedures charts - Simulator reports - Flight data and questionnaires analysis and comments/recommendations
Number of trials	3 flights conducted by easyJet 11 flights conducted by Aegean 28 flights conducted by Emirates 2 flight conducted by Edelweiss 10 flights conducted by Rossiya Airlines 1 flight conducted by Austrian Airlines 3 flights conducted by Etihad

6.4.2 Conduct of Demonstration Exercise EXE-02.08-004

6.4.2.1 Exercise Preparation

The preparation activities include all those necessary to prepare the design, assessment, validation and implementation of the procedures.

The output of the Exercise Preparation phase is the Project Specification document, signed by all stakeholders, that summarizes the project scope and objectives, data to be used for the design of the procedures and conceptual design of the procedures.

Larnaca project specification has been approved by all stakeholders in June 2015.

6.4.2.2 Exercise execution

The following activities have been performed in the Exercise execution for Larnaca RNP1 to ILS and RNAV Visual procedures:

Exercise execution activity	Included in the scope for Paphos airport?	Timeline
Procedure design	YES	June to December 2015
Procedures simulator validation	YES	
Safety study	YES	
Environmental study	NO	
ATC training or briefing	YES	
Flight trials & data analysis	YES	February 2016 to July 2016 Total number of flights: 58

6.4.2.2.1 Procedures design

RNP1 to ILS and RNAV Visual procedures have been designed to Larnaca runway 22.

The final procedures approach charts are shown in Appendix D.

The RNP1 to ILS procedures design main highlight is:

- It is the approach where the initial approach segment is defined by an RNP1 route, using RNP systems for track guidance. The RNP route is terminated at IF. The IF is located on the LOC course and the inbound intermediate segment is defined by the LOC. After the IF the pilot will follow the ILS for landing. The aircraft is protected from obstacles throughout the procedure.
- The procedures have been designed so that the aircraft will level off before the FAP, whatever the temperature in order to allow for proper interception of the G/S.
- Missed approach segment has been designed with RNP1.

The RNAV Visual procedures design main highlights are:

- As no RNAV Visual procedure criteria exists, the DCAC chose to use RNAV1 procedure design criteria for the approach and missed approach paths, except for the final visual leg (no protection design area defined for this final visual leg).

- In general, the initial approach segment is defined by an RNAV1 route, using RNAV systems for track guidance. The RNAV route is terminated at VAP (Visual Approach Point) which is located at the start of the final leg, or any other identified point from where the pilot will continue its approach visually with reference to ground (obstacles) and having the airport in sight all times.
- The aircraft is protected from all obstacles until the VAP (Visual Approach Point). In order to descend lower than the altitude of the VAP, the pilot has to have the aerodrome and ground visual at all times and has the responsibility to avoid any obstacles (visual part of the procedure)

6.4.2.2.2 Procedures simulator validation

The designed procedures have been tested on Airbus A320 Full Flight Simulator.

It has been demonstrated that the designed procedures are fly able. In particular:

a. Flight plans are correctly displayed on ND and MCDU
b. No TAWS warning or caution alerts are triggered along the designed paths
c. Experienced cross track errors are within acceptable limits
d. Experienced bank angles are within acceptable limits
e. Procedures are manageable from an energy management point of view.

6.4.2.2.3 Safety study

A safety study has been conducted for RISE trials, for both RNAV Visual and RNP1 to ILS procedures.

The study has been conducted in the context of official publication of all procedures. The approval in the frame of RISE trials has been granted by the NSA.

6.4.2.2.4 ATC training

The Air Traffic Controllers of Larnaca have been trained prior to the start of RISE trials.

Classroom training has been conducted by DCAC: it included general information on GNSS Systems and specific information related to the RISE trials.

6.4.2.2.5 Crew briefing

Emirates has developed a crew briefing to support the trials phase, which is provided in Appendix N.

easyJet provided Flight Crew with a Notice to Crew (NTC) that provided an overview of the RISE project, and a NTC that detailed the specific conditions related to the trials at Larnaca (Refer to Appendix P).

6.4.2.2.6 Flight trials & data analysis

58 flights have been conducted by Emirates, Aegean, Edelweiss, Rossiya Airlines, Etihad, Austrian Airlines and easyJet, on A319, A320, A321, A330, A340 and B777.

Procedure	Nb of requests	Nb of clearances	Nb of satisfactory approaches
		Clearance rate (%)	Satisfactory approaches rate (%)
RNP1 to ILS 22 via AMAKO	NIL		
RNP1 to ILS 22 via BOSIS	15	15	15
		100%	100%
RNP1 to ILS 22 via REXAL	NIL		
RNP1 to ILS 22 via SOBOS	14	14	
		100%	100%
Total RNP1 to ILS	29	29	29
		100%	100%
RNAV Visual 22 via ADLAS	27	27	27
		100%	100%
RNAV Visual 22 via AMAKO	NIL		
RNAV Visual 22 via BOSIS	1	1	1
		100%	100%
RNAV Visual 22 via REXAL	NIL		
RNAV Visual 22 via SOBOS	1	1	1
		100%	100%

Total RNAV Visual	28	28	28
		100%	100%
Total Larnaca airport	58	58	58
		100%	100%

Results per KPI are provided in paragraph 6.1.3.

6.4.2.3 Deviation from the planned activities

All activities planned have been conducted.

6.4.3 Exercise Results

6.4.3.1 Summary of Exercise Results

Refer to paragraph 5.1

6.4.3.1.1 Results per KPA

6.4.3.1.1.1 Safety

The procedures have been assessed during the flight trials period, by Emirates, easyJet, Aegean and Paphos Air Traffic Controllers.

The controllers' feedback was very positive since the flight paths are fully repeatable which allows for better timing and sequencing of the arrivals. It also provides an alternate to the conventional navigation and less worries about entering uncontrolled/unauthorised airspace.

Emirates feedback is very much in line with ATCo.

Aegean feedbacks highlight that the RNP to ILS procedure for runway 22 enhances safety and ensures consistently stabilized approaches with prescribed tracks and mileage. It eliminates the need for requesting visual approach in order to cut track miles, reducing significantly pilots' workload and hand-flying maneuvers.

easyJet states that no Air Safety Reports (ASRs) were received in relation to these procedures, in line with the reporting detailed in the NTC.

No adverse comment was raised by Flight Crew conducting the Flight Trials.

easyJet believe that the key driver for the introduction of these procedures is safety. The benefits primarily accrue from the following:

- Maximum use of the aircraft automation, leading to accurate horizontal and vertical path tracking, in a multitude of meteorological conditions, with a commensurate reduction in cockpit workload.
- The above significantly increases the likelihood of a stabilised approach which is a key prerequisite for the avoidance of landing incidents/accidents and the reduction of missed approaches.
- In a procedural flying environment, the fixed path/speed nature of the procedures provides a more ordered ATC environment with the possibility for reduced RT loading.

In addition, Easyjet provided a sample of ACARS report related to the Larnaka (LCLK, LCA) procedures:

Tail	Arr	Freetext
G-EZFX	LCA	- HI NAV. ILS-P-22 LCA PERFORMED TODAY. SUCCESSFUL.
G-EZFK	LCA	- HI GUYS. SUCCESSFULLY FLEW THE RNP TRANSITION SOBOS 1P +ILS P 22 INTO LCA. PROCEDURE IS FINE HOWEVER MORE CHALLENGING IF SPEED IS GIVEN BY ATC

6.4.3.1.1.2 Environment

As shown on the approach charts (Appendix D) the designed RNAV Visual procedures from ADLAS avoid the uncontrolled occupied areas by Turkey, British Helicopter transiting at 500ft MSL and main area of Larnaca city, which perfectly answers to the objective.

In addition, the flight trials demonstrated that the procedures are fully repeatable down to the runway threshold, and it allows for much less dispersion in the critical part of the approach paths (close to the unauthorized airspace). See Appendix M.

6.4.3.1.1.3 Efficiency

A track miles analysis comparison has been done, comparing the new designed procedures with the published VOR to ILS procedure, results are provided in the below table:

Larnaca RWY 22 – Track miles comparison new procedures (RNP1 to ILS) versus published procedure (VOR to ILS)	
Procedure	Difference in NM with the published VOR to ILS procedure
RNP1 to ILS via AMAKO	-3 NM
RNP1 to ILS via BOSIS	-1 NM
RNP1 to ILS via REXAL	-2.5 NM
RNP1 to ILS via SOBOS	-1 NM
Average RNP1 to ILS	*New procedures 1.9 NM shorter*
RNAV Visual via ADLAS	-12 NM
RNAV Visual via AMAKO	-6 NM
RNAV Visual via BOSIS	-7 NM
RNAV Visual via REXAL	-6.5 NM
RNAV Visual via SOBOS	-2 NM
Average RNAV Visual	*New procedures 6.7NM shorter*

Emirates delta fuel burn analysis:

Also, Emirates conducted a theoretical DELTA fuel burn for their typical entry waypoint in Larnaca, for an A330, using Airbus IFP tool. While the study is theoretical, the weight, temperature and wind data used for the study were extracted from the flight data recorders.

The results are:

a. For the arrivals from SOBOS entry waypoint: no measurable difference is expected from a fuel perspective as tracks and profiles are very similar.

b. For the arrivals from BONEK entry waypoint (connecting then either to the new RNAV approaches from ADLAS, or to the existing VOR22+ILS procedure): savings of around 90kg per approach is foreseen.

   These savings are mainly derived from the outbound leg on the ILS teardrop procedure (from LCA) which is flown 'almost level' in flaps Conf2 and then Conf3 whereas RNAV22 (from ADLAS) allows for a continuous descent on the whole profile.

Aegean qualitative feedback:
The RNP to ILS procedure reduces significantly the track mileage (especially coming from the northwest) and eliminates the need to fly overhead the airport to join the outbound leg.

Due to lack of access to FDM data, no specific analysis on benefits was conducted by easyJet

6.4.3.1.2 Results impacting regulation and standardisation initiatives

The following topics have been discussed and a need for updating the existing regulatory and standardisation initiatives has been identified in the following area:

1. Visual RNAV (or RNAV Visual) procedures: at the time of this project, no standard and no regulation did exist to cover Visual RNAV procedures. In particular, there was no defined Concept of Operation, and no procedure design criteria. The DCAC chose to use its internally defined criteria.

6.4.3.1.3 Unexpected Behaviours/Results

There was no unexpected behaviour/result.

6.4.3.1.4 Quality of Demonstration Results

There was no specific issue concerning the quality of the results achieved in this Exercise.

6.4.3.1.5 Significance of Demonstration Results

The results are deemed significant of the real operations.

The significance of the trial results is that they clearly demonstrate the reliability of RNAV and RNP procedures at a high level, and provide validation that these procedures in particular have benefited from a robust design and construction process.

easyJet comment:

Based upon our involvement in the RISE project and procedure construction, and our experience of other PBN procedures in our operational environment, we are not surprised by the success of the demonstration results. Please note that all demonstration flights were performed by line Flight Crew who only had access to the briefing material contained herein.

6.4.4 Conclusions and recommendations

6.4.4.1 Conclusions

The Exercise results were as expected and confirmed the need to implement RNP1 to ILS and RNAV Visual procedures to Larnaca RWY 22, main objective being to propose shorter trajectories and facilitate Continuous Descent Approach (CDA), thus reduce fuel consumption, and define trajectories avoiding penetration of unauthorized airspaces.

The DCAC is in the process of getting the procedures approved by the Regulator, for publication of the procedures end of 2016 / beginning of 2017.

6.4.4.2 Recommendations

The Exercise highlighted a need to update regulatory documents and standards, as detailed in paragraph 6.4.3.1.2.

In addition, easyJet made the following recommendations:

- Ensure that the procedures are published in a timely manner.
- Encourage the use of the procedures, to the benefit of all airspace users.
- Keep abreast of PBN developments and incorporate, where appropriate, within existing procedures.

6.5 Demonstration Exercise #5 Report

6.5.1 Exercise Scope

This demonstration exercise covers RNP AR and RNP APCH approaches demonstrations into RWY 16 and 34 of Mykonos airport.

Demonstration Exercise ID and Title	EXE-02.08-D-005 : RNP AR and RNP APCH Operations at LGMK (Mykonos)
Leading organization	Aegean, easyJet, HCAA, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. • Airport accessibility, • Safety, • Track miles reduction, • Fuel savings and CO2 emission reduction.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator - Revenue flight **Output:** - Procedures charts - Simulator reports - Flight data and questionnaires analysis and comments/recommendations
Number of trials	16 flights conducted by Aegean 32 flights conducted by easyJet (*)

(*) The above mentioned number has been provided by HCAA. The number of flight trials monitored by easyJet is 25 flights for easyJet. The difference is due to the difficulty to sometimes get pilot's feedback/questionnaires

6.5.2 Conduct of Demonstration Exercise EXE-02.08-005

6.5.2.1 Exercise Preparation

The preparation activities include all those necessary to prepare the design, assessment, validation and implementation of the RNP procedures.

The output of the Exercise Preparation phase is the Project Specification document, signed by all stakeholders, that summarizes the project scope and objectives, data to be sued for the design of the procedures and conceptual design of the procedures.

Mykonos project specification has been approved by all stakeholders in May 2015.

6.5.2.2 Exercise execution

The following activities have been performed in the Exercise execution for Mykonos RNP AR procedures:

Exercise execution activity	Included in the scope for Mykonos airport?	Timeline
Procedure design	YES	May 2015 to September 2015
Procedures simulator validation	YES	
Safety study	YES	
Environmental study	NO	
ATC training or briefing	YES	September 2015 March 2016
Flight trials & data analysis	YES	February to August 2016 Total number of flights: 48 (*)

(*) The above mentioned number has been provided by HCAA. The number of flight trials monitored by easyJet is 25 flights for easyJet. The difference is due to the difficulty to sometimes get pilot's feedback/questionnaires

6.5.2.2.1 Procedures design

RNP AR procedures have been designed to Mykonos runway 16 and one RNP APCH procedure has been designed to Mykonos runway 34. STARs feeding the new designed procedures have also been designed.

The final procedures approach charts are shown in Appendix E.

The RNP AR procedures (RWY 16) design main highlights are:

- While weather conditions did not really necessitate to lower minima, RNP AR procedures were deemed necessary for approaches on runway 16 due to the terrain and obstacle environment.
- As the new designed procedures are shorter than the existing ones, and due to the fact that the TMA is relatively small with relatively high entry waypoints altitudes, it was recommended to lower some of the entry waypoints altitude constraints (action still on-going on HCAA side).
- Design of the procedures has been done in accordance with ICAO 9905 document. However, two deviations have been highlighted during the design phase:

a. The ICAO 9905 Document paragraph 4.5.13 recommends that the procedures that incorporate an RF leg in the final segment shall establish the aircraft at Final Roll Out Point (FROP) aligned with the runway centreline prior to a minimum distance before OCA/H for a time of 50 seconds (RNP value in missed approach <1).

   In Mykonos, due to the terrain constraint, it was not possible to meet this recommendation, and the FROP is located after OCA/H for runway 16.

   This deviation to ICAO 9905 recommendation has been mitigated thanks to IFPP/11 report dated 2012 providing further clarification on the rationale for this recommendation, and the fact that AMC 20-26 requires that, for missed approach less than RNP1 aircraft shall remain in LNAV upon initiating a go-around or, for missed approaches of RNP 0.3 or greater this may be mitigated by adequate crew training.

   It was recommended that this deviation to ICAO should be highlighted to operators and covered in the FOSA (Flight Crew Operational Safety Assessment).

b. The ICAO 9905 Document recommends that the bank angles in RF legs are limited to 20° in approach and 15° in missed approach (considering ICAO wind table). Due to the terrain environment in Mykonos higher bank angles have been considered. This deviation has been mitigated thanks to the actual aircraft capabilities (AutoPilot supporting higher bank angle values).

   It was recommended that this deviation to ICAO should be highlighted to operators and covered in the FOSA (Flight Crew Operational Safety Assessment).

   The HCAA Regulator has been involved in the discussion all along the RISE project. They accepted these deviations for RISE trials.

The RNP APCH procedures (RWY 34) design main highlights are:

- As the new designed procedures are shorter than the existing ones, and due to the fact that the TMA is relatively small with relatively high entry waypoints altitudes, it was recommended to lower some of the entry waypoints altitude constraints (action still on-going on HCAA side).
- Design of the procedures has been done in accordance with ICAO 8168 document. However, one deviation has been highlighted during the design phase:
  a. The ICAO 8168 recommends that the descent gradient is no more than 8%, which was not always respected (see bullet above about entry waypoints altitude constraints).

6.5.2.2.2 Procedures simulator validation

All the designed procedures have been tested on Airbus A320 Full Flight Simulator equipped with the minimum equipment required for RNP AR operations.

It has been demonstrated that the designed procedures are fly able. In particular:

a. Flight plans are correctly displayed on ND and MCDU
b. No TAWS warning or caution alerts are triggered along the designed paths
c. Experienced cross track errors are within acceptable limits
d. Experienced bank angles are within acceptable limits
e. Procedures are manageable from an energy management point of view, pending appropriate flight techniques are used (use of speed brakes, etc…). Airbus ProSky highly recommended lowering the altitude constraints at the entry waypoints.

6.5.2.2.3 Safety study

It concludes that the implementation of RNP procedures in Mykonos TMA does not lead to the identification of new hazards. Therefore, no Safety Requirement has been identified. The list of assumptions has been clearly established, highlighting the need for training the ATC (as per ICAO DOC 9613) and briefing the flight crews (RF specificities, briefing on the charts & procedures, etc…), prior to the flight trials.

6.5.2.2.4 ATC training

5 Air Traffic Controllers of Mykonos, as well as one person from Athens Aerodrome Control Unit and one person from Athens APP Control Unit have been trained prior to the start of RISE trials. In addition, a training refresher has been conducted in March 2016, in order to prepare the 2016 summer season trials.

6.5.2.2.5 Flight Crew briefing

easyJet provided Flight Crew with a Notice to Crew (NTC) that provided an overview of the RISE project, and a NTC that detailed the specific conditions related to the trials at Mykonos and Santorini. Refer to Appendix O.

6.5.2.2.6 Flight trials & data analysis

The ATCos of Mykonos reported that 48 flights (16+32) have been successfully conducted by Aegean and easyJet, on A320 aircraft type.

(*) easyJet reported at least 25 RISE flights at Mykonos (24 for runway 34 and 1 for runway 16). The difference is due to the difficulty to sometimes get pilot's feedback/questionnaires.

The below table shows figures reported by the Air Traffic Controllers.

Procedure	Nb of requests	Nb of clearances	Nb of satisfactory approaches
		Clearance rate (%)	Satisfactory approaches rate (%)
Total Mykonos airport	51 (*)	50	48
		98%	96% (*)

Results per KPI are provided in paragraph 6.5.3.

(*) Unsuccessful approaches recorded by the Air Traffic Controller: go-around requested by the pilot on final.

6.5.2.3 Deviation from the planned activities

All activities planned have been conducted.

6.5.3 Exercise Results

6.5.3.1 Summary of Exercise Results

Refer to paragraph 5.1

6.5.3.1.1 Results per KPA

6.5.3.1.1.1 Safety

The procedures have been assessed during the flight trials period, by Aegean and easyJet and Mykonos Air Traffic Controllers.

The Air Traffic Controllers reported no impact on safety.

Aegean comments:

Aegean reported that the RNP AR RWY16 approach greatly enhances safety, by replacing a demanding non-standard visual approach procedure by autopilot-coupled instrument approach tracks.

Remark: Aegean reported that during warm days (temperatures in excess of 28'), it happened that 3-4 white PAPI lights were indicating when the aircraft reached the DA during the RNP APCH on RWY34. This is normal as the vertical profile is dependent on the temperature conditions, and it is worth emphasizing this item in the flight crew training.

easyJet comments:

No Air Safety Reports (ASRs) were received in relation to these procedures, in line with the reporting detailed in the NTC.

No adverse comments were raised by Flight Crew conducting the Flight Trials.

easyJet believes that the key driver for the introduction of these procedures is safety. The benefits primarily accrue from the following:

- Maximum use of the aircraft automation, leading to accurate horizontal and vertical path tracking, in a multitude of meteorological conditions, with a commensurate reduction in cockpit workload.
- The above significantly increases the likelihood of a stabilised approach which is a key prerequisite for the avoidance of landing incidents/accidents and the reduction of missed approaches.
- In a procedural flying environment, the fixed path/speed nature of the procedures provides a more ordered ATC environment with the possibility for reduced RT loading.

In addition, easyJet provided a sample of ACARS messages related to Mykonos PBN procedures (See below), reporting a safe and easy to fly procedure with a tendency to have 3 to 4 white PAPI lights depending on the temperature conditions.

Tail	Arr	Freetext
G-EZWZ	JMK	- RNAV 34 SUCCESSFUL. A/C ON PROFILE THROUGHOUT ALTHOUGH PAPIS SHOWED HIGH UNTIL 200 FT
G-EZTL	JMK	- RNAV 34 COMLETED SUCCESS FULLY. 1 RMK- PAPI NOT ALIGNED WITH RNAV PATH/ HAD CONSTANTLY 4 WHITES UNTIL THE END STILL BELOW THE BRICK... CHEERS
G-EZDF	JMK	- RNAV 34 SUCCESSFUL
G-EZPD	JMK	- SUCCESS FOR RNAV VISUAL 34 AT LGMK. BYE

G-EZTY	JMK	- RNAV APPROACH RUNWAY 34 FLOWN VISUALLY. NO PROBLEMS TO REPORT.
HB-JZX	JMK	- HI. FOR INFO- RNAV GNSS APP RWY 34 IN JMK SUCCESSFUL.
G-EZTM	JMK	- HI. FLEW RNAV VISUAL RWY 34 LGMK. NO PROBLEMS TO REPORT. ALL OK. THANKS.
G-EZSM	JMK	- RNAV34 JMK SATISF
G-EZPH	JMK	- PERFORMED RNAV VIS 34 IN JMK SUCCESFULL. RMK PROFILE SEEMED SLIGH TLY HIGH BELOW 1000 IN RGDS TO PAPI.
G-EZOL	JMK	- HI MKN RNAV VISUAL APP ALL WORKED WELL. A/C MAINTAINED SPEED + ALT CONSTRAINTS.
G-EZPI	JMK	- IAW NTC WE HAVE FLOWN A SUCCESFUL RNAV VISUAL RNWY 34 IN JMK. CHEERS
G-EZPI	JMK	- HI. JMK RNAV VISUAL RWY 34 WAS A SUCCESS. CHEERS
G-EZFW	JMK	- HI SUCCESSFUL COMPLETION OF RNAV/GNSS APPROACH TO RWY 34 JMK.
G-EZOV	JMK	- RNAV RNP Z 16 SUCCESFUL AT LGMK
G-EZOW	JMK	- HI RNAV RWY 34 TRANSITION FROM VARIX AIRPORT JMK. ALL SUCCESSFUL
G-EZDW	JMK	- PERFORMED SUCCESFULLY RNAV GNSS 34 AT JMK
G-EZOV	JMK	- RNAV RWY 34 APPROACH SUCCESFUL. BRGDS
G-EZOJ	JMK	- RNAV TO RW 34 SUCCESSFUL. NO PROBLEMS. OJ EZY5157 LGW JMK
G-EZOV	JMK	- 2X SUCCESFULL RNAV VISUAL 34 APPROACHES. FIRST FROM VARIX AND 2ND FROM MKN AS WE HAD TO GA ON 1ST APPROACH.
G-EZWI	JMK	- RNAV VIS 34 AT JMK PERFORMED TO GREAT ENJOYMENT AND SUCCESS...
HB-JXC	JMK	- HI - JUST DID THE RNAV GNSS APP RWY 34 IN JMK. VMC CONDITIONS ACC TRACKING ON APP. SUCCESSFUL. RNAV APP – DISCONNECTED AUTOMATION AT 3NM FINAL.
HB-JZZ	JMK	- RNAV VISUAL 34 LGMK/JMK SUCCESSFULLY COMPLETED.
G-EZPH	JMK	- HI. JMK RNAV 34 VIA MKN VOR PERFORMED. WORKS PROPERLY. BRANG US 1000FT AGL WITH 4 WHITE ON THE PAPI. RGDS
G-EZWJ	JMK	- HI.FLOWN THE RNAV34 IN JMK...SUCCESSFULL...THANKS
G-EZFX	JMK	- HI. RNAV GNSS 34 FROM VARIX ALL OK. MIGHT BE NICE TO HAVE SOME STEPS THOUGH.IT GOES STRAIGHT DOWN TO 2000FT. CHEERS

6.5.3.1.1.2 Airport accessibility

The below table compares published procedures minima and new RNP procedures minima, for a CAT C aircraft (and 5% M.A climb gradient).

In addition, operators and ATCOs reported that for Mykonos, cloud base can be low 2 or 3 times a year at the most, but nothing worth measuring. The only instances that could be considered would be when strong southerly winds prevailed and RWY16 would normally be designated as the runway-in-use. These cases many times lead either to a cancellation of flight or an aborted approach and landing. This is exacerbated especially at night. On a roughly estimated average via local ATC input, it would probably be safe to say that up to today at least 20 flights per year are in this way affected. Therefore, it could be said that an analogous number of additional flights would probably be able to access the airport thanks to the new RNP procedure, while they could not up to today.

Overall, the major benefit is linked to the fact that a managed procedure to the runway threshold is proposed, thus providing a stabilized procedure in challenging wind conditions.

	Current procedure minima	New RNP procedures DA	Benefit (ft)	Estimated nb of additional flights
Mykonos 16	1700ft (circling)	850 ft	850 ft Stabilized procedure down to RWY THR.	More than 20 flights per year
Mykonos 34	1200ft (straight in) / 1700ft (circling)	880 ft	- 320 / 820 ft Stabilized procedure down to RWY THR.	None

6.5.3.1.1.3 Efficiency

The below table compares track miles of the published procedures with track miles of the new procedures for runway 34 (no procedure currently published for runway 16):

Mykonos RWY 34 – Track miles comparison new procedures (RNP APCH) versus published procedure (VORy and VORz)		
Procedure	**Difference in NM with the published VORy**	**Difference in NM with the published VORz**
RNP APCH 34 via BISMO	N/A	-12.9 NM
RNP APCH 34 via VARIX	-3.7 NM	-17.4 NM
RNP APCH 34 via DIDIS	-2.9 NM	-27.6 NM

RNP APCH 34 via NITSA	-1.2 NM	-31.4 NM
RNP APCH 34 via PIDAX	+0.3 NM	-31.6 NM
RNP APCH 34 via LETSO	-1.9 NM	-20.8 NM
RNP APCH 34 via MKN	N/A	+11.8 NM
Average	*New procedures 2 NM shorter*	*New procedures 19 NM shorter*

However, it is worth mentioning that some airlines currently do not use the published procedures but perform the approaches under visual approach conditions, thus using a shorter approach path.

Aegean feedback:

The RNP AR Rwy16 approach reduces significantly the track mileage required in marginal weather conditions as the majority of the traffic is approaching LGMK from the north-northwest. In VMC where visual approaches are predominant, there is little or no fuel saving opportunity.

easyJet feedback:

Due to lack of access to FDM data, no specific analysis on benefits was conducted.

6.5.3.1.2 Results impacting regulation and standardisation initiatives

The following topics have been discussed and a need for updating the existing regulatory and standardisation initiatives has been identified in the following areas:

1. ICAO DOC 9905: due to the terrain environment in Mykonos, the procedure designers had to deviate from 2 ICAO recommendations: a) distance between the FROP (Final Roll Out Point) and the OCA/H b) bank angle limit in RF leg.

   Mitigation means have been proposed, and deemed acceptable by the Regulator for the purpose of trials.

   Refer to paragraph 6.5.2.2.1 for details, and Mykonos RNP AR procedures technical report.

6.5.3.1.3 Unexpected Behaviours/Results

There was no unexpected behaviour/result.

6.5.3.1.4 Quality of Demonstration Results

There was no specific issue concerning the quality of the results achieved in this Exercise.

6.5.3.1.5 Significance of Demonstration Results

The Demonstration results are deemed significant.

As compared to real RNP AR operations:

- The trials have been conducted in VMC conditions. However, the procedures used by the flight crew were as if these flights were IMC.
- The aircraft was not certified for RNP AR operations (however it was certified for RNP APCH operations); however the aircraft was equipped with the minimum equipment required for this type of operations.

easyJet comment:

Based upon our involvement in the RISE project and procedure construction, and our experience of other PBN procedures in our operational environment, we are not surprised by the success of the demonstration results. Please note that all demonstration flights were performed by line Flight Crew who only had access to the briefing material contained herein.

6.5.4 Conclusions and recommendations

6.5.4.1 Conclusions

The demonstration results, despite some minor problems, familiarised HCAA personnel (ATCOs and procedure designers) with a kind of procedures that is totally different in design and navigation philosophy from the conventional type. The whole process was thus extremely beneficial, especially in laying the foundation stones for further development in this area, where Greece still lags somewhat.

The Exercise results were as expected and confirmed the need to implement RNP AR and RNP APCH procedures to Mykonos airport, mainly in order to enhance safety and accessibility. The ATCOs have greeted the new procedures very warmly and are looking forward to their publication and timely integration into the system

The HCAA is in the process of getting the RNP APCH procedures approved for their publication in 2016/2017. RNP AR will be processed for approval and publication after the maintenance problem has been resolved (no qualified RNP AR designer yet in HCAA).

6.5.4.2 Recommendations

The Exercise highlighted a need to update regulatory documents and standards, as detailed in paragraph 6.5.3.1.2.

easyJet made the following recommendations:

- Develop appropriate PBN knowledge and experience within the HCAA so that PBN procedures can be expanded at Greek airport where there is an operational need.
- Ensure that the procedures are published in a timely manner.
- Encourage the use of the procedures, to the benefit of all airspace users.
- Keep abreast of PBN developments and incorporate, where appropriate, within existing procedures.
- Continue the trial for approved Operators to gather further information, notably for Mykonos runway 16.
- Take note of the comments related to PAPI vertical alignment with the final approach.
- Ensure that there is a regulatory framework that can permit non RNP AR approved Operators from utilising RNP AR designed procedures in a visual capacity.

6.6 Demonstration Exercise #6 Report

6.6.1 Exercise Scope

This demonstration exercise covers RNP AR and RNP APCH approaches demonstrations into RWY 16 and 34 of Santorini airport.

Demonstration Exercise ID and Title	EXE-02.08-D-006 : RNP AR and RNP APCH Operations at LGSR (Santorini)
Leading organization	Novair, easyJet, Aegean, HCAA, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. • Airport accessibility, • Safety, • Track miles reduction, • Fuel savings and CO2 emission reduction.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator - Revenue flight **Output:** - Procedures charts - Simulator reports - Flight data and questionnaires analysis and comments/recommendations
Number of trials	17 flights conducted by Novair 30 flights conducted by easyJet 22 flights conducted by Aegean

6.6.2 Conduct of Demonstration Exercise EXE-02.08-006

6.6.2.1 Exercise Preparation

The preparation activities include all those necessary to prepare the design, assessment, validation and implementation of the RNP procedures.

The output of the Exercise Preparation phase is the Project Specification document, signed by all stakeholders, that summarizes the project scope and objectives, data to be used for the design of the procedures and conceptual design of the procedures.

Santorini project specification has been approved by all stakeholders in March 2015, and then modified later during the project (in particular, need for additional procedures RNP APCH on runway 16 in September 2015).

6.6.2.2 Exercise execution

The following activities have been performed in the Exercise execution for Santorini RNP AR and RNP APCH procedures:

Exercise execution activity	Included in the scope for Santorini airport?	Timeline
Procedure design	YES	March 2015 to February 2016
Procedures simulator validation	YES	
Safety study	YES	
Environmental study	NO	
ATC training or briefing	YES	September 2015 March 2016
Flight trials & data analysis	YES	September 2015 to September 2016 Total number of flights: 69

6.6.2.2.1 Procedures design

RNP AR and RNP APCH procedures have been designed to Santorini runway 16 and RNP AR procedures have been designed to Santorini runway 34. STARs feeding the new designed procedures have also been designed.

The final procedures approach charts are shown in Appendix F.

The RNP AR procedures (RWY 16 and 34) design main highlights are:

- Particular care was given to RW34 Approach, to reduce the track miles for approach coming from the North (i.e. RW34 Z App).
- Design of the procedures has been done in accordance with ICAO 9905 document. However, two deviations have been highlighted during the design phase:
    a. The ICAO 9905 Document paragraph 4.5.13 recommends that the procedures that incorporate an RF leg in the final segment shall establish the aircraft at Final Roll Out Point (FROP) aligned with the runway centreline prior to a minimum distance before OCA/H for a time of 50 seconds (RNP value in missed approach <1).

In Santorini, due to the terrain constraint, it was not possible to meet this recommendation, and the OCA/H for runway is located before the FROP, or only a few seconds after the FROP.

This deviation to ICAO 9905 recommendation has been mitigated thanks to IFPP/11 report dated 2012 providing further clarification on the rationale for this recommendation, and the fact that AMC 20-26 requires that, for missed approach less than RNP1 aircraft shall remain in LNAV upon initiating a go-around or, for missed approaches of RNP 0.3 or greater this may be mitigated by adequate crew training.

It was recommended that this deviation to ICAO should be highlighted to operators and covered in the FOSA (Flight Crew Operational Safety Assessment).

b. The ICAO 9905 Document recommends that the bank angles in RF legs are limited to 20° in approach and 15° in missed approach (considering ICAO wind table). Due to the terrain environment in Santorini higher bank angles have been considered. This deviation has been mitigated thanks to the actual aircraft capabilities (AutoPilot supporting higher bank angle values).

   It was recommended that this deviation to ICAO should be highlighted to operators and covered in the FOSA (Flight Crew Operational Safety Assessment).

   The HCAA Regulator has been involved in the discussion all along the RISE project. They accepted these deviations for RISE trials.

The RNP APCH procedures (RWY 16) design main highlights are:

- Following Detailed Design Review meeting (September 2016), Santorini Air Traffic Controllers and operators have required an additional RNP-APCH procedure to RW16. While this procedure is longer than the RW16 RNP-AR procedure, this procedure will be more widely operated (by any airline approved against AMC20-27 which is the majority of airlines flying this destination).

6.6.2.2.2 Procedures simulator validation

All the designed procedures have been tested on Airbus A320 Full Flight Simulator equipped with the minimum equipment required for RNP AR operations.

It has been demonstrated that the designed procedures are fly able. In particular:

a. Flight plans are correctly displayed on ND and MCDU
b. No TAWS warning or caution alerts are triggered along the designed paths
c. Experienced cross track errors are within acceptable limits
d. Experienced bank angles are within acceptable limits
e. Procedures are manageable from an energy management point of view. However, for the approach from GIVIS (RWY34) and PEXAN (RWY16), specific flight techniques (e.g. use of speed brakes) should be used to allow for proper energy management.

6.6.2.2.3 Safety study

It concludes that the implementation of RNP procedures in Santorini TMA does not lead to the identification of new hazards. Therefore, no Safety Requirement has been identified. The list of assumptions has been clearly established, highlighting the need for training the ATC (as per ICAO DOC 4444) and briefing the flight crews (RF specificities, briefing on the charts & procedures, etc…), prior to the flight trials.

6.6.2.2.4 ATC training

4 Air Traffic Controllers of Santorini have been trained prior to the start of RISE trials. In addition, a training refresher has been conducted in March 2016, in order to prepare the 2016 summer season trials.

6.6.2.2.5 Flight Crew training

easyJet provided Flight Crew with a Notice to Crew (NTC) that provided an overview of the RISE project. Refer to Appendix O.

6.6.2.2.6 Flight trials & data analysis

The ATCos of Santorini reported that 69 flights (22+30+17) have been conducted by Aegean, easyJet, and Novair on A320/A321 aircraft types.

(*) easyJet reported that at least 30 RISE flights at Santorini. The difference with the number of flights reported by the ATCos is probably due to the fact that the flight crew have requested a visual approach and then used one of the trial procedures.

The below table shows figures reported by the Air Traffic Controllers.

Procedure	Nb of requests	Nb of clearances	Nb of satisfactory approaches
		Clearance rate (%)	Satisfactory approaches rate (%)
Total Santorini airport	69	69	67
		100%	97% (*)

Results per KPI are provided in paragraph 6.6.3.

(*) Unsuccessful approaches reported by the Air Traffic Controllers. One approach was discontinued due to airplane's higher than normal altitude. One approach was discontinued due to loss of pilot's visual contact.

6.6.2.3 Deviation from the planned activities

All activities planned have been conducted.

6.6.3 Exercise Results

6.6.3.1 Summary of Exercise Results

Refer to paragraph 5.1

6.6.3.1.1 Results per KPA

6.6.3.1.1.1 Safety

The procedures have been assessed during the flight trials period, by Novair, Aegean, easyJet and Santorini Air Traffic Controllers. Overall feedback is that the procedures greatly enhance safety.

The ATC of Santorini reported no negative impact on safety.

Novair comments:

Novair did perform a detailed analysis of the flight data recordings demonstrating positive impact on safety, which is provided below:

- Being closed loop procedures, the RNP AR procedures facilitate the descent planning for the flight crew compared to open loop visual approaches. This can also be seen in the data. The RNP AR approaches are flown with a stable and quite low IAS and a stable vertical speed during the descent. This has a direct positive effect on flight safety (to avoid high energy approaches).
  For the visual approaches, there is a larger scatter, indicating that the flight crew had to make considerable adjustments to the vertical profile in order to match the actual distance to go. This can be seen in the following two charts where the IAS and vertical speed for the RNP AR and visual approaches that were not obviously affected by ATC are plotted against distance to threshold.

- In addition to this, RNP AR at Santorini will improve flight safety due to lateral and vertical guidance to the runway threshold, especially during night time operations.

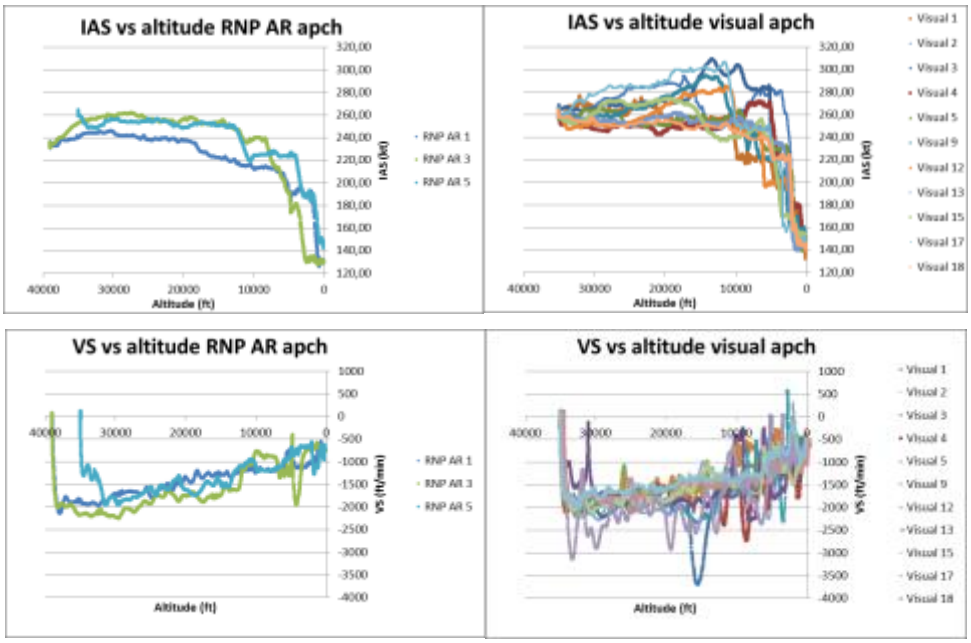


Figure 4 Novair flight data analysis in Santorini : positive impact of RNP on IAS and Vertical Speed.

Aegean feedbacks are also positive, saying that the RNP procedures enhance safety for both runways and ensure consistently stabilized approaches. On Rwy34, a VOR Letdown circling approach is replaced by an RNP AR "straight-in" approach, whereas on Rwy16 an offset VOR approach is replaced by a perfectly aligned with the runway RNP AR and RNP APCH one.

easyJet comments:

No Air Safety Reports (ASRs) were received in relation to these procedures, in line with the reporting detailed in the NTC.

No adverse comments were raised by Flight Crew conducting the Flight Trials.

easyJet believes that the key driver for the introduction of these procedures is safety. The benefits primarily accrue from the following:

- Maximum use of the aircraft automation, leading to accurate horizontal and vertical path tracking, in a multitude of meteorological conditions, with a commensurate reduction in cockpit workload.
- The above significantly increases the likelihood of a stabilised approach which is a key prerequisite for the avoidance of landing incidents/accidents and the reduction of missed approaches.
- In a procedural flying environment, the fixed path/speed nature of the procedures provides a more ordered ATC environment with the possibility for reduced RT loading.

In addition, easy provided a sample of ACARS messages related to Santorini PBN procedures (See below):

Tail	Arr	Freetext
G-EZTG	JTR	- FYI RNAV Z 34R LGSR COMPLETED WITHOUT ANY PROBLEMS. WORKED WELL. ATC RECEPTIVE PLUS RQST VARIOUS POSN RPTS. CHEERS
G-EZPF	JTR	- RNAV RNP Z 34R AT JTR SUCCESFULL. CHEERS
G-EZOE	JTR	- RNAV34R ZULU AT JTR CONDUCTED WELL
G-EZOT	JTR	- HI. FOR INFO WE FLEW THE TEMPO RNAV RNP Z 34R IN TO JTR. SUCCESSFUL APPROACH. WE LIKE. REGARDS
G-EZOD	JTR	- IAW NTC OPS28/16+OPS1/16 REQUESTED RNAV Z 34R JTR. OPERATION GREAT SUCCESS
HB-JYF	JTR	- HI WE VE FLOWN RNAV Z RWY 34 IN JTR. KEPT HIGH BY ATC INITIALLY BUT MANAGED TO CAPTURE THE APPROACH BEFORE FAF AND FLEW RF FIXES TO RWY. ALL OK. SUCCESFUL APPR
G-EZPF	JTR	- JTR RNAV Z 34R FEEDBACK. WITH WIND 340/11 A/C FLEW PROFILE VERY WELL.ONLY POINT TO RAISE IS THE CHANGE IN DIRECTION AT SR604. SIG BANK REQ NEAR RWY THAT OTHER APPR DO NOT
G-EZFH	JTR	- LGSR RNAV Z 34R FLOWN WITH SUCCES. NO ISSUES. REGARDS
G-EZSM	JTR	- EZY3371 VCEJTR. HI.FLOWN RNAV Z 34R ALL WORKED WELL. CHEERS
G-EZOF	JTR	- RNAV Y 34R JTR. NO PROBLEMS
G-EZTM	JTR	- RNAV VISUAL Z 34R COMPLETED SATISFACTORILY
G-EZBA	JTR	- HI. WE PERFORMED RNAV 34R AT LGSR THAT WAS WORKING WELL
G-EZOP	JTR	- RNAV Z 34R FLOWN.NO PROBS
G-EZTI	JTR	- EZY2959. LGSR RNAV Z 34R SUCCESSFUL. RNAV APPR JOINED FROM SR644 WAYPOINT
G-EZOC	JTR	- RNAV 34R PROCEDURE Z FLOWN. SUCCESSFUL. SANTORINI LGSR JTR

G-EZWI	JTR	- HI. RNAV-Z 34R LGSR/JTR WAS SUCCESSFUL. BEST REGARDS
G-EZTI	JTR	- JTR RNAV RNP Y 34R CONDUCTED WITH GREAT JOY AND SUCCESS...
G-EZPC	JTR	- HI. FEEDBACK RNAV-34R-Z IN JTR. GOOD APPR. CAUTION NOT TO PUT 4000FT REQ CEILING IN AS MIN TO PREVENT A/P DROPOUT. KREGARDS
G-EZIM	JTR	- HI. DID THE RNAV Z 34R APPROACH IN JTR WITH SUCCESS
G-EZFR	JTR	- REF NTC OPS28/16 FLOWN RNAV-Y-34R INTO JTR. SUCCESSFUL NO PROBS
G-EZUC	JTR	- RNAV VISUAL 34R JTR. INITIALLY MAINTAINED TRACK AND PROFILE. DISCONNECTED AND POSITIONED VISUALLY AS NOT HAPPY WITH PROFILE IN LATTER STAGES.
G-EZUN	JTR	- JTR RNAV Y 34R. COMPLETED WITH SUCCESS. THANKS
G-EZDW	JTR	- RNAV Z 34R FLOWN IN LGSR PROCEDURE WELL CODED INTHE DB SUGGEST TO DISCONNECT AP NOT LATER THAN 1000FT DUE TO LARGE OFFSET AT LATER STAGES OF THE PROCEDURE
G-EZOA	JTR	- RNAV Z RWY34R JTR COMPLETED SUCCESSFULLY.. HOWEVER A/P WAS DISCONNECTED AFTER FINAL TURN TO LINE UP WITH RWY AND AVOID THE CODED WOBBLE AT APPX 500FT.
G-EZWV	JTR	- HI. JUST DID RNAV Z 34R INTO JTR. ALL WORKED FINE ALTHOUGH THE TURN TO FINAL IS VERY LATE. RGDS
HB-JYJ	JTR	- HI NAV TEAM. WE PERFORMED SUCCESSFULY THE RNAV Y 34R IN SANTORINI/LGSR. RGDS
G-EZTG	JTR	- RNAV 34R IN JTR SUCCESSFUL. CIAO. RNAV Z 34R IN JTR SUCCESSFUL
G-EZDW	JTR	- PERFORMED TEMPO RNAV Z APP IN JTR SUCCESSFULLY
G-EZWG	JTR	- JUST SUCCESSFULLY COMPLETED RNAV/Z R/W 34R IN LGSR-NO PROBLEMS
G-EZOM	JTR	- WE FLEW RNAV-VISUAL RWY34R ZULU INTO LGSR. ALL RIGHT BUT NOT EASY TO LOOSE ENERGY ON A HEAVY A320 WITH WINGLETS. DEMANDING TO MEET STABLE CRITERIA AT 1000FT

6.6.3.1.1.2 Airport accessibility

The below table compares published procedures minima and new RNP procedures minima, for a CAT C aircraft.

However, the HCAA and operators highlighted that for Santorini weather is usually not an issue because cloud base is seldom that low; therefore, improvement of accessibility cannot be easily measured.

	Current procedure minima	New RNP procedures DA	Benefit (ft)	Estimated nb of additional flights
Santorini 16	1150ft	500ft (AR) 1620ft (APCH)	-650ft +470ft	N/A
Santorini 34	1700ft	650ft	-1050ft	N/A

6.6.3.1.1.3 Efficiency

The below table compare track miles of the published procedures with track miles of the new procedures for runway 34 and runway 16:

Santorini RWY 16 – Track miles comparison new procedures (RNP AR & RNP APCH) versus published conventional procedure	
Procedure	**Difference in NM with the published conventional procedure**
RNP AR 16 via PEXAN	-1.5 NM
RNP AR 16 via SNI	-14.1 NM
RNP AR 16 via UVRIT	-9.6 NM
RNP AR 16 via GIVIS	-15 NM
Average for RNP AR procedures	*New procedures 10 NM shorter*
RNP APCH 16 via PEXAN	+0.7 NM
RNP APCH 16 via SNI	N/A
RNP APCH 16 via UVRIT	+3.7 NM
RNP APCH 16 via GIVIS	+6.8 NM
RNP APCH 16 via IRGEG	+6.4 NM
RNP APCH 16 via BINKI	+6.2 NM
Average for RNP APCH procedures	*New procedures 4.7 NM longer*

Santorini RWY 34 – Track miles comparison new procedures (RNP AR) versus published conventional procedure	
Procedure	**Difference in NM with the published conventional procedure**
RNP AR 34 via PEXAN	-10.7 NM
RNP AR 34 via SNI	-5.3 NM
RNP AR 34 via UVRIT	-31.5 NM
RNP AR 34 via GIVIS	-35.5 NM
Average	*New procedures 21 NM shorter*

However, it is worth mentioning that some airlines currently do not use the published procedures but perform the approaches under visual approach conditions, thus using a shorter approach path.

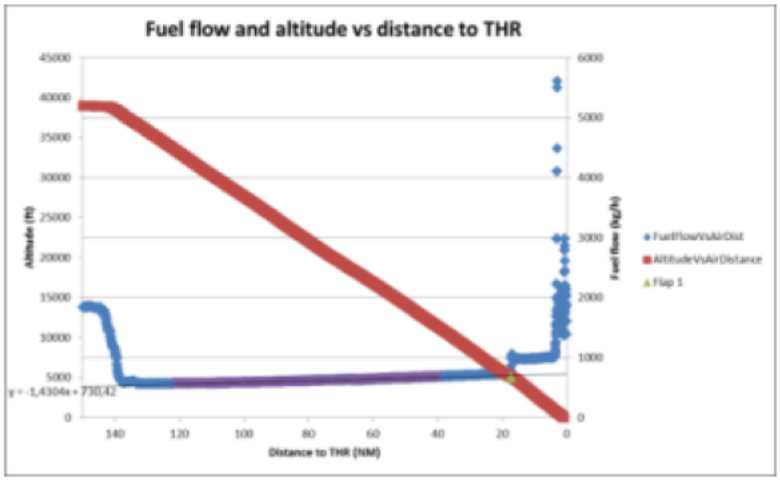
Detailed fuel consumption analyses have been performed by Novair, results are provided below:

a) Novair study

Methodology:

Due to the fact that a very limited number of RNP AR flight recorded data were available (five in total and using three different procedures) there was not enough material to conduct a quantitative delta burn analysis with reliable results. Therefore a qualitative analysis was instead conducted zooming in on a number of interesting aspects of the flights. Flight recorder data (QAR data) was used for the analysis and data was plotted in Excel.

For each flight the vertical profile, fuel flow, IAS and vertical speed were plotted against distance to threshold for the last part of the cruise segment and for the descent.



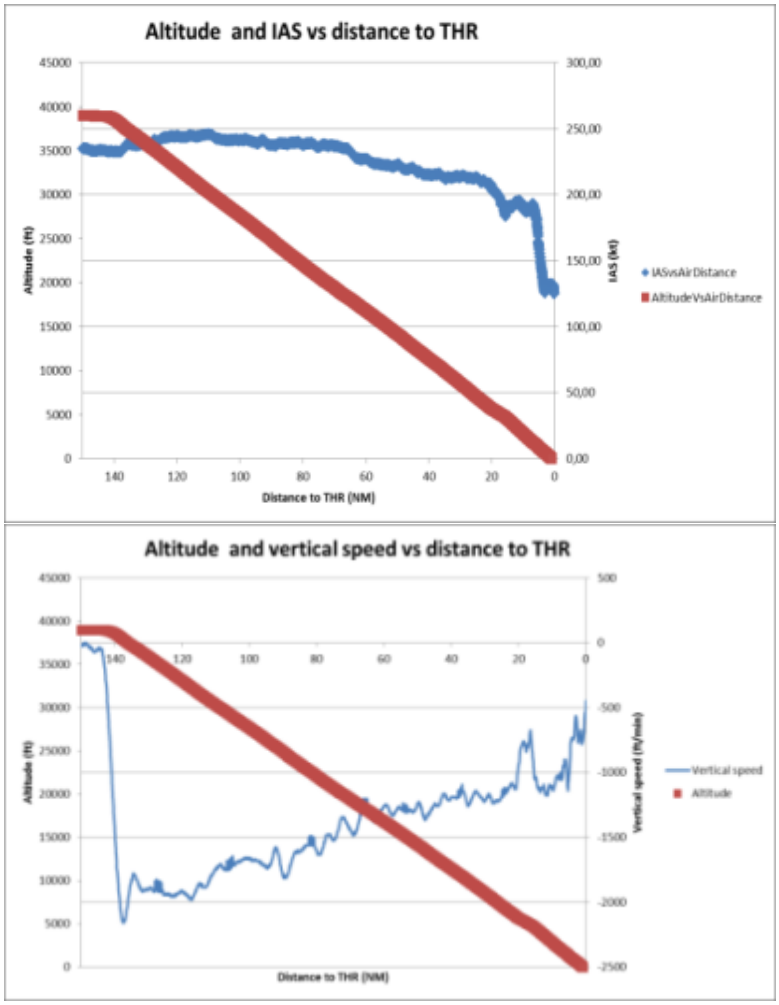


Figure 5 Novair flight data analysis in Santorini : fuel flow, IAS and vertical speed representation.

In order to get an indicative merit of how far from an optimum scenario each approach was, a trend line was added to each fuel flow chart for a segment of the fuel flow where it was idle. The amount of fuel used above idle fuel flow during the descent could then be calculated for each flight (“Integrated delta fuel”). Please note that this figure should be seen as an indicative figure only due to the estimative nature of the method used.

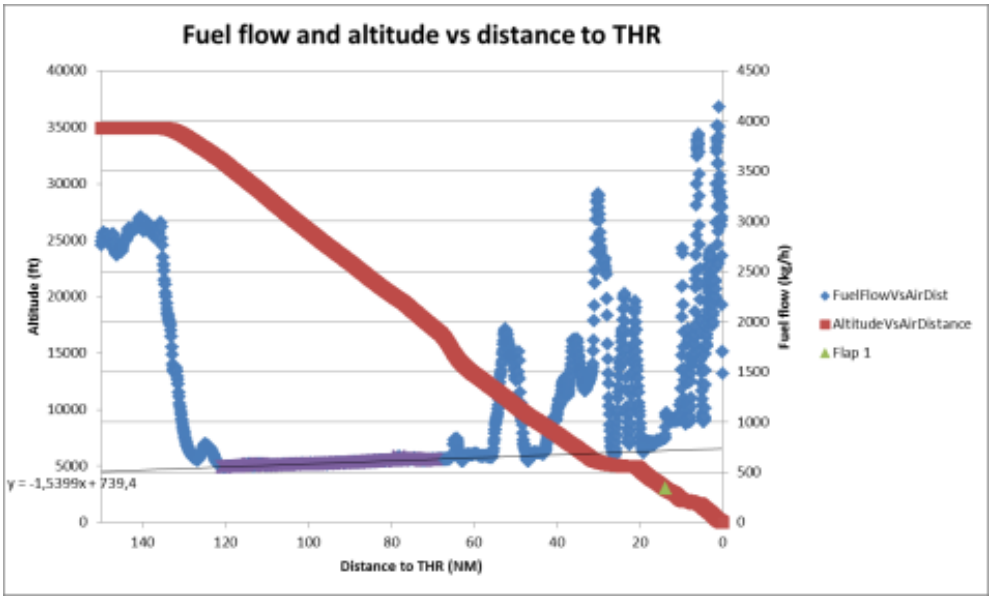


Figure 6 Novair flight data analysis in Santorini : fuel flow representation.

Flights that obviously were affected by ATC constraints (very early descent from the en-route phase or significant level offs during the descent) were removed in the comparison between RNP AR and visual approaches. Among the RNP AR flights two of the five flights were obviously affected by ATC and among the visual approaches, eight of the twenty flights were obviously affected by ATC and hence removed.

Novair results

The estimated figure of kilograms of fuel used above idle power between top of descent and selection of flap 1 (Integrated delta fuel from ToD to Flap 1) for the flights can be seen below. Among the RNP AR flights one flight is very close to optimal and among the visual flights five flights are very good. The three flights with the highest figure can be found in the group of visual approaches. More flights in the group of RNP AR flights would have been desirable though in order to draw any conclusions on a pattern. Novair usually conducts visual approaches into Santorini (because of arriving in the daytime) and the reference flights in the post flight analysis were all visual approaches. Therefore no results can be presented on the efficiency aspect of the RNP AR approaches compared to the published conventional approaches.

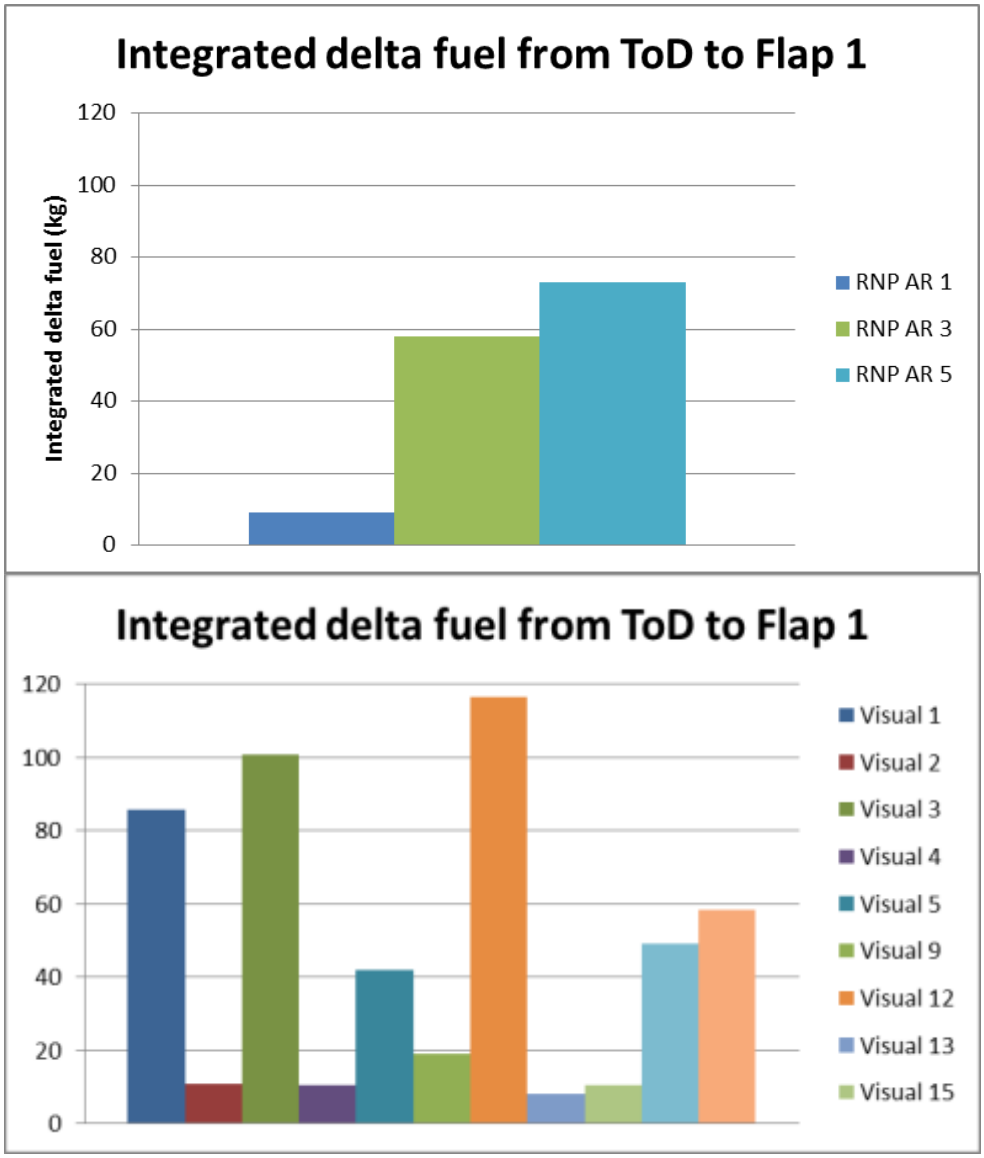


Figure 7 Novair flight data analysis in Santorini : delta fuel burn – Visual approach versus RNP AR

b) Aegean study

Despite no actual flight data recording has been analysed, Aegean considers that there will be little or no benefit on fuel savings as compared to visual approaches linked to the definition of the new lateral path (benefits linked to the optimized vertical profile not assessed). This is due to the fact that the majority of approaches in LGSR are flown as visual approaches from the north on both runways by very experienced on-the-specific aerodrome crews. In marginal weather, the straight-in VOR Rwy16 approach or VOR Rwy16 circle-to-land Rwy34 provides a very fuel efficient and low minima approach. As compared to published VOR DME runway 34, some benefits are however expected.

c) easyJet study

Due to lack of access to FDM data, no specific analysis on benefits was conducted.

6.6.3.1.2 Results impacting regulation and standardisation initiatives

The following topics have been discussed and a need for updating the existing regulatory and standardisation initiatives has been identified in the following areas:

1. ICAO DOC 9905: due to the terrain environment in Santorini, the procedure designers had to deviate from 2 ICAO recommendations: a) distance between the FROP (Final Roll Out Point) and the OCA/H b) bank angle limit in RF leg.

   Mitigation means have been proposed, and deemed acceptable by the Regulator for the purpose of trials.

   Refer to paragraph 6.5.2.2.1 for details, and Santorini RNP AR / RNP APCH procedures technical reports.

6.6.3.1.3 Unexpected Behaviours/Results

There were no unexpected behaviour/results.

However, Aegean emphasized that three white PAPI lights were observed almost on every RNP AR RWY34 approach at DA. Given the fact that the DA is at 650' MSL (600'AGL), Aegean reported that a very careful and precise pilot manoeuvre is required if the pilot decides to follow the PAPI which is not aligned with the VPA of the procedure. The fact that the vertical path might not be aligned with the PAPI is normal as the vertical profile is dependent on the temperature conditions like any Baro-VNAV procedure, and it is worth emphasizing this item in the flight crew training.

6.6.3.1.4 Quality of Demonstration Results

There was no specific issue concerning the quality of the results achieved in this Exercise.

6.6.3.1.5 Significance of Demonstration Results

The Demonstration results are deemed significant.

As compared to real RNP AR operations:

- The trials have been conducted in VMC conditions. However, the procedures used by the flight crew were as if these flights were IMC.
- For easyJet and Aegean flights, the aircraft was not certified for RNP AR operations (however it was certified for RNP APCH operations); however the aircraft was equipped with the minimum equipment required for this type of operations.

easyJet comment:

Based upon our involvement in the RISE project and procedure construction, and our experience of other PBN procedures in our operational environment, we are not surprised by the success of the demonstration results. Please note that all demonstration flights were performed by line Flight Crew who only had access to the briefing material contained herein.

6.6.4 Conclusions and recommendations

6.6.4.1 Conclusions

The demonstration results, despite some minor problems, familiarised HCAA personnel (ATCOs and procedure designers) with a kind of procedures that is totally different in design and navigation philosophy from the conventional type. The whole process was thus extremely beneficial, especially in laying the foundation stones for further development in this area, where Greece still lags somewhat.

The Exercise results were as expected and confirmed the need to implement RNP AR and RNP APCH procedures to Santorini airport, mainly in order to enhance safety and accessibility.

Also, the approach 34-Z provides great benefits in terms of efficiency compared to the published conventional procedure. RNP AR procedures (closed loop) facilitate descent planning for the crew compared to visual approaches (open loop). The analysis indicates that the RNP AR approaches in general are flown with a lower and more stabilized IAS combined with a more stabilized vertical speed compared to the visual approaches. This is beneficial both from a fuel efficiency and flight safety perspective (to avoid high energy approaches).

RNP AR also improves repeatability in the lateral and vertical path compared to a visual approach.

The ATCOs have greeted the new procedures very warmly and are looking forward to their publication and timely integration into the system

The HCAA is in the process of getting the RNP APCH procedure approved for their publication in 2016/2017. RNP AR will be processed for approval and publication after the maintenance problem has been resolved (no qualified RNP AR designer yet in HCAA).

6.6.4.2 Recommendations

The Exercise highlighted a need to update regulatory documents and standards, as detailed in paragraph 6.5.3.1.2.

In addition Novair and easyJet recommendation is to publish the RNP AR procedures as RNAV Visual procedures, in order to have them available for any operator: since most arriving traffic do visual approaches to Santorini it is believed it is a good way to increase safety and have most traffic following the same track, increase predictability.

easyJet made the following recommendations:

- Develop appropriate PBN knowledge and experience within the HCAA so that PBN procedures can be expanded at Greek airport where there is an operational need.
- Ensure that the procedures are published in a timely manner.
- Encourage the use of the procedures, to the benefit of all airspace users.
- Keep abreast of PBN developments and incorporate, where appropriate, within existing procedures.
- Continue the trial for approved Operators to gather further information, notably for Santorini RWY16L.
- Ensure that there is a regulatory framework that can permit non RNP AR approved Operators from utilising RNP AR designed procedures in a visual capacity.

6.7 Demonstration Exercise #7 Report

6.7.1 Exercise Scope

This demonstration exercise covers RNP APCH approaches demonstrations into RWY 27 of Iraklion airport.

Demonstration Exercise ID and Title	EXE-02.08-D-007 : RNP APCH Operations at LGIR (Iraklion)

Leading organization	Novair, HCAA
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Revenue flight **Output:** - Operator and Air Traffic Controllers feedback
Number of trials	2 demonstration flights conducted by Novair

6.7.2 Conduct of Demonstration Exercise EXE-02.08-007

6.7.2.1 Exercise Preparation

All conducted activities are detailed in the “Exercice execution” part.

6.7.2.2 Exercise execution

The Exercise execution for Iraklion RNP APCH 27 procedure consisted in:

- Validating the previously designed (not part of RISE project) RNP APCH procedure to Iraklion RWY 27 on Airbus MFTD,
- Training the ATCOs of Iraklion,
- Performing two flight demonstrations to Iraklion RWY 27, using the RNP APCH approach and missed approach.

6.7.2.2.1 Procedures simulator validation

Despite not initially included in the RISE project, all the designed procedures have been tested on Airbus A320 MFTD. It has been demonstrated that the procedures are fly able.

6.7.2.2.2 ATC training

The Air Traffic Controllers of Iraklion have been trained prior to the demonstration flight.

20 ATCos participated in the first training which lasted 3 days in total, including 2 days of ground class and 1 day of tower training. The training covered both general PBN topics and specific RNP operations in Iraklion.

A second (refresher) training has then been conducted in Athens, which was requested by the ATCos.

6.7.2.2.3 Flight trials & data analysis

Two demonstration flights have been conducted by Novair in May 2015.

Results are provided in paragraph 6.7.3.

6.7.2.3 Deviation from the planned activities

All activities planned have been conducted.

6.7.3 Exercise Results

6.7.3.1 Summary of Exercise Results

Refer to paragraph 5.1

6.7.3.1.1 Results per KPA

6.7.3.1.1.1 Safety

The demonstration flight to Iraklion RWY 27 has been conducted by Novair, with HCAA representatives on board as observers. In total, two approaches were flown in VMC including a missed approach initiated at approximately 800ft on the first approach, followed by a full landing after the second approach. The first approach was flown via the IAF BASAS, and the second approach via IAF GONSO.

The approach chart is provided in Appendix G.

The flight crew reported good fly ability of the procedure, and no particular issue regarding the communication with ATC. The RNP APCH to RWY 27 gives the pilots lateral and vertical guidance to the RWY threshold and therefore enhances flight safety compared to the conventional procedure.

The ATCos had nothing relevant to report.

6.7.3.1.2 Results impacting regulation and standardisation initiatives

The results did not highlight a need to impact regulation and standardisation initiatives.

6.7.3.1.3 Unexpected Behaviours/Results

There was no unexpected behaviour/results.

6.7.3.1.4 Quality of Demonstration Results

There was no specific issue concerning the quality of the results achieved in this Exercise.

6.7.3.1.5 Significance of Demonstration Results

The Demonstration results are deemed quite significant. The operational realism of the Demonstration Exercise was however slightly affected by the fact that the Air Traffic Controllers cleared the flights as visual approaches, rather than IMC approaches. However, the procedures used by the flight crew were exactly the same, as if these flights were IMC RNP APCH.

Despite this, it gave the controllers a chance to interact with the flight and issue relevant instructions (associated preliminary clearances above MSA, radar vectoring to the IAF according to the taught and discussed rules concerning angles of interception, and thereafter, radar monitoring), albeit without a clearance for the unpublished procedure itself. Through this process the radar controllers were also able to observe and assess the achieved adherence to the flight path of the designed procedure and then compare with that of long-established conventional procedures.

6.7.4 Conclusions and recommendations

6.7.4.1 Conclusions

The Exercise results were as expected and confirmed the need to implement RNP APCH procedure to Iraklion RWY 27, in order to enhance safety by proposing a coded, repeatable and managed procedure down to the runway threshold.

The HCAA is in the process of getting the procedures approved, for publication of the procedures in 2016. Prior to this approval, HCAA has asked Aegean to perform a minimum number of 10 additional trials in order to get additional operational feedback. These trials have been completed and the results were sent to HCAA. The procedure should be approved and published for effective use by the end of 2016.

6.7.4.2 Recommendations

The holding pattern at BETAK is a conventional one, which is not consistent with the designed (RNP) procedure. Design of the procedure not being part of the RISE project, rationale for this is unknown. As

an interim solution, the design will be kept as is, but it is recommenced that it is further assessed and potential procedure design change made in the future.

6.8 Demonstration Exercise #8 Report

6.8.1 Exercise Scope

This demonstration exercise covers RNP APCH approaches demonstrations into RWY 35 of Corfu airport.

Demonstration Exercise ID and Title	EXE-02.08-D-008 : RNP APCH Operations at LGKR (Corfu)
Leading organization	Novair, HCAA
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Revenue flight **Output:** - Operator and Air Traffic Controllers feedback
Number of trials	2 demonstration flights conducted by Novair

6.8.2 Conduct of Demonstration Exercise EXE-02.08-008

6.8.2.1 Exercise Preparation

All conducted activities are detailed in the “Exercice execution” part.

6.8.2.2 Exercise execution

The Exercise execution for Corfu RNP APCH 35 procedure consisted in:

- Validating the previously designed (not part of RISE project) RNP APCH procedure to Corfu RWY 35 on Airbus MFTD,
- Training the ATCOs of Corfu,
- Performing two flight demonstrations to Corfu RWY 35, using the RNP APCH approach and missed approach.

6.8.2.2.1 Procedures simulator validation

Despite not initially included in the RISE project, all the designed procedures have been tested on Airbus A320 MFTD. It has been demonstrated that the procedures are fly able.

6.8.2.2.2 ATC training

The Air Traffic Controllers of Corfu have been trained prior to the demonstration flight.

21 ATCos participated to the training which lasted 3 days in total, including 2 days of ground class and 1 day of tower training. The training covered both general PBN topics and specific RNP operations in Corfu.

The constraints/differences concerning vectoring to join the various segments of an RNP APCH, compared with joining the final of a pilot-interpreted approach, were covered in the training sessions. As a result, and after the trials period, the Air Traffic Controllers reported that some training on a simulator would be required to cope with the change from the current operational tactics of vectoring to establish on a RADIAL (RADIAL 163 GAR VOR) to vectoring to a point at which a DIRECT TO an IAF or IF (own navigation) will be issued for successive arrivals.

6.8.2.2.3 Flight trials & data analysis

Two demonstration flights have been conducted by Novair in May 2015.

Results are provided in paragraph 6.8.3

It is also worth mentioning, that, even not included in the RISE project, nine additional extra-RISE trials have been conducted by Aegean.

6.8.2.3 Deviation from the planned activities

All activities planned have been conducted.

6.8.3 Exercise Results

6.8.3.1 Summary of Exercise Results

Refer to paragraph 5.1

6.8.3.1.1 Results per KPA

6.8.3.1.1.1 Safety

The demonstration flight to Corfu RWY 35 has been conducted by Novair, with one HCAA representative on board as observer. In total, two approaches were flown in VMC including a missed approach initiated at approximately 800ft on the first approach, followed by a full landing after the second approach. The first approach was flown via the IAF BETAK, and the second approach via KRK VOR and the IF KR601.

Corfu approach chart is provided in Appendix H.

The flight crew reported good fly ability of the procedure, and no particular issue regarding the communication with ATC. The procedure was very well received by the flight crew, highly appreciating the lateral and vertical guidance, thus enhancing flight safety.

The ATCos reported that the track of the RNAV RWY 35 approach is close to the track of existing VORy RWY 35 approach procedure, and that a second PBN approach for RWY 17 would be very useful.

6.8.3.1.2 Results impacting regulation and standardisation initiatives

The results did not highlight a need to impact regulation and standardisation initiatives.

6.8.3.1.3 Unexpected Behaviours/Results

There was no unexpected behaviour/results.

6.8.3.1.4 Quality of Demonstration Results

There was no specific issue concerning the quality of the results achieved in this Exercise.

6.8.3.1.5 Significance of Demonstration Results

The Demonstration results are deemed quite significant. The operational realism of the Demonstration Exercise was however slightly affected by the fact that the Air Traffic Controllers cleared the flights as visual approaches, rather than IMC approaches. However, the procedures used by the flight crew were exactly the same, as if these flights were IMC RNP APCH.

6.8.4 Conclusions and recommendations

6.8.4.1 Conclusions

The Exercise results were as expected and confirmed the need to implement RNP APCH procedure to Corfu RWY 35, in order to enhance safety by proposing a coded, repeatable and managed procedure down to the runway threshold.

The HCAA is in the process of getting the procedures approved, for publication of the procedures by December 2016.

6.8.4.2 Recommendations

The Air Traffic Controllers recommend developing a PBN procedure for RWY 17 as well. The main challenge for this runway is the proximity to the Albanian airspace. As a consequence, two options could be considered:

- Develop an RNP AR procedure that would avoid the uncontrolled airspace
- A proposal to ALBANIA, perhaps via EUROCONTROL, could be made requesting ATC to be allocated to the CORFU ATS Unit for some small portion of their airspace for the establishment and management of a PBN approach for RWY 17 starting from the point PITAS.

6.9 Demonstration Exercise #9 Report

6.9.1 Exercise Scope

This demonstration exercise covers RNP AR approaches demonstrations into RWY 05 and RWY 23 of Madeira airport.

Demonstration Exercise ID and Title	EXE-02.08-D-009 : RNP AR Operations at LPMA (Madeira)
Leading organization	TAP Portugal, NAV Portugal, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. f. Airport accessibility, g. Safety.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator - Revenue flight **Output:** - Procedures charts - Simulator reports - Flight data and questionnaires analysis and comments/recommendations
Number of trials	42 flights conducted by TAP Portugal 16 flight conducted by SAS 1 flight conducted by Air Berlin

6.9.2 Conduct of Demonstration Exercise EXE-02.08-009

6.9.2.1 Exercise Preparation

The preparation activities include all those necessary to prepare the design, assessment, validation and implementation of the RNP procedures.

The output of the Exercise Preparation phase is the Project Specification document, signed by all stakeholders, that summarizes the project scope and objectives, data to be sued for the design of the procedures and conceptual design of the procedures.

Madeira project specification has been approved by all stakeholders in March 2015.

6.9.2.2 Exercise execution

The following activities have been performed in the Exercise execution for Madeira RNP AR procedures:

Exercise execution activity	Included in the scope for Madeira airport?	Timeline
Procedure design	YES	March to June 2015
Procedures simulator validation	YES	
Safety study	YES	
Environmental study	NO	
ATC training	YES	July 2015
Flight trials & data analysis	YES	September 2015 to April 2016 Total number of flights: 59

6.9.2.2.1 Procedures design

RNP AR procedures have been designed to Madeira runway 05 and 23.

The final procedures approach charts are shown in Appendix I.

The RNP AR procedures design main highlights are:

h. The trajectories have been designed so that they are as close as possible to the paths currently flown in visual conditions by the airlines, while trying to design RF legs with bank angles as close as possible to the values recommended by ICAO DOC 9905, even if not always compliant (see below).

i. The holding for runway 23 is similar to the one used for conventional traffic, despite not being aligned with the runway centreline: this will allow using it for RNP AR and non-RNP AR traffic.

j. Design of the procedures has been done in accordance with ICAO 9905 document. However, two types of deviations have been highlighted during the design phase:

   a. The ICAO 9905 Document paragraph 4.5.13 recommends that the procedures that incorporate an RF leg in the final segment shall establish the aircraft at Final Roll Out Point (FROP) aligned with the runway centreline prior to a minimum distance before OCA/H for a time of 50 seconds (RNP value in missed approach <1).

      In Madeira, due to the terrain constraint, it was not possible to meet this recommendation, and the OCA/Hs are located after the FROP.

      This deviation to ICAO 9905 recommendation has been mitigated thanks to IFPP/11 report dated 2012 providing further clarification on the rationale for this recommendation, and the fact that AMC 20-26 requires that, for missed approach less

than RNP1 aircraft shall remain in LNAV upon initiating a go-around or, for missed approaches of RNP 0.3 or greater this may be mitigated by adequate crew training.

It was recommended that this deviation to ICAO should be highlighted to operators and covered in the FOSA (Flight Crew Operational Safety Assessment).

b. The ICAO 9905 Document recommends that the bank angles in RF legs are limited to 20° in approach and 15° in missed approach (considering ICAO wind table). Due to the terrain environment in Madeira and in order to limit the extension of the approach and missed approach paths, slightly higher bank angles have been considered. This deviation has been mitigated thanks to the actual aircraft capabilities (AutoPilot supporting higher bank angle values), and/or considering more realistic approach speeds for the calculation.

   It was recommended that this deviation to ICAO should be highlighted to operators and covered in the FOSA (Flight Crew Operational Safety Assessment).

The ANAC (Portuguese Regulator) has been involved in the discussion all along the RISE project. They accepted these deviations for RISE trials since the procedures were flown in visual conditions and weather conditions are equal or better than: Ceiling – 3000ft and Visibility – 10km.

6.9.2.2.2 Procedures simulator validation

All the designed procedures have been tested on Airbus A320 Full Flight Simulator equipped with the minimum equipment required for RNP AR operations.

It has been demonstrated that the designed procedures are fly-able. In particular:

k. Flight plans are correctly displayed on ND and MCDU
l. No TAWS warning or caution alerts are triggered along the designed paths
m. Experienced cross track errors are within acceptable limits
n. Experienced bank angles are within acceptable limits
o. Procedures are manageable from an energy management point of view.

Wind conditions being particularly challenging in Madeira, strong winds have been tested on full flight simulator: the results were satisfactory as cross track errors were always within acceptable limits and the aircraft did properly converge to the runway axis in final. As it was not possible to exactly simulate Madeira wind conditions, which are very specific, the flight trials allowed completing this set of simulator testing.

6.9.2.2.3 Safety study

A safety study has been conducted for both the RNP AR procedures.

After undertaking the safety study, no hazards have been identified related to the operational impact in the Air Traffic Management, in safety terms. Therefore, the implementation of the RNP AR APCH and STARs RNAV 1 procedures for the Airport of Madeira has been considered as Acceptable.

6.9.2.2.4 ATC briefing

The Air Traffic Controllers of Madeira have been trained prior to the start of RISE trials.

17 ATCos participated to the training which lasted 3 days in total, including 2 days of ground class and 1 day of tower training. The training covered both general PBN topics and specific RNP operations in Madeira.

The training items addressed were:

RNP

- Background on RNP
- Definitions of terms
- Airspace Environment
- Difference between RNAV and RNP trajectories
- Differences RNP APCH and RNP AR
- Who can fly a RNP procedure
- Flight planning

Continuous Descent Operations (CDO)

- Background
- CDO overview
- What are the benefits

Impact on ATC

- How a RNP procedure is conducted
- Pre-flight
- Before entering into procedure
- Published procedure
- Radar vectoring (highlight importance of correct radar vector to establish on RNP course) (*)
- Contingency procedures
- Missed approach
- GNSS service status report
- NOTAM / RAIM / Websites / GPS
- Charting and coding (could be specific to the intended RNP operations)

Separation minima

- Airspace configuration
- ATC environment
- Sequencing Baro VNAV

(*) Radar vectoring might be used (for sequencing purpose) to connect to the RNP AR approach procedure, rather than using the STARs. In other words, aircraft vectoring will be used in Madeira before entering the RNP AR approach procedure, and not after. Usual rules, as per ICAO 4444 apply.

6.9.2.2.5 Crew training

TAP Portugal trained / briefed their crew prior to the start of RISE trials in Madeira:

- Only TRE/I Captains with specific training and experienced in APV Baro/VNAV (GNSS) approaches and qualified to operate at LPMA have been trained prior to the start of RISE trials.

- The aim of the “LPMA RNP AR RISE TRN” was to train TAP Portugal A320 Commanders with RNP AR operations in LPMA (category C airport) in order to execute the Flight Trials phase of RISE project and to comply with the requirements established by ANAC with a high level of safety. This training was designed for A320 rated Commanders only.

- There were 41 pilots involved in the training and they received 2 classroom briefings of 5 hours each in order to be able to participate in the trials.

- The training items addressed were:

RISE PROJECT

RISE RNP AR Concept

RISE Flight Trial forms/Filling instructions and Procedures

RNP-AR OPERATIONAL ISSUES / PROCEDURES

Review of aircraft's navigation and flight control systems to enable pilots to identify failures affecting the aircraft's RNP capability.

Review TAP RNP APP SOPs and differences to RNP-AR.

Review on "RF" turn requirements and "volume of containment" in FAS – Final Approach Segment and MAS – Missed Approach Segment.

Review and emphasis that all approaches shall be stabilized at 1.000 feet AAL and the Autopilot should be kept until minimums.

Madeira (LPMA) OPERATIONAL BRIEFING

Visual meteorological conditions

Requirements and aerodrome terrain environment.

6.9.2.2.6 Flight trials & data analysis

42 flights have been conducted by TAP Portugal on A320 aircraft type.

In addition, as the Authorities published the procedures in a Supplement to the AIP and authorized other Airlines participating to the trials, 16 flights have been conducted by SAS and 1 flight has been conducted by Air Berlin on B737 aircraft type.

From the 59 flights that requested to conduct the RNP AR to Madeira, only 1 flight didn't complete it due to weather degradation below the trials weather conditions.

Procedure	Nb of requests	Nb of clearances	Nb of satisfactory approaches
		Clearance rate (%)	Satisfactory approaches rate (%)
RNV-23 via MA532	20	20	19
		100	95
RNV-23 via MA514		0	0

		0	0
Total RNV-23		20	19
		100	95
RNV-05Y		0	0
		0	0
RNV05-Z	39	39	39
		100	100
Total RNV-05	39	39	39
		100	100
Total Madeira airport	59	59	58
		100	98

Results per KPA are provided in paragraph 6.9.3.

6.9.2.3 Deviation from the planned activities

All activities planned have been conducted.

6.9.3 Exercise Results

6.9.3.1 Summary of Exercise Results

Refer to paragraph 5.1

6.9.3.1.1 Results per KPA

6.9.3.1.1.1 Safety

The procedures have been assessed during the flight trials period, by TAP Portugal, Air Berlin, SAS and Madeira Air Traffic Controllers.

According to NAV Portugal, the major safety improvement is the consistency of the track flown versus visual circling, therefore increasing the approaches' timing and enabling more precise monitoring of the flights, thus improving the overall operation safety.

The reports filled-out by the pilots, show that little or no deviation was consistently found at the end of the procedure, with the aircraft being led to the runway centreline, as intended by the pilots. This kind

of behaviour, especially when flying in adverse weather conditions, is of paramount importance in order to improve safety.

In addition, TAP Portugal analysed recorded flight data, and demonstrated that the lateral deviation to the published trajectory is almost negligible. All results are summarized in TAP Portugal safety report provided in Appendix J. The below figures, extracted from the report, show the flown RNP AR trajectories, and zooms on the waypoints with a representation of the RNP value (circles).

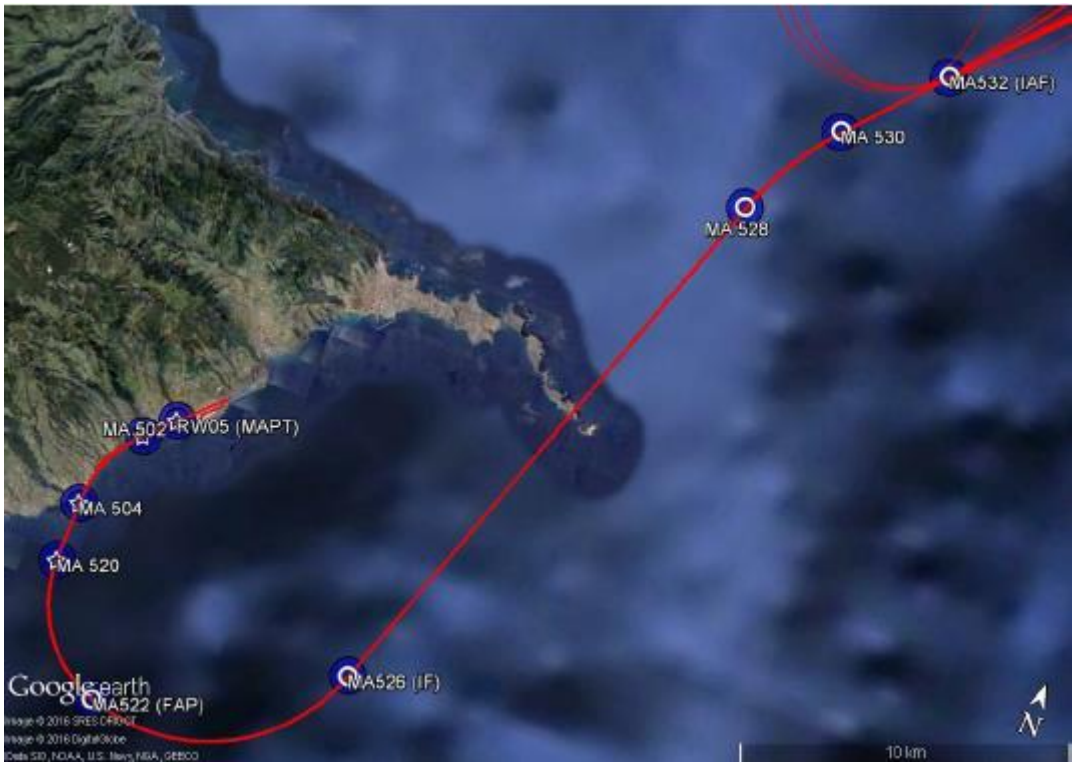


Figure 8 TAP Portugal recorded trajectories RWY 05

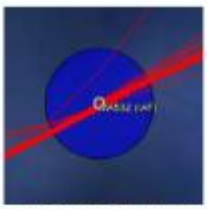


Figura 5 - Raio 0.3 NM || Radius 0.3 NM

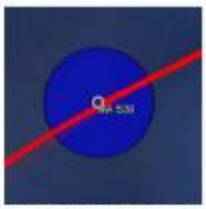


Figura 6 - Raio 0.3 NM || Radius 0.3 NM

Figura 7 - Raio 0.3 NM || Radius 0.3 NM

Figura 8 - Raio 0.3 NM || Radius 0.3 NM

Figura 9 - Raios 0.3/0.2/0.1 NM || Radius 0.3/0.2/0.1 NM

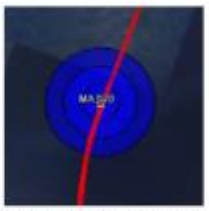


Figura 10 - Raios 0.3/0.2/0.1 NM || Radius 0.3/0.2/0.1 NM

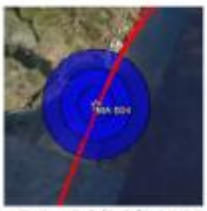


Figura 11 - Raios 0.3/0.2/0.1 NM || Radius 0.3/0.2/0.1 NM

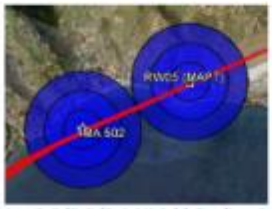


Figura 12 - Raios 0.3/0.2/0.1 NM || Radius 0.3/0.2/0.1 NM

Figure 9 TAP Portugal recorded trajectories RWY 05 – Zoom on waypoints

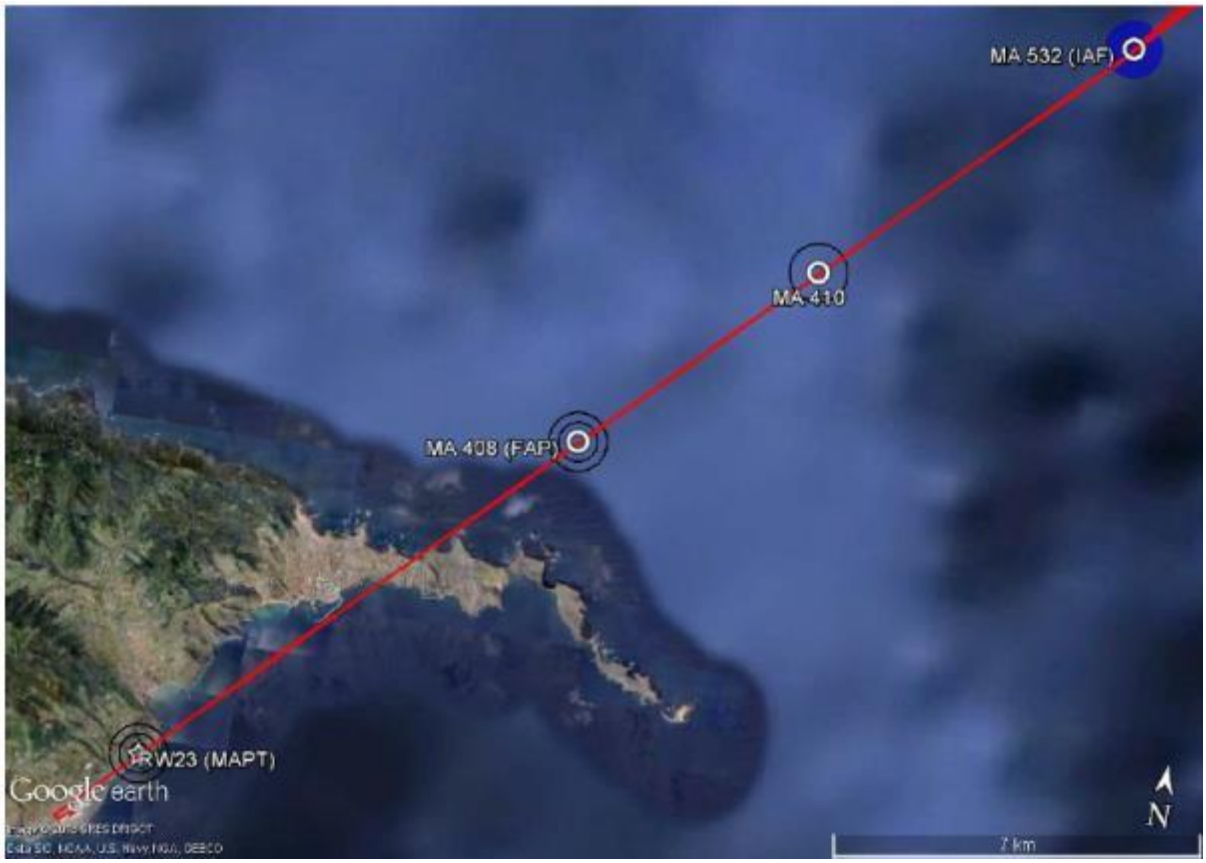


Figure 10 TAP Portugal recorded trajectories RWY 23

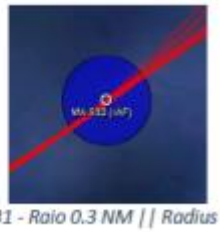


Figura 31 - Raio 0.3 NM || Radius 0.3 NM

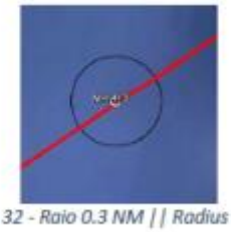


Figura 32 - Raio 0.3 NM || Radius 0.3 NM

Figura 33 - Raios 0.3/0.2/0.1 NM || Radius 0.3/0.2/0.1 NM

Figura 34 - Raios 0.3/0.2/0.1 NM || Radius 0.3/0.2/0.1 NM

Figure 11 TAP Portugal recorded trajectories RWY 23 – Zoom on waypoints

6.9.3.1.1.2 Airport accessibility

The below table compares published procedures minima (VOR DME procedures) and new RNP AR procedures minima (RNP AR 0.1 is assumed), for a CAT C aircraft.

	VOR DME MDA	**New RNP AR DA**	**Benefit (ft)**	**Estimated nb of additional flights**
Madeira 05	940ft	520ft	-420ft	Negligible, although the operationality of the aerodrome is improved
Madeira 23	1300ft	490ft	-810ft	Negligible

6.9.3.1.2 Results impacting regulation and standardisation initiatives

The following topics have been discussed and a need for updating the existing regulatory and standardisation initiatives has been identified in the following area:

- ICAO DOC 9905: due to the terrain environment in Madeira, the procedure designers had to deviate from 2 ICAO recommendations:
  - a) distance between the FROP (Final Roll Out Point) and the OCA/H, and
  - b) bank angles in the RF legs.

  Mitigation means have been proposed, and deemed acceptable by the Regulator for the purpose of RISE flight trials.

  Refer to paragraph 6.9.2.2.1 for details, and Madeira RNP AR procedures technical report.

6.9.3.1.3 Unexpected Behaviours/Results

There was no unexpected behaviour/result.

6.9.3.1.4 Quality of Demonstration Results

There was no specific issue concerning the quality of the results achieved in this Exercise.

6.9.3.1.5 Significance of Demonstration Results

The Demonstration results are deemed significant.

As compared to real RNP AR operations:

- The trials have been conducted in VMC conditions. However, the procedures used by the flight crew were as if these flights were IMC.
- For TAP Portugal flights, the aircraft was not certified for RNP AR operations; however the aircraft was equipped with the minimum equipment required for this type of operations.

6.9.4 Conclusions and recommendations

6.9.4.1 Conclusions

The Exercise results were as expected and confirmed the benefit to implement RNP AR procedure in Madeira airport, in order to enhance safety and improve airport accessibility. The safety benefit has clearly been demonstrated by the airlines during the trials phase: all airlines reported good stabilization of the aircraft on final approach, even in strong wind conditions. This has been demonstrated on both Airbus and Boeing aircraft types.

The RNP AR procedures are already published in SUP AIP, for the purpose of RISE trials in weather conditions equal or better than Ceiling of 3.000 feet and 10 Km of visibility.

NAV Portugal is in the process of delivering the procedures for approval by the Regulator which is expected to be done in December 2016.

One of the open items which still need to be confirmed by ANAC is the fact that these new procedures are intended to be implemented on runways today certified as “non-instrument runway”. Based on the new ICAO approach classification applicable as of November 2014 and the latest EASA Opinion 03/2016 it is possible to publish the RNP AR APCH to runway 23 at Madeira Airport, providing that the references to the forbidden straight-in approaches are removed from Portuguese AIP, and the Portuguese Civil Aviation Authority publishes the conditions for this operation, namely what concerns wind restrictions and visibility, after redefining runway 23 as an instrument runway.

Differently, the approach to runway 05 seems only to gather conditions to accommodate a RNAV under visual conditions, this meaning profiting the lateral and vertical guidance of RNP AR criteria up to a point where the remaining approach procedure shall continue under VMC conditions.

6.9.4.2 Recommendations

The Exercise highlighted a need to update regulatory documents and standards, as detailed in paragraph 6.9.3.1.2.

6.10 Demonstration Exercise #10 Report

6.10.1 Exercise Scope

This demonstration exercise covers RNP AR approaches demonstrations into RWY 10 and RWY 28 of Horta airport.

Demonstration Exercise ID and Title	EXE-02.08-D-010 : RNP AR Operations at LPHR (Horta)
Leading organization	TAP Portugal, NAV Portugal, Airbus ProSky
Demonstration exercise objectives	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05. p. Airport accessibility, q. Safety.
OFA addressed	02.01.01 Optimised 2D / 3D Routes
Applicable Operational Context	Refer to Demonstration Plan RISE (project number LSD.02.08) version 00.00.05.
Demonstration Technique	**Demonstration:** - Procedure design activities - Full Flight Simulator **Output:** - Procedures charts - Simulator reports
Number of trials	0

6.10.2 Conduct of Demonstration Exercise EXE-02.08-010

6.10.2.1 Exercise Preparation

The preparation activities include all those necessary to prepare the design, assessment, validation and implementation of the RNP procedures.

The output of the Exercise Preparation phase is the Project Specification document, signed by all stakeholders, that summarizes the project scope and objectives, data to be sued for the design of the procedures and conceptual design of the procedures.

Horta project specification has been approved by all stakeholders in April 2015.

6.10.2.2 Exercise execution

The following activities have been performed in the Exercise execution for Horta RNP AR procedures:

Exercise execution activity	Included in the scope for Horta airport?	Timeline
Procedure design	YES	March to June 2015
Procedures simulator validation	YES	
Safety study	YES	
Environmental study	NO	
ATC training	YES	February 2016
Flight trials & data analysis	NO	

6.10.2.2.1 Procedures design

RNP AR procedures have been designed to Horta runway 10 and 28.

The final procedures approach charts are shown in Appendix K.

The RNP AR procedures design main highlights are:

- One of the main constraints for designing Horta RNP AR approach procedure was to avoid the zones of turbulence between the Islands.
- Design of the procedures has been done in accordance with ICAO 9905 document. However, one type of deviation has been highlighted during the design phase:
    a. The ICAO 9905 Document recommends that the bank angles in RF legs are limited to 20° in approach and 15° in missed approach (considering ICAO wind table). Due to the terrain environment in Horta and in order not to extend the approach and missed approach paths, higher bank angles have been considered. This deviation has been mitigated thanks to the actual aircraft capabilities (AutoPilot supporting higher bank angle values), and/or considering more realistic approach speeds for the calculation.

    It was recommended that this deviation to ICAO should be highlighted to operators and covered in the FOSA (Flight Crew Operational Safety Assessment).

The ANAC (Portuguese Regulator) has been involved in the discussion all along the RISE project. They accepted these deviations for RISE trials.

6.10.2.2.2 Procedures simulator validation

All the designed procedures have been tested on Airbus A320 Full Flight Simulator equipped with the minimum equipment required for RNP AR operations.

It has been demonstrated that the designed procedures are fly able. In particular:

a. Flight plans are correctly displayed on ND and MCDU
b. No TAWS warning or caution alerts are triggered along the designed paths
c. Experienced cross track errors are within acceptable limits
d. Experienced bank angles are within acceptable limits
e. Procedures are manageable from an energy management point of view.

6.10.2.2.3 Safety study

A safety study has been conducted for both runways' (10/28) RNP AR procedures.

NAV Portugal conducted an ATM Safety study at Horta's airport, and the outcome was that there are no safety concerns with this implementation regarding the ATM procedures. Given this conclusion, NAV Portugal assessment is that there is even a safety improvement with this type of operations, especially with the flight guidance until the aircraft is established on final approach, allowing good navigation and flight procedures in the "Canal" between Horta and Pico islands.

6.10.2.2.4 ATC briefing

The Air Traffic Controllers of Horta have been trained to the designed RNP AR procedures.

7ATCos participated to the training which lasted 3 days in total, including 2 days of ground class and 1 day of tower training. The training covered both general PBN topics and specific RNP operations in Horta..

6.10.2.3 Deviation from the planned activities

All activities planned have been conducted as planned.

6.10.3 Exercise Results

6.10.3.1 Summary of Exercise Results

Refer to paragraph 5.1

6.10.3.1.1 Results per KPA

6.10.3.1.1.1 Safety

While the procedures have not been assessed during a trial period (as no airline has been identified to fly the Horta RNP AR procedures), the procedures have been thoroughly validated on Full Flight Simulator fully representative of the aircraft environment. The results were satisfactory. In particular it has been demonstrated that the aircraft remains on the design trajectory defined down to the runway threshold, whatever the environmental conditions were, which constitutes a great safety enhancement as compared to the existing procedures.

6.10.3.1.1.2 Airport accessibility

The below table compares published procedures minima (Circling procedures) and new RNP AR procedures minima (RNP AR 0.1 is assumed), for a CAT C aircraft. In addition, thanks to the available weather and number of flights statistics, NAV Portugal has estimated the number of additional flights that could land thanks to the new RNP AR procedures while they could not today (due to the visibility / ceiling, or wind conditions). The most common months with low ceilings/fog are May and June (where

most often flights are cancelled due weather), although flights are cancelled also due weather between November and April. Taking this in consideration NAV Portugal estimates 15 flights per year that can benefit from RNP AR approaches within the Horta's airport users.

	Circling (MSL)	New RNP AR DA	Benefit (ft)	Estimated nb of additional flights
Horta 10	990ft	603ft	-387ft	5
Horta 28	880ft	414ft	-466ft	10

6.10.3.1.2 Results impacting regulation and standardisation initiatives

The following topics have been discussed and a need for updating the existing regulatory and standardisation initiatives has been identified in the following area:

- ICAO DOC 9905: due to the terrain environment in Madeira, the procedure designers had to deviate from 1 ICAO recommendation: bank angles in the RF legs.

  Mitigation means have been proposed, and expected to be acceptable by the Regulator for approval and publication of the procedures..

  Refer to paragraph 6.10.2.2.1 for details, and Horta RNP AR procedures technical report.

6.10.3.1.3 Unexpected Behaviours/Results

There was no unexpected behaviour/results.

6.10.3.1.4 Quality of Demonstration Results

There was no specific issue concerning the quality of the results achieved in this Exercise.

6.10.3.1.5 Significance of Demonstration Results

The significance of the Demonstration Results may have been re-inforced thanks to a flight trial period. Despite not included in the RISE project, such trial period may happen in 2016/2017.

A flight trial period would have allowed captured flight trials data, as done for the other airports, including pilots' and ATCs' feedback, flight data recordings, etc… and thus would have allowed demonstrating to a greater extent the benefits.

6.10.4 Conclusions and recommendations

6.10.4.1 Conclusions

Although the flight trials are not yet conducted, estimated benefits are foreseen in the implementation of RNP AR procedure to Horta airport, in order to enhance safety and improve airport accessibility.

NAV Portugal is in the process of delivering the procedures for approval by the Regulator after the flight trials exercise, which are expected to be published in the 2nd semester of 2017. One of the open items which still need to be confirmed by ANAC is the fact that these new procedures are intended to be implemented on runways today certified as "non-instrument runway". Based on the new ICAO approach classification applicable as of November 2014 and

the latest EASA Opinion 03/2016 it is possible to publish the RNP AR APCH to runways 10/28 at Horta Airport, providing that the Portuguese Civil Aviation Authority publishes the conditions for this operation, namely what concerns wind restrictions and visibility, after redefining runways 10/28 as an instrument runways.

6.10.4.2 Recommendations

The Exercise highlighted a need to update regulatory documents and standards, as detailed in paragraph 6.10.3.1.2.

7 Summary of the Communication Activities

Activity	When	Responsible	Where	Targets	Audience
Press Release	Launch –December 2014	Airbus ProSky		Business Wire and Trade Media	More than 100,000 readers
	Greece Trials – December 2015	Novair		Trade Media	More than 6,000+ readers
	Greece Trials – January 2016	Airbus ProSky		Trade Media	More than 6,000+ readers
	Madeira Trials - March 2016	Airbus ProSky		Trade Media	More than 6,000+ readers
	Cyprus Trials – July 2016	Airbus ProSky		Trade Media	More than 6,000+ readers
	France Trials – Sept 2016	*Airbus ProSky*		*Trade Media*	More than 6,000+ readers
	Final Release – planned in October 2016	*Airbus ProSky*		*Trade Media*	
RISE Presentations	APS Seminar in Toulouse – January 2015	Airbus ProSky Air France TAP Portugal Novair	Toulouse		
	RAISG Meeting (EUROCONTROL)- Aprils 2015	Airbus ProSky	Brussels		
	ICAO PBN Seminar – June 2015	Airbus ProSky	Bangkok		
	Salon du Bourget - June 2015	DSNA	Paris		
	PBN Workshop Portugal – August 2015	ANAC, NAV Portugal, TAP Portugal, Airbus ProSky	Lisbon		
	Aerodays in London – October 2015	Airbus ProSky	London		1000
	RAISG Meeting – November 2015	DCAC	Brussels		
	Airbus ProSky Seminar, Bangkok – November 2015	Novair Airbus ProSky	Bangkok		
	DSNA Forum SESAR in Athis Mons – December 2015	DSNA, Airbus ProSky	Athis Mons		
	Airbus Fuel Savings Seminar – May 2016	Novair, Airbus ProSky	Toulouse		
	Airbus Flight Ops and Training	Airbus ProSky	Berlin		431

	Symposium – May 2016				
	Airbus ProSky Seminar	Airbus ProSky	Miami		
Articles	Articles Aerodays 2015 book To be published in Sept	Airbus ProSky			
	Article in ICAO journal July 2016	Airbus ProSky			More than 13,000 readers
	Article in DSNA&vous – July 2016	DSNA, Air France		DSNA customers	More than 12,000 readers
	Article in "Lettre d'information de la DSNA)	DSNA		DSNA Customers	More than 12,000 readers
Video Capture	During RNP AR flight demonstrations and at Airbus ProSky Seminar in Toulouse	Airbus ProSky		Airbus ProSky Network	
Internal Communications - Airbus ProSky	During demonstration flights and at completion	Airbus ProSky		Airbus ProSky employees (185 employees)	

Notes:

- *The above mentioned Press release and presentation are provided in Appendix Q. Presentation are provided in Appendix R.*
- *Link to the RISE video: https://www.youtube.com/watch?v=2GJwyIknHbU*

7.1 Communication

Per the project's communications plan schedule, a post kick-off meeting communication will be produced and distributed as a press release. The article will be released via the Airbus ProSky network (6000+ contacts).

- Our methodology included targeting those involved in the air traffic management community, in particular executives in European and international aircraft operators, airports, civil aviation authorities as well as ANSPs. We did so through a multi-communication channel approach including press releases, earned media and conferences, where both presentations and videos were showcased. Press releases and videos were also shared through SESAR JU's networks, including their newsletter, social media handles and Youtube.http://www.airbusprosky.com/news/press-releases/660-airbus-prosky-and-its-sesar-ju-partners-launch-rise-project-to-increase-airspace-efficiency.html
    - Readership: More than 6,000 readers
- http://www.airtrafficmanagement.net/2014/12/airbus-prosky-launches-sesar-rise-project/
    - Readership: More than 3,000 readers
- http://aviationweek.com/commercial-aviation/three-airlines-trial-precision-navigation-routes-europe

- Readership: More than 65,000 readers

- http://www.airbus.com/presscentre/quick-news/issue-5/
  - Readership: More than 10,000 readers

http://aviationweek.com/aftermarket-solutions/airbus-boeing-recycle-technology-new-atm-products

7.2 Communication – Demonstration Flights

For the completion of demonstration flights, press releases were distributed by Airbus ProSky which were published on a variety of trade platforms:

- Air Traffic Management
- Aviation Week
- ATCA's Daily Newsletter
- CANSO
- Intelligent Aerospace
- Jane's Airport Review

A video was also created and leveraged at a variety of events, including:

- World ATM Congress, 2015 (3,000 attendees)
- World ATM Congress, 2016 (3,300 attendees)

7.3 Communication – End of Project

The RISE members plan to distribute a final press release in conjunction with an infographic in September 2016 announcing the end of the project with major outcomes and next steps.

8 Next Steps

All activities of the RISE project, as defined in the RISE Demonstration Plan, have been conducted.

Beyond RISE, and in line with the SESAR deployment plan (PCP AF#1), the possible next steps for implementation and entry into operation of the procedures developed in the frame of this project are:

For operators non RNP AR approved:

- To have aircraft qualified for RNP AR operations
- To submit RNP AR approval, in order to be able to operate the RNP AR approach procedures

  However, some airliners remind that, before launching those two tasks, RNP AR business case is still to be worked on. Indeed, enough though RNP AR is recognized as an attractive and mature technology, studies are still ongoing to turn the business case to green for some large fleet operators, with network mostly composed by airports equipped with CAT 3 ILS.

For ANSPs and/or Regulators:

- When applicable, to continue on-going work in order to solve potential show stoppers for publication (mainly linked to runway certification requirements and VSS penetration) in order to publish the procedures in the AIP
- When applicable, to continue on-going actions in order familiarize and train appropriately air traffic controllers, procedure designers, flight inspectors, etc… to PBN.
- When relevant, to improve design of the procedures for places where changes have been suggested by operators during the trials phase.
- To capitalize on the experience gained during the RISE project, and implement the RNP1 to ILS, RNP APCH and RNP AR procedures for operation in IMC conditions.

8.1 Conclusions

8.1.1 General

More than 500 demonstration flights were achieved to Madeira, Nice, Ajaccio, Corfu, Iraklion, Mykonos, Santorini, Paphos and Larnaca, using the developed RNP1 to ILS, RNAV Visual, RNP APCH and RNP AR procedures.

The project's objective was to demonstrate the benefits of SESAR solutions (solution #62 "Enhanced Terminal Airspace for RNP-based Operations", and solution #9 "Enhanced terminal operations with automatic RNP transition to ILS/GLS") in real life environment, focusing on lot 2 (Solutions targeting improvements in particular, but not necessarily limited to, a small/medium size airport) and specifically addressing Precision Arrival and Departure Procedures focus area.

The results of the project highlight the benefits linked to the use of those procedures in terms of accessibility, safety enhancement, trajectory repeatability, avoidance of sensitive zones for all places where procedures have been designed. It also demonstrates track miles and fuel consumption reduction for some of the airports.

Those results clearly illustrate stakeholder interest and support in current PBN implementation plan in Europe, and pave the way to large deployment of PCP AF#1.

8.1.2 Significance of demonstration results

The Demonstration results are deemed significant. The operational realism of the Demonstration Exercice could have been affected by the fact that:

- The trials have been conducted in VMC conditions. However, the procedures used by the flight crew were as if these flights were IMC.
- For RNP AR procedures, the aircraft was not always certified for RNP AR operations; however the aircraft was equipped with the minimum equipment required for this type of operations. In other words, the aircraft was equipped with the minimum pre-requisites in terms of avionics (FMS, ADIRU, EIS, MMR, TAWS, …) to fly RNP AR 0.3 procedures, but was not always certified (the airline was not able to demonstrate RNP AR capability as usually stated in the AFM page).

  Note: all operators had their aircraft not certified for RNP AR operations (and no RNP AR operational approval by their state of registration), except Novair, SAS and Emirates.

  Reminder: The purpose of RISE trials was to demonstrate the benefits of PBN procedures through flight trials in VMC conditions by collecting crew / ATCos feedback and aircraft data recording. For this purpose, the results of the trials phase are deemed significant.

  It was not within the objectives of the trial flights to validate the designed PBN procedures (procedure validation has been conducted on Full Flight Simulator) nor to use the trials for RNP AR operational approval purpose

8.2 Recommendations

The RISE project highlighted a **need to update regulatory documents and standards**, as detailed in paragraph 5.3.4, in particular in the following areas, in order to ease implementation of the developed procedures:

- ICAO DOC 9905 (RNP AR procedure design criteria): procedure design recommendation related to position of the FROP (Final Roll Out Point); bank angle limitation / usage of statistical winds in approach and missed approach; and VSS (Visual Segment Surface) penetration; should be clarified or updated.
- EASA Opinion Letter 03/2016 dated 8.3.2016: definition for “non-instrument” runway should be clarified. It directly impacts the approval & publication of PBN procedures by local Authorities, and therefore airlines business case.
- Standardized concept of operations and procedure design criteria for RNAV Visual procedures should be provided.

Work is on-going at EASA or ICAO level to cover the above items.

About RNAV Visual procedures,

Different points of view have been raised by operators and ANSPs, regarding publication of the procedures: some States plan to publish the procedures in the AIP, while others States recommend waiting for the definition of ICAO criteria before publishing any RNAV Visual procedures in the AIP.

On the operators’ side:

- Some prefer that standardized ICAO recommendations are provided before such type of procedure is published in order to allow common operational procedures (SOP, charting policy, …) thus avoiding safety events coming from pilot’s misunderstanding.
- Some others are pushing to have these procedures in the AIP, and even, to publish designed RNP AR procedures as Visual RNAV procedures to that they can be used in VMC conditions in order to enhance safety (due to the fixed path nature of the procedures, reduced workload…)

From an operational perspective, operators recommend that the use of automation (Flight Director/autopilot) when flying this type of procedure is left at each airline’s discretion, based on their internal safety study and SOPs.

Finally, operators highlighted that use of RNAV Visual procedures should be left at pilot's discretion, and not imposed ("free" visual approach procedures should remain an option when traffic and local conditions permit. Indeed, some operators highlighted that it supports basic pilot skills practice, practice which is recognized on the industry as a key factor for safety). On some ANSPs' side, it is emphasized that benefit of RNAV Visual is actually to have all aircraft flying the same path (enhance timing and sequencing), so will tend to favour this type of procedure.

About RNP AR procedures,

Operators recommend that full advantage of the RNP AR capability (in terms of design flexibility) is taken so that efficient trajectories (from a track miles / fuel perspective) are defined, while properly addressing local constraints and mixed traffic operations. RNP AR procedures defined as overlays of existing procedures bring little benefit in terms of fuel efficiency. This directly impacts the business case for RNP AR.

Also, it should be possible to use RNP AR procedures regularly and not only in remote conditions (e.g. bad weather conditions).

Finally, some operators recommend that the designed RNP AR procedures are also published as RNAV Visual procedure (when weather conditions permit that use), so that they can be used by non RNP AR approved operators in visual conditions. Each airline would then decide if they allow their pilots to fly it or not (based on internal safety assessment).
Some ANSPs, in line with what is described in item a) above, are not in favour of this as it would lead to implement RNAV Visual procedures defined with RNP AR criteria, while today no standardized RNAV Visual concept and design criteria exist (once available, criteria could eventually be very different from RNP AR ones). The risk without a harmonized concept, thus no common operational procedures (SOP, charting policy,…) is to increase safety events coming from pilot's misunderstanding

About PBN procedures in general,

More generally, operators encourage publication of the designed PBN procedures in a timely manner (and development of such type of procedures on other airports when needed), and encourage the use of PBN procedures.

Operators recommend that full advantage of the PBN capability (in terms of design flexibility) is taken, while properly addressing local constraints and mixed traffic operations, so that efficient trajectories (from a track miles / fuel perspective) are defined. PBN procedures defined as overlay of existing procedures brings little benefits in terms of fuel efficiency, and thus directly impact airline's business case.

Note: some procedure design recommendations have also been made for some of the airports, which are not traced here in the general conclusions as they are very specific to each airport, but are put in the conclusions of each Exercise.

9 References

9.1 Applicable Documents

[1] EUROCONTROL ATM Lexicon

9.2 Reference Documents

[1] ATM Master Plan
https://www.atmmasterplan.eu

[2] OFA 02.01.01 Description Form

[3] RISE Demonstration Plan V00.00.05

[4] AMC 20-26 “Airworthiness Approval and Operational Criteria for RNP Authorisation Required (RNP AR) Operations”

[5] AMC 20-27 “Airworthiness Approval and Operational Criteria for RNP APPROACH (RNP APCH) Operations Including APV BAROVNAV Operations”

[6] ICAO DOC 8168 volume II “Construction of Visual and Instrument Flight Procedures”

[7] ICAO DOC 9905 “RNP AR procedure design manual”

[8] ICAO DOC 9906 “Quality Assurance Manual for Flight Procedure Design”

[9] Technical Note DSNA/DO2 n°3 RNAV Visual v1.4

[10] ICAO working paper IFPP/11 dated 23/09/2012

[11] ICAO working paper “Concept of Operations Visual RNAV” dated 27-31 October 2014

Appendix A Nice (LFMN) approach charts

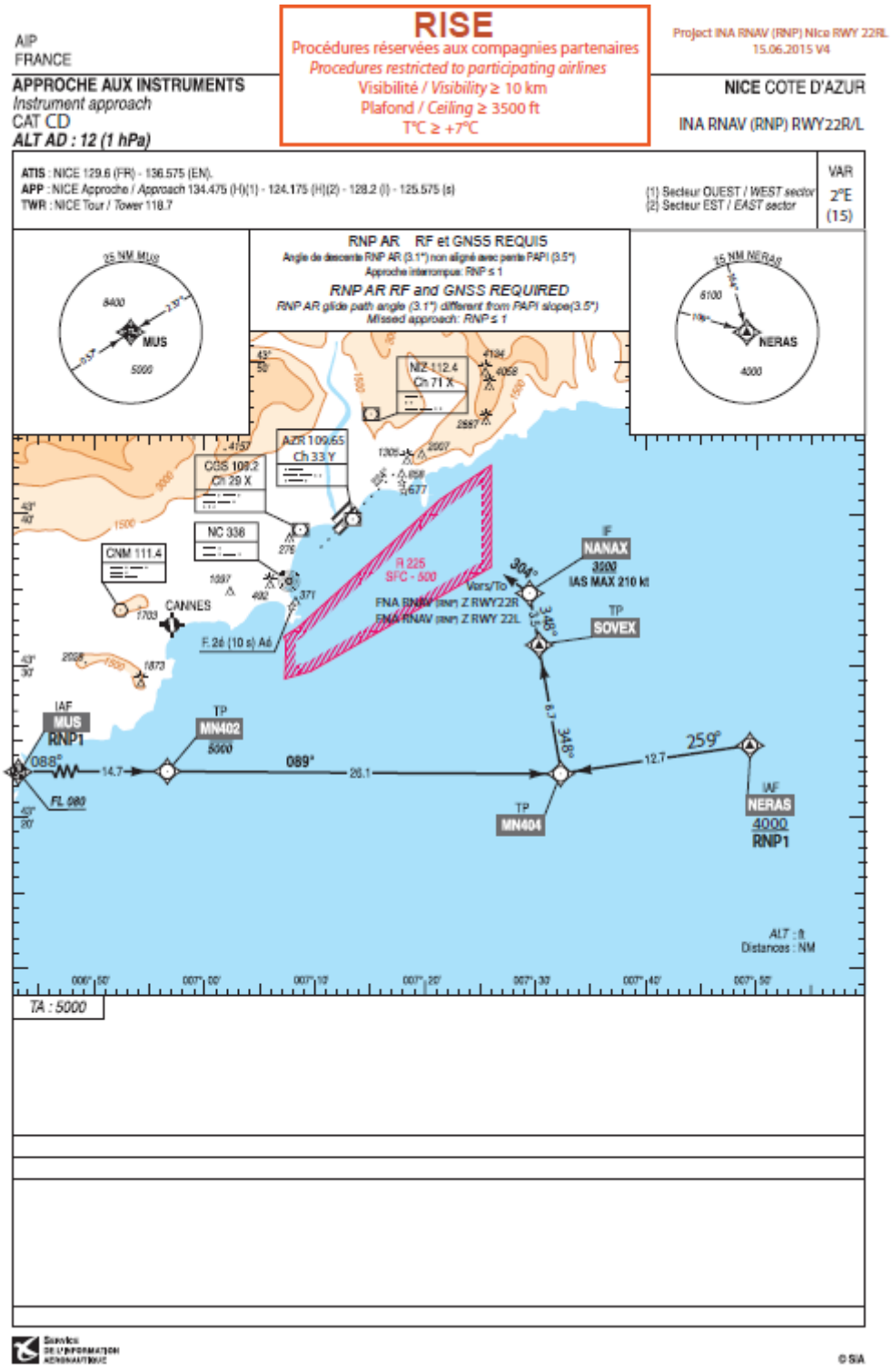


Figure 12 Chart LFMN INA RNAV (RNP) RWY 22L/R

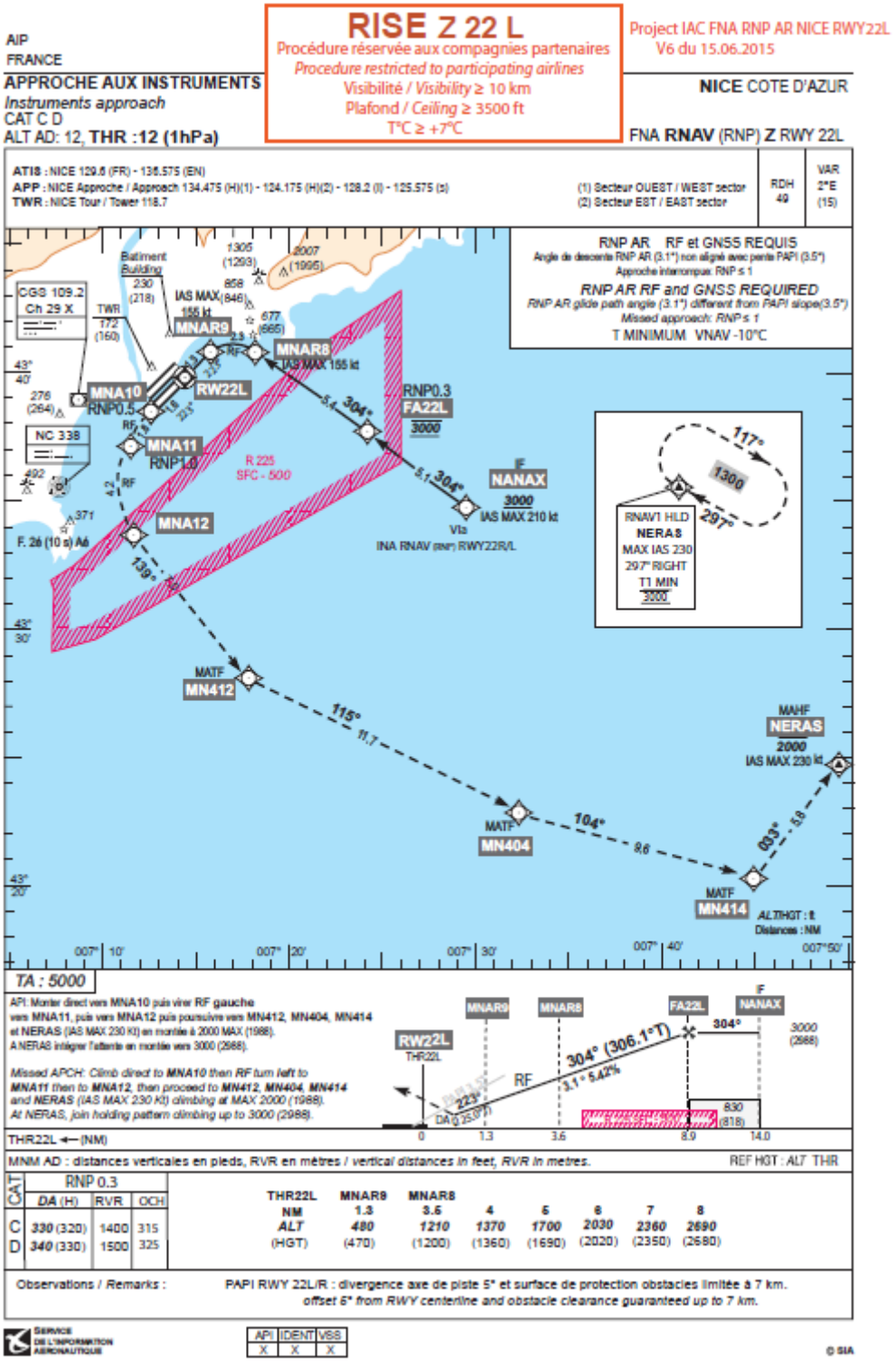


Figure 13 Chart LFMN FNA RNAV (RNP) RWY 22L

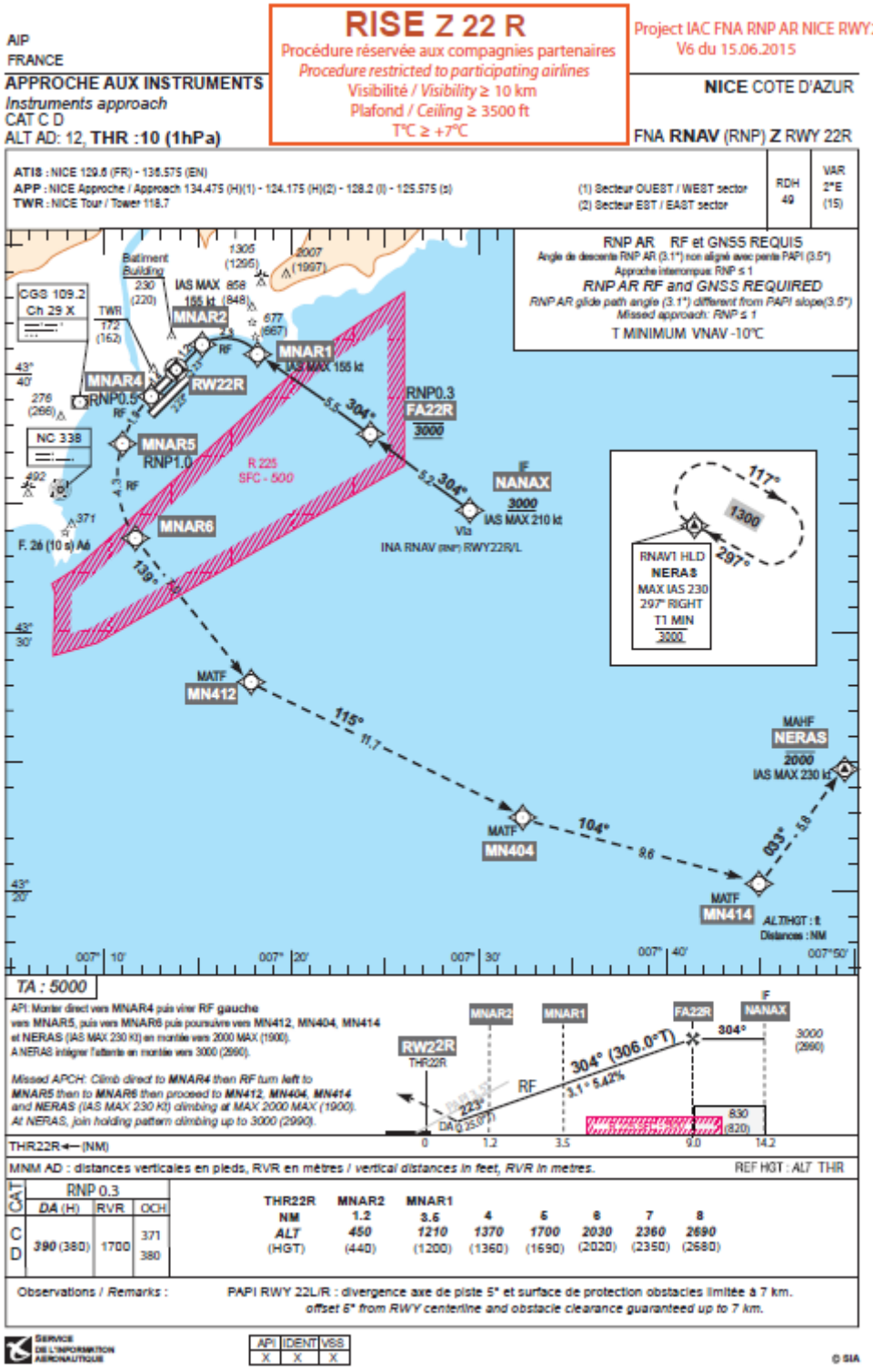


Figure 14 Chart LFMN FNA RNAV (RNP) RWY 22L

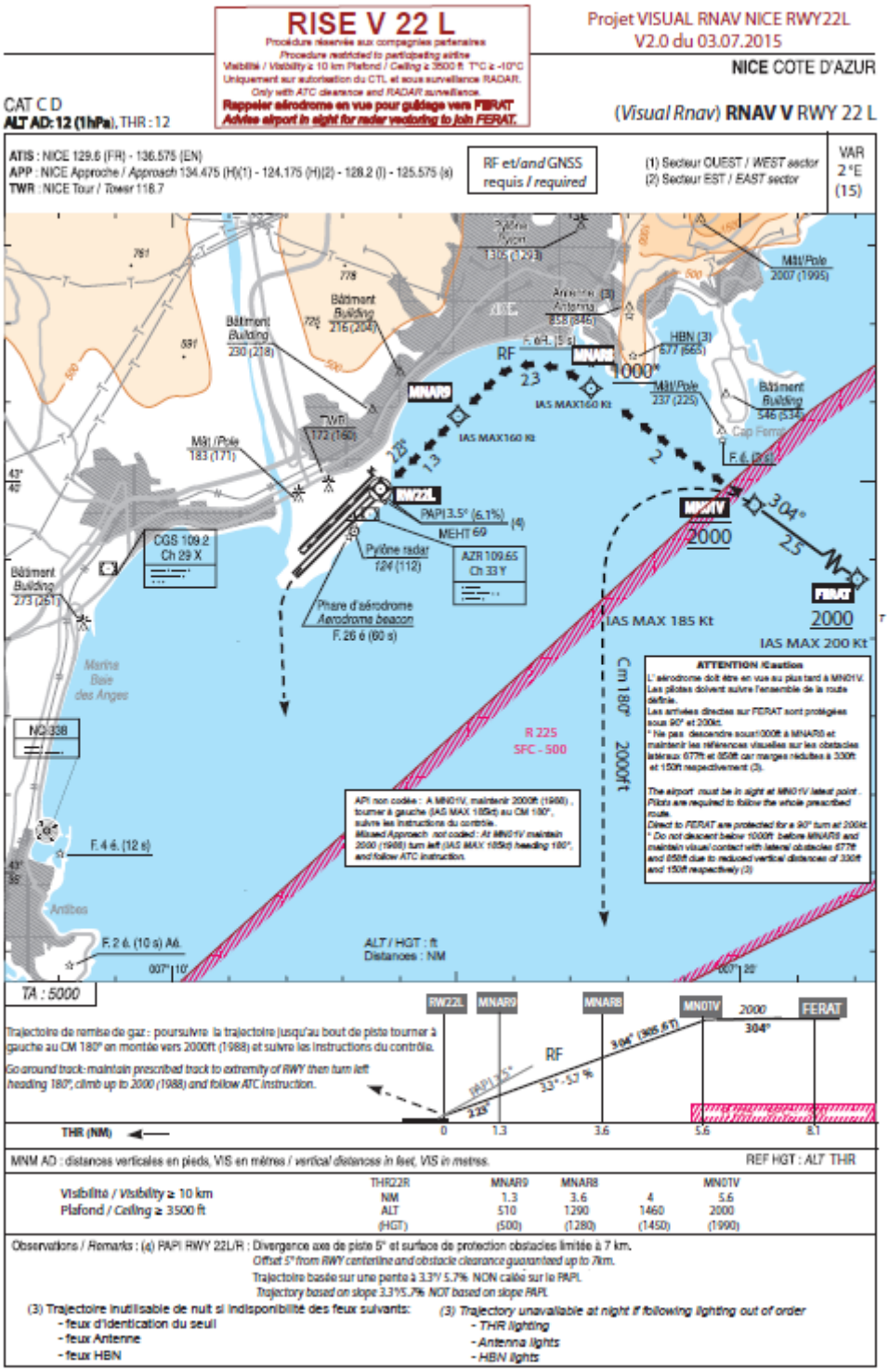


Figure 15 Chart LFMN Visual RNAV RWY 22L

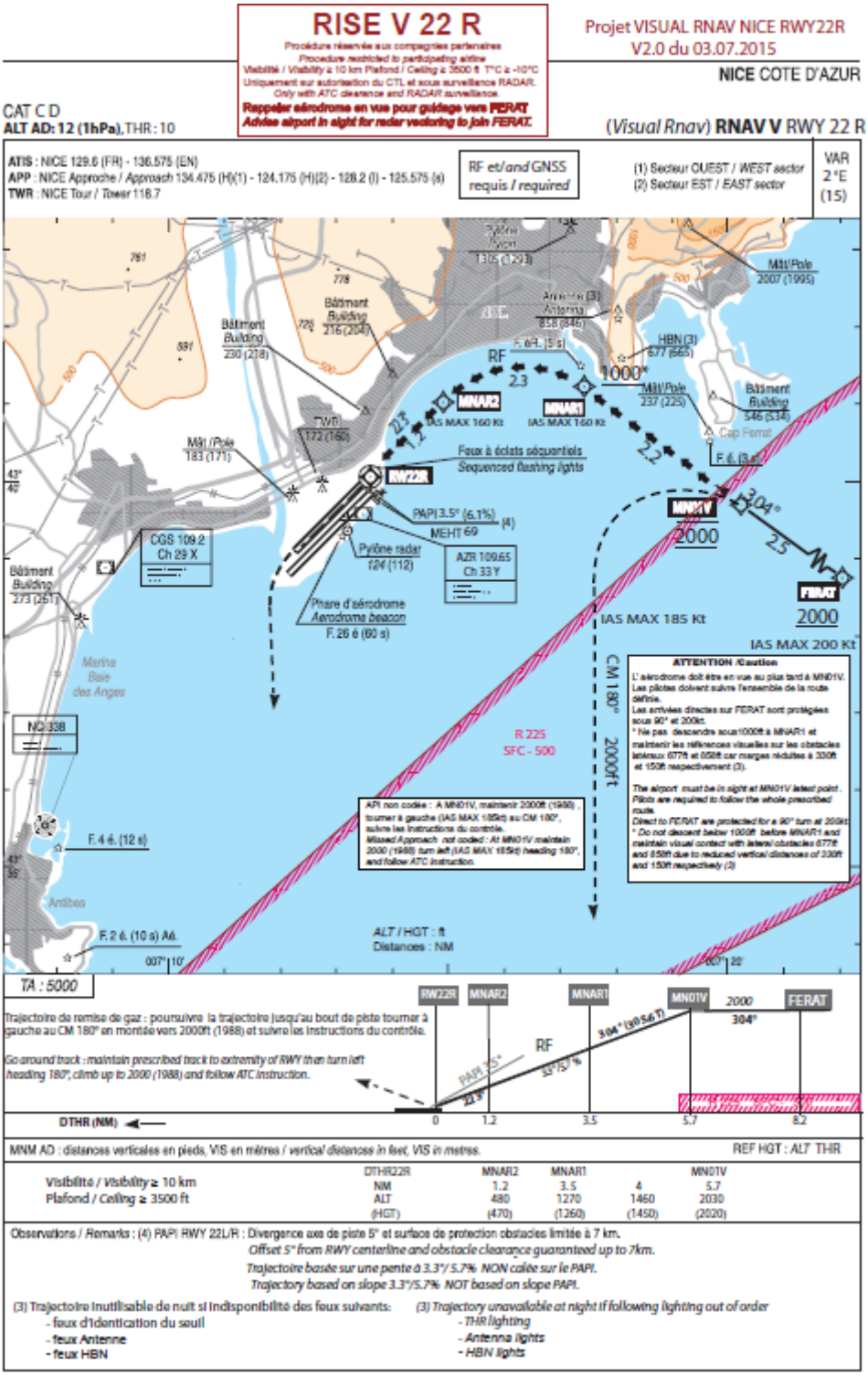


Figure 16 Chart LFMN Visual RNAV RWY 22R

Appendix B Ajaccio (LFKJ) approach charts

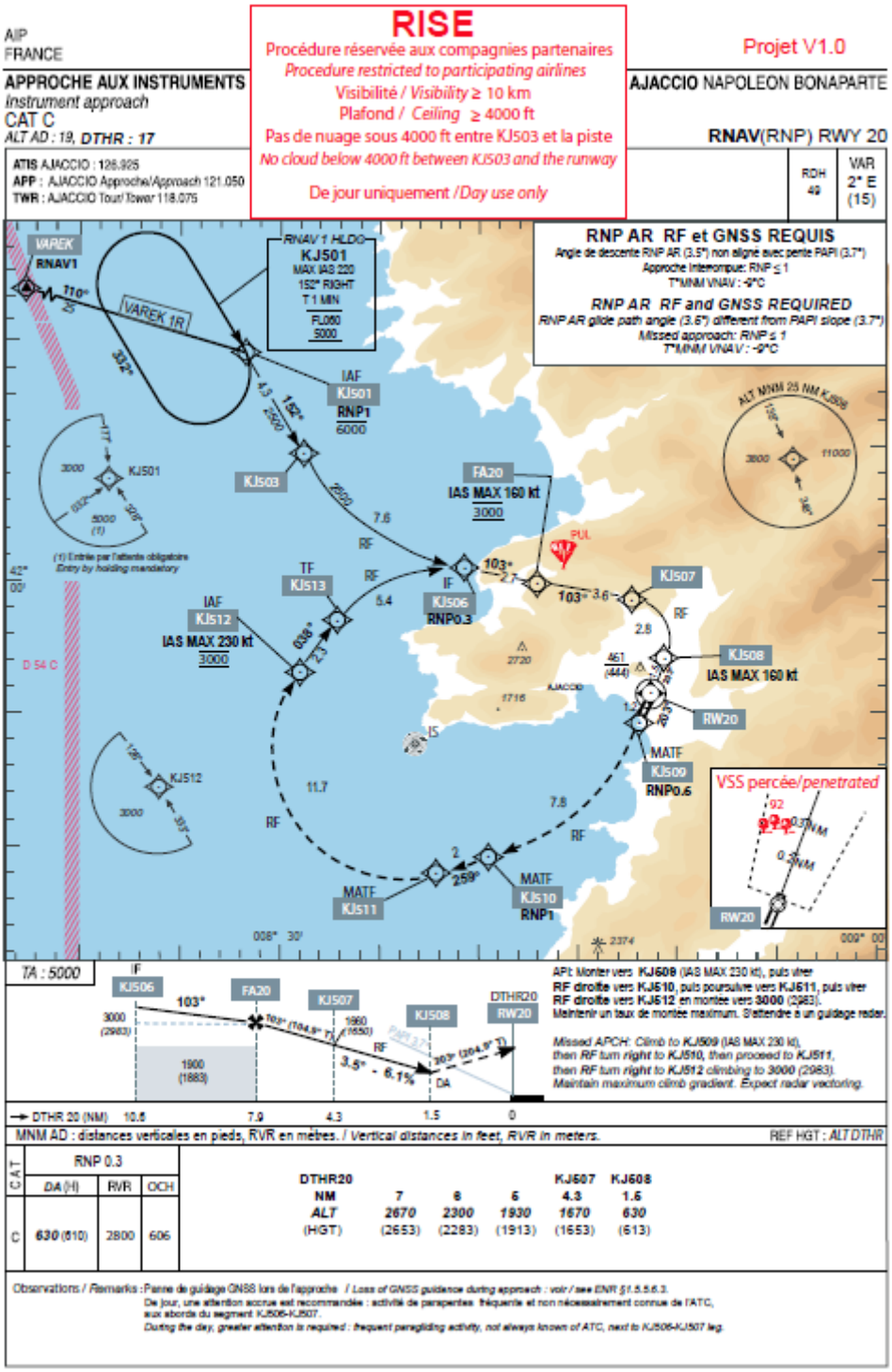


Figure 17 Chart LFKJ RNAV (RNP) RWY 20

Appendix C Paphos (LCPH) approach charts

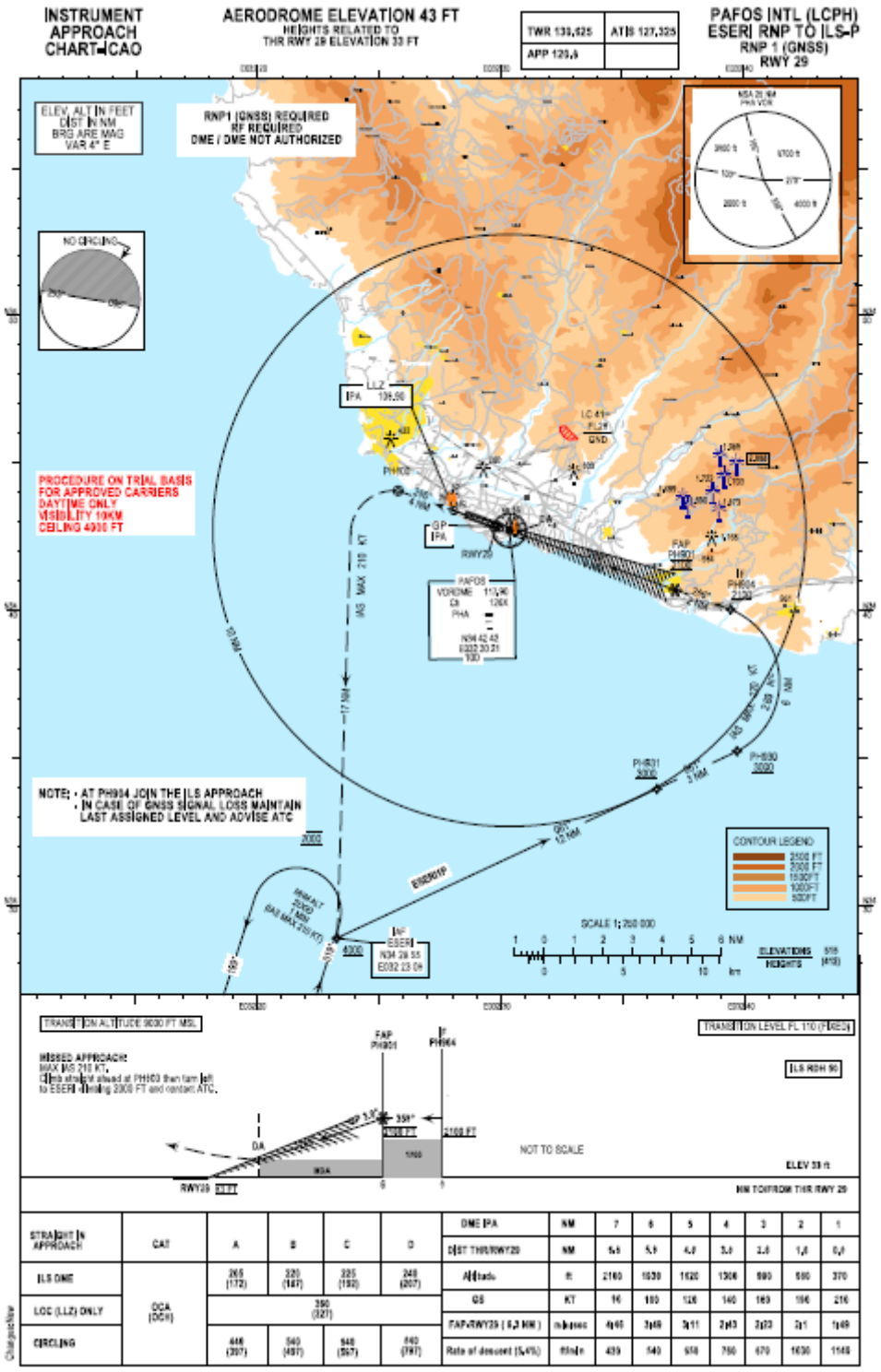


Figure 18 Chart LCPH RNP1 to ILS ESERI RWY 29

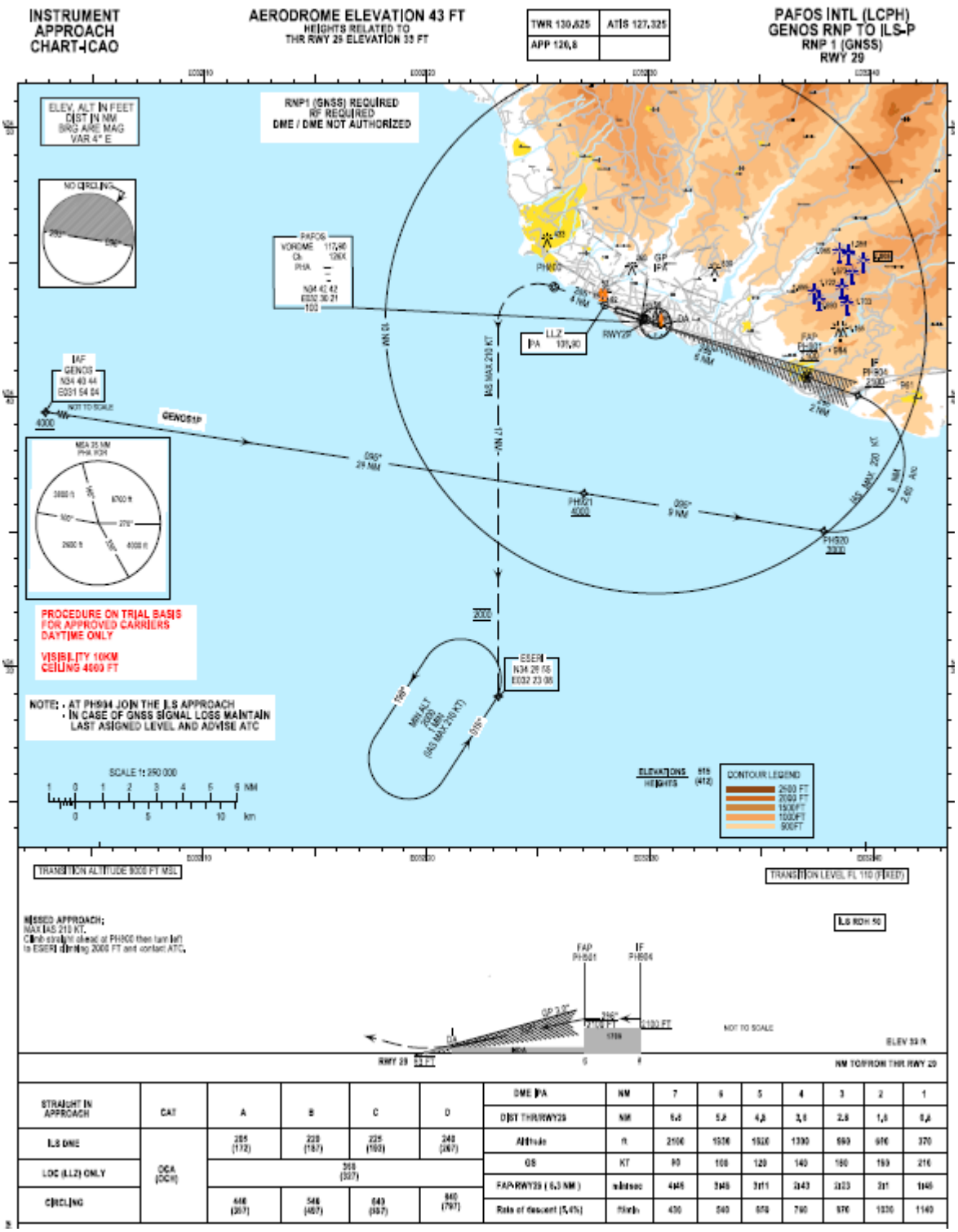


Figure 19 Chart LCPH RNP1 to ILS GENOS RWY 29

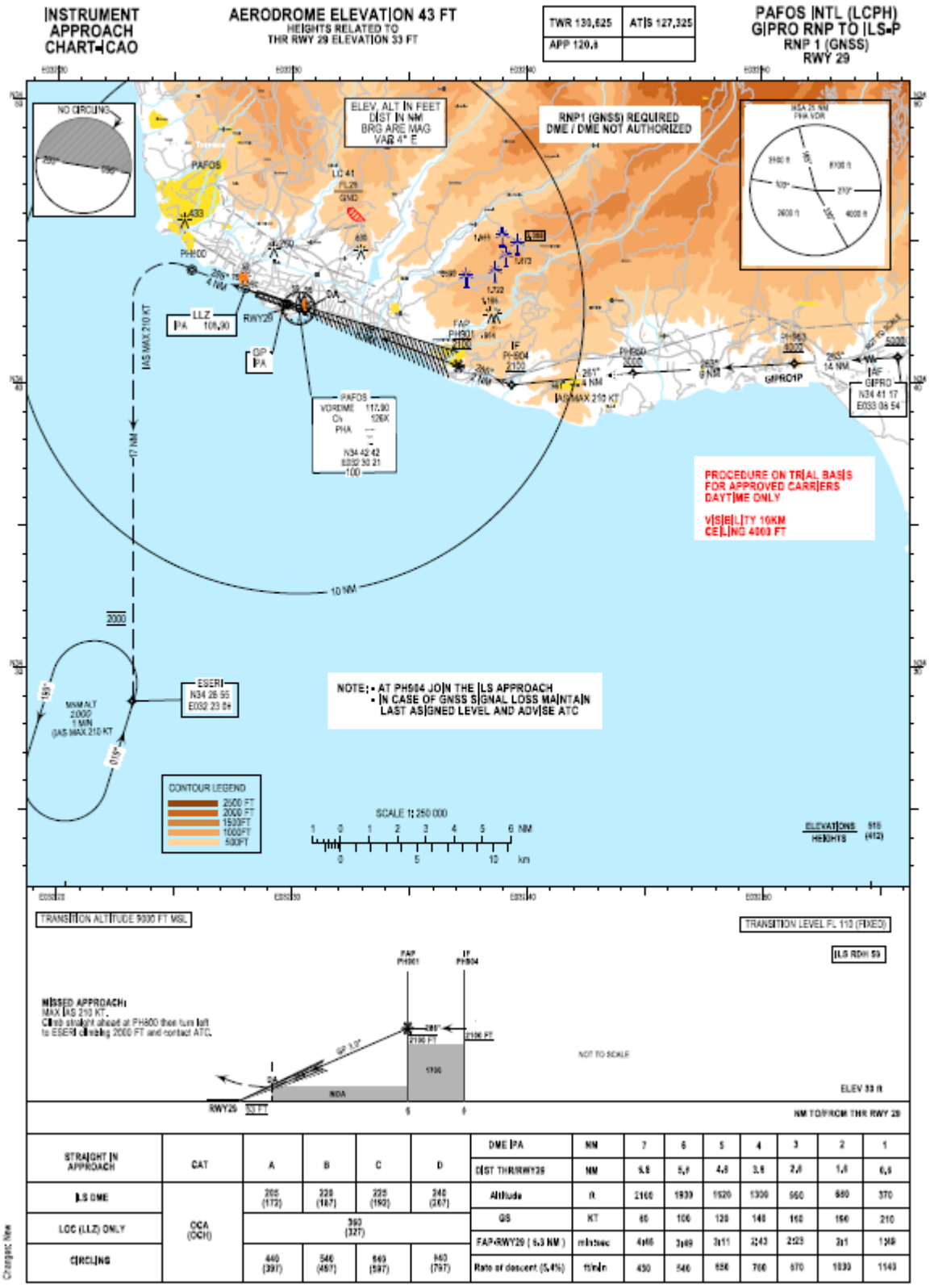


Figure 20 Chart LCPH RNP1 to ILS GIPRO RWY 29

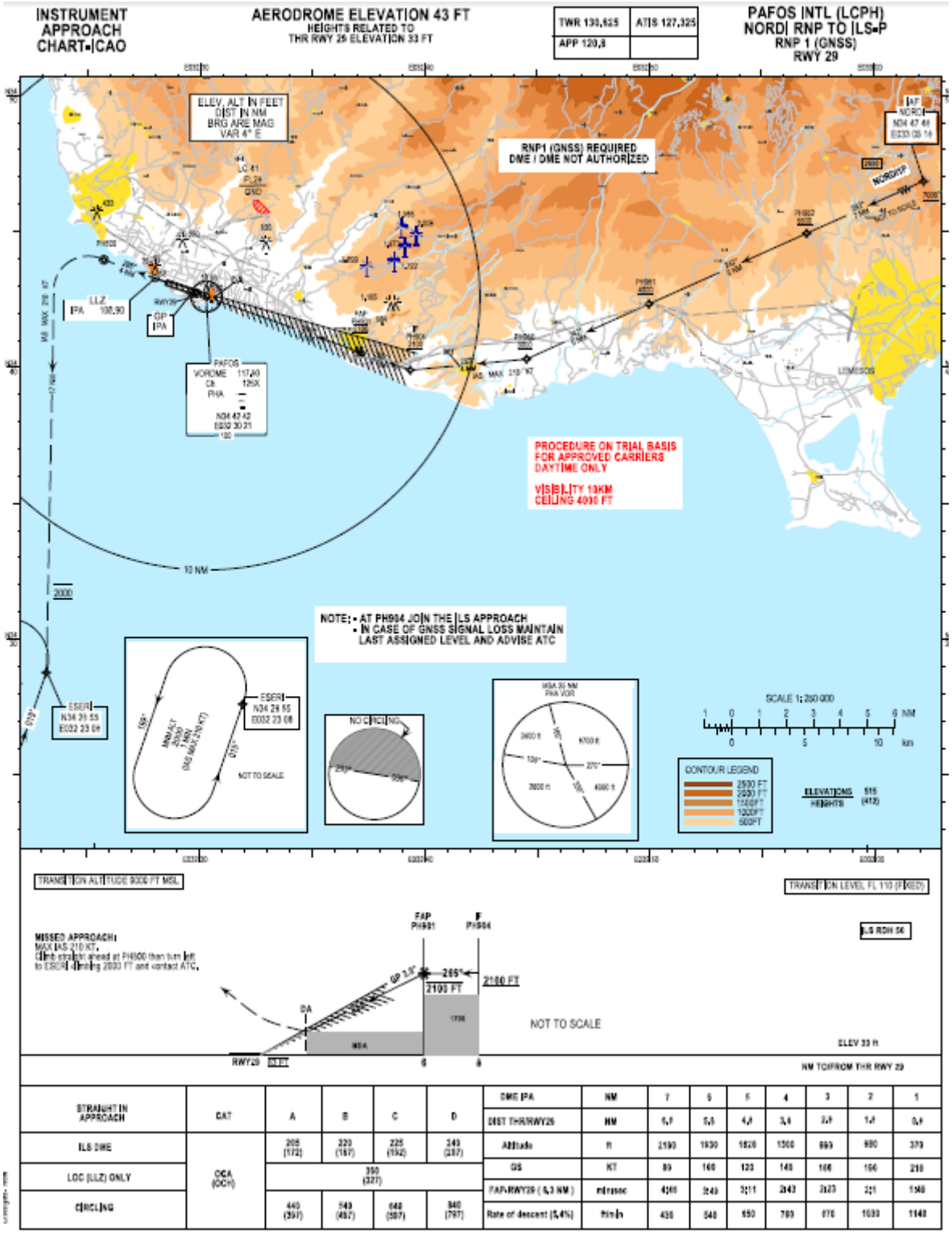


Figure 21 Chart LCPH RNP1 to ILS NORDI RWY 29

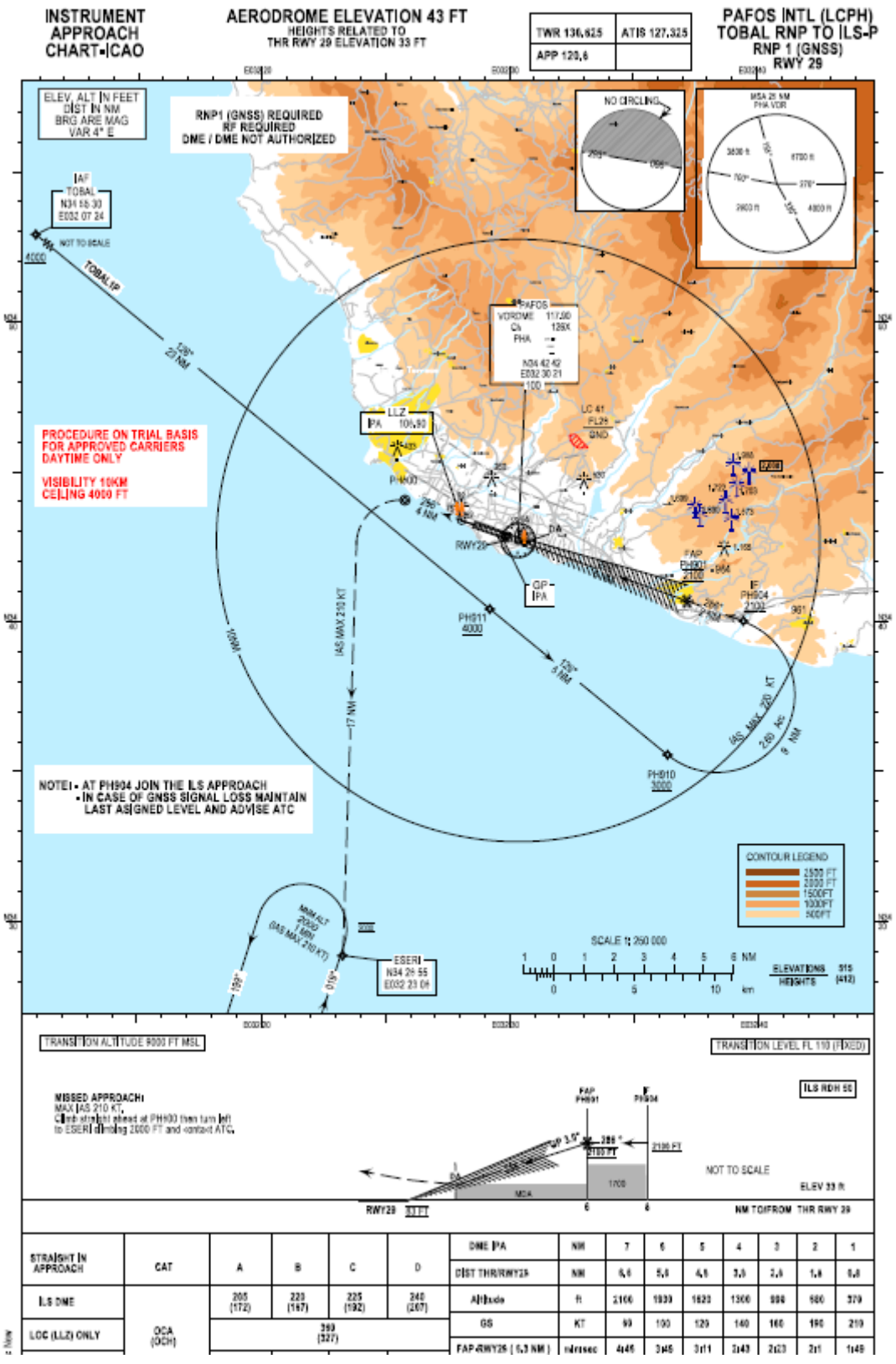


Figure 22 Chart LCPH RNP1 to ILS TOBAL RWY 29

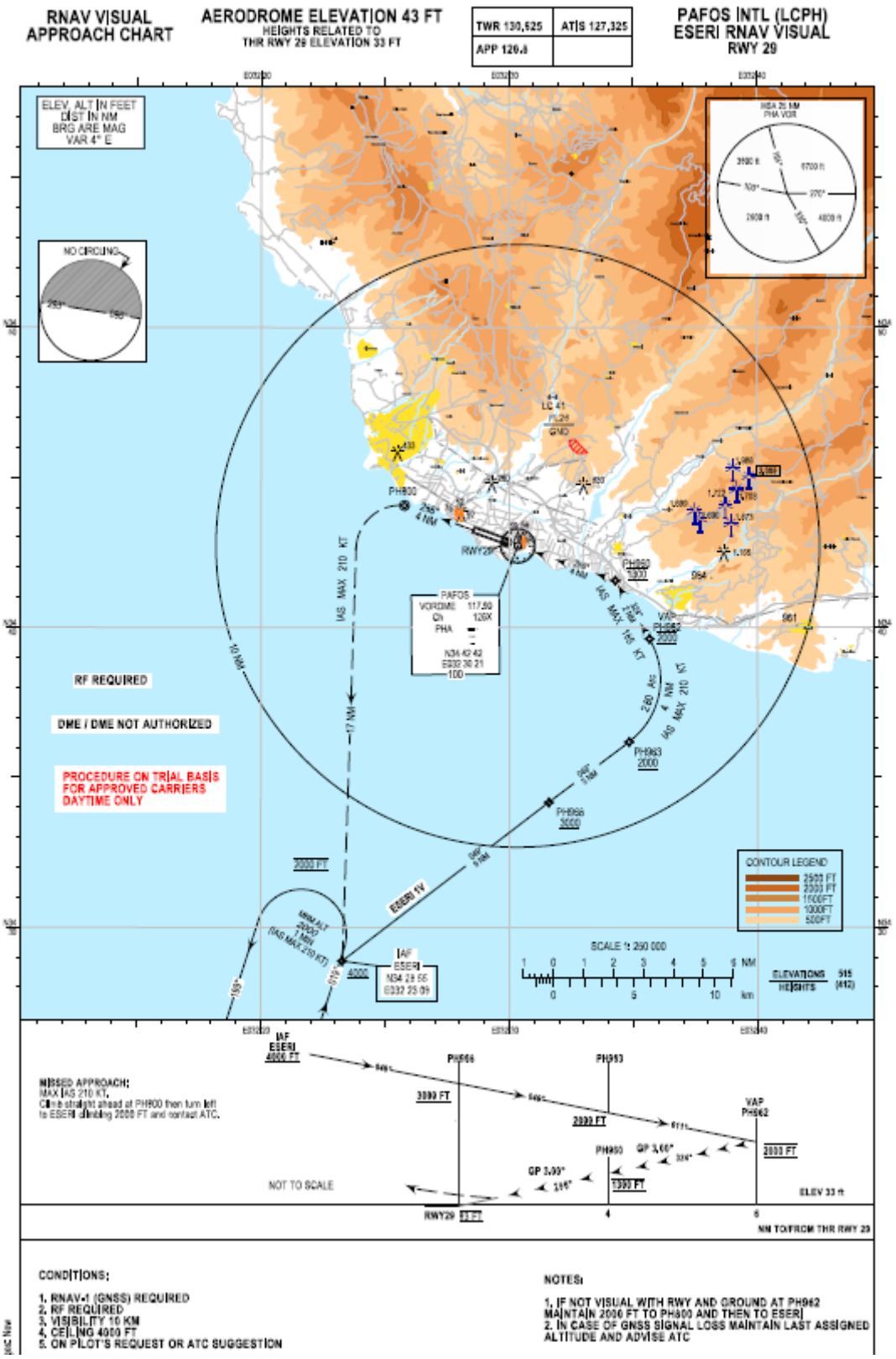


Figure 23 Chart LCPH RNAV Visual ESERI RWY 29

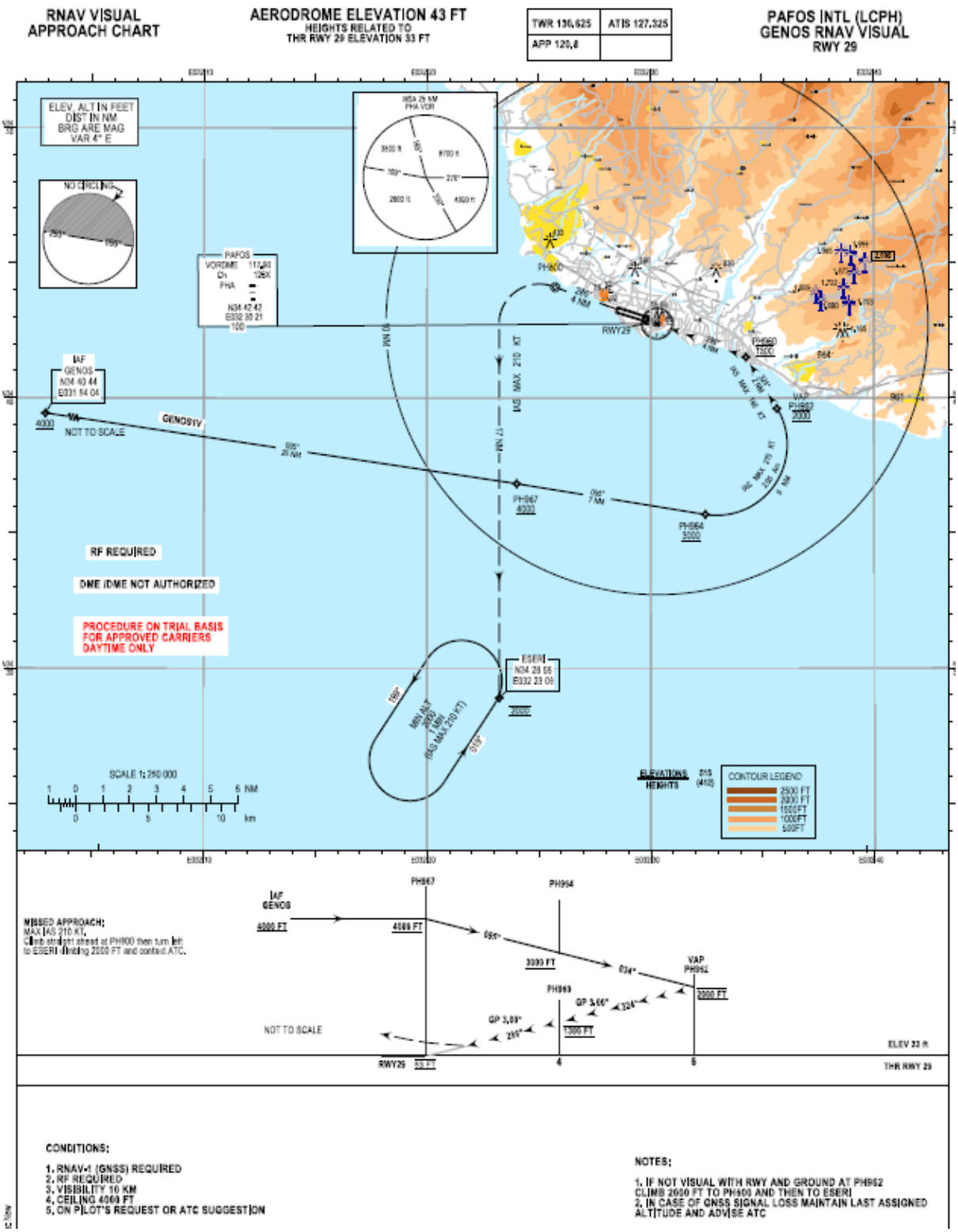


Figure 24 Chart LCPH RNAV Visual GENOS RWY 29

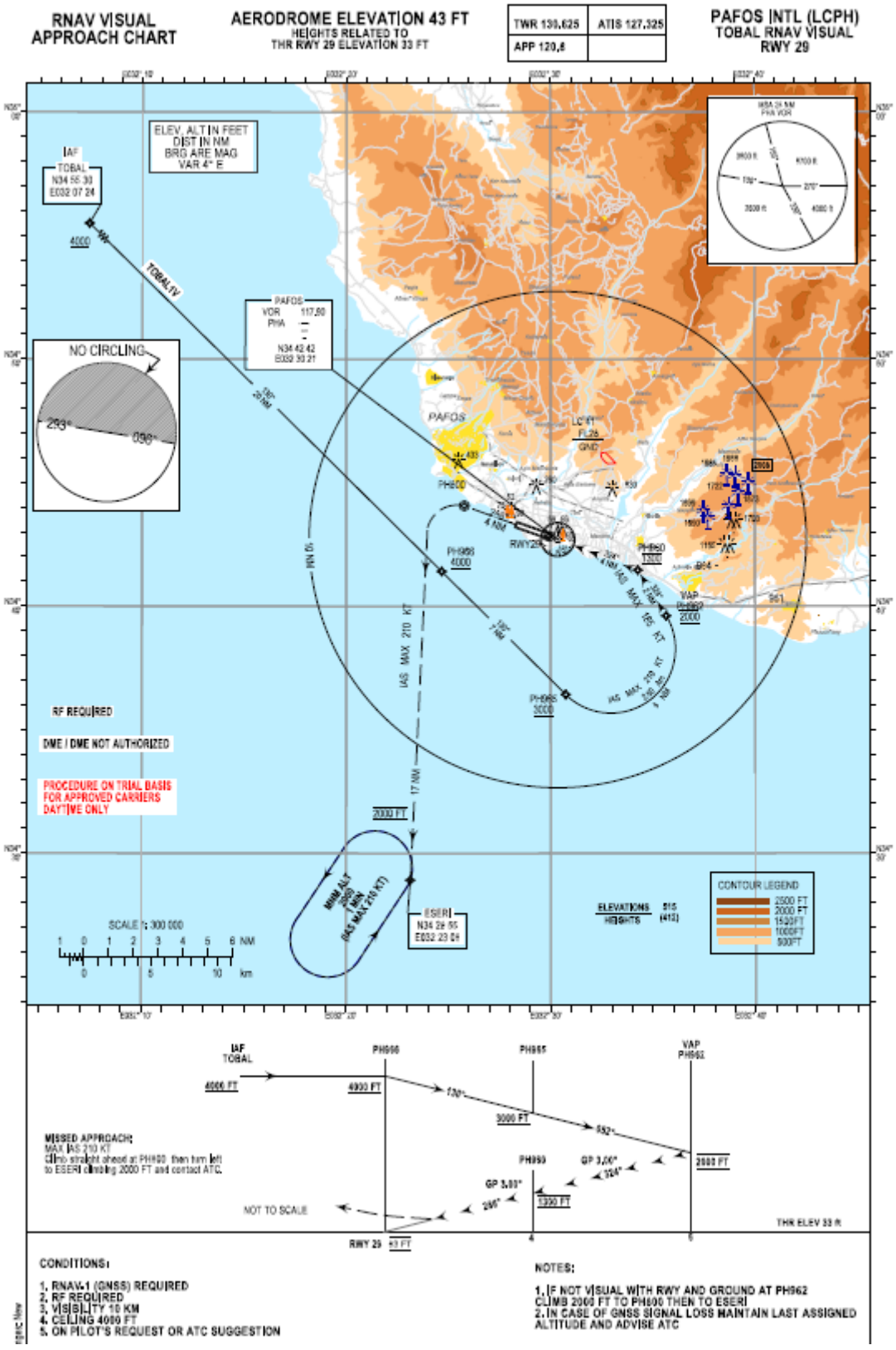


Figure 25 Chart LCPH RNAV Visual TOBAL RWY 29

Appendix D Larnaca (LCLK) approach charts

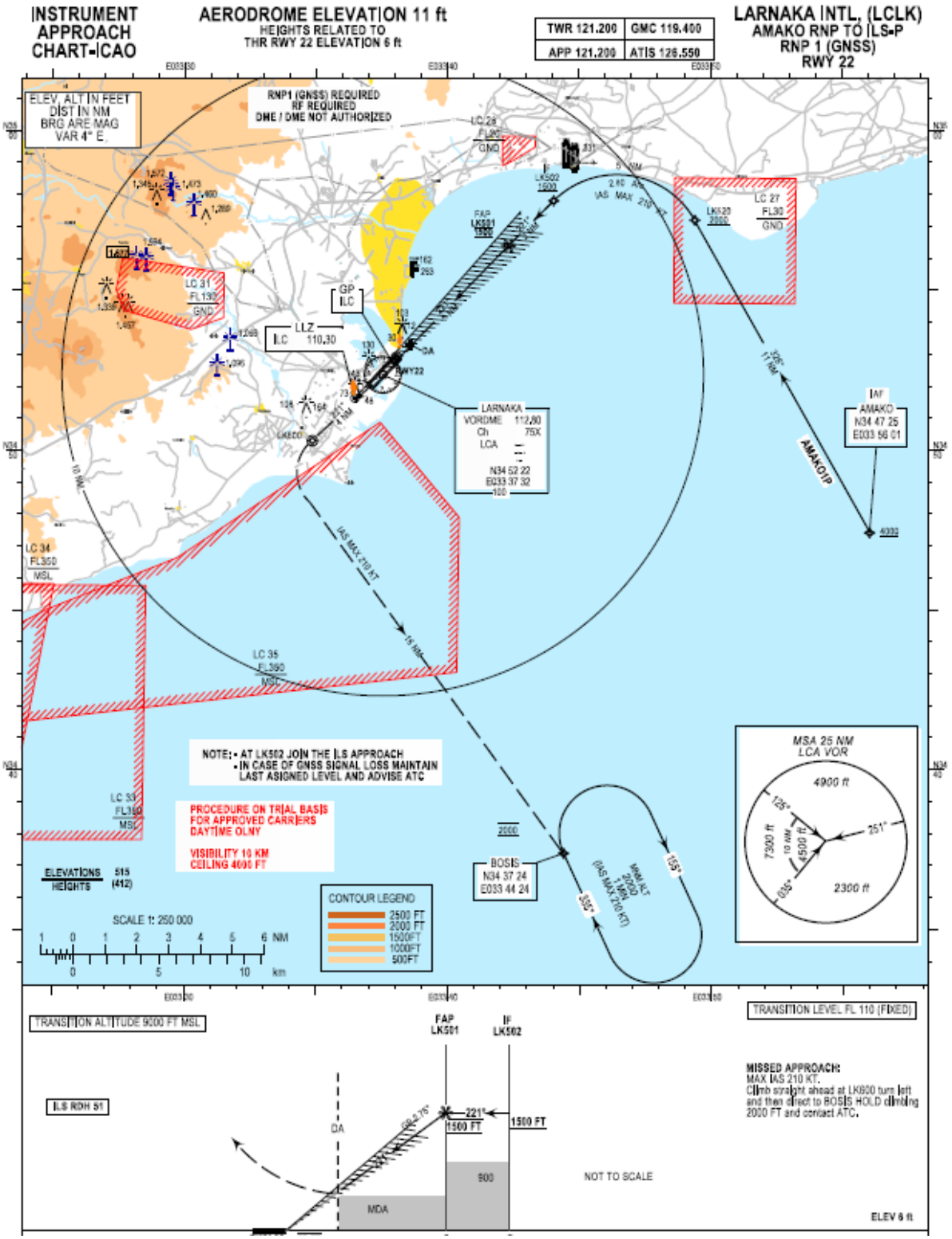


Figure 26 Chart LCLK RNP1 to ILS AMAKO RWY 22

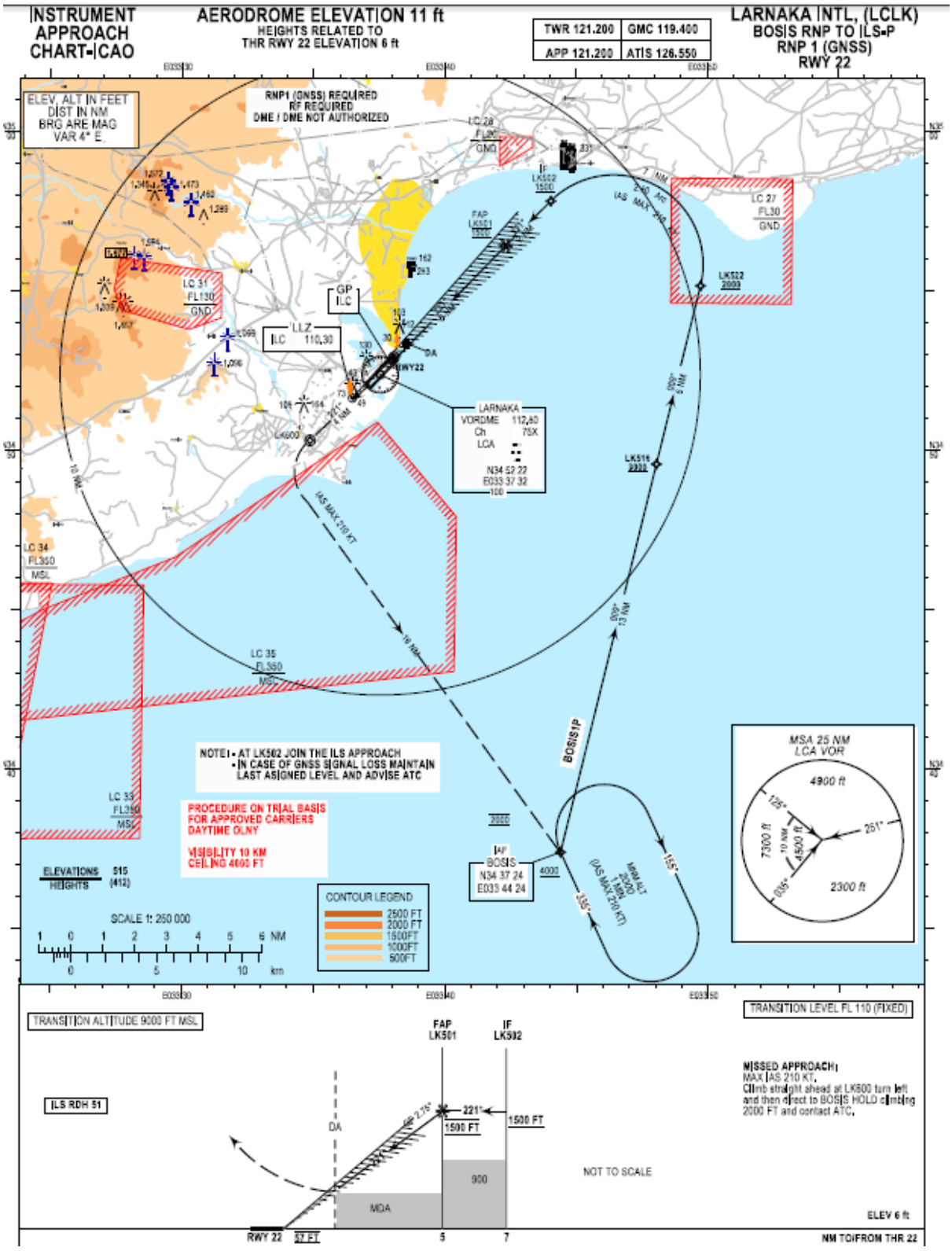


Figure 27 Chart LCLK RNP1 to ILS BOSIS RWY 22

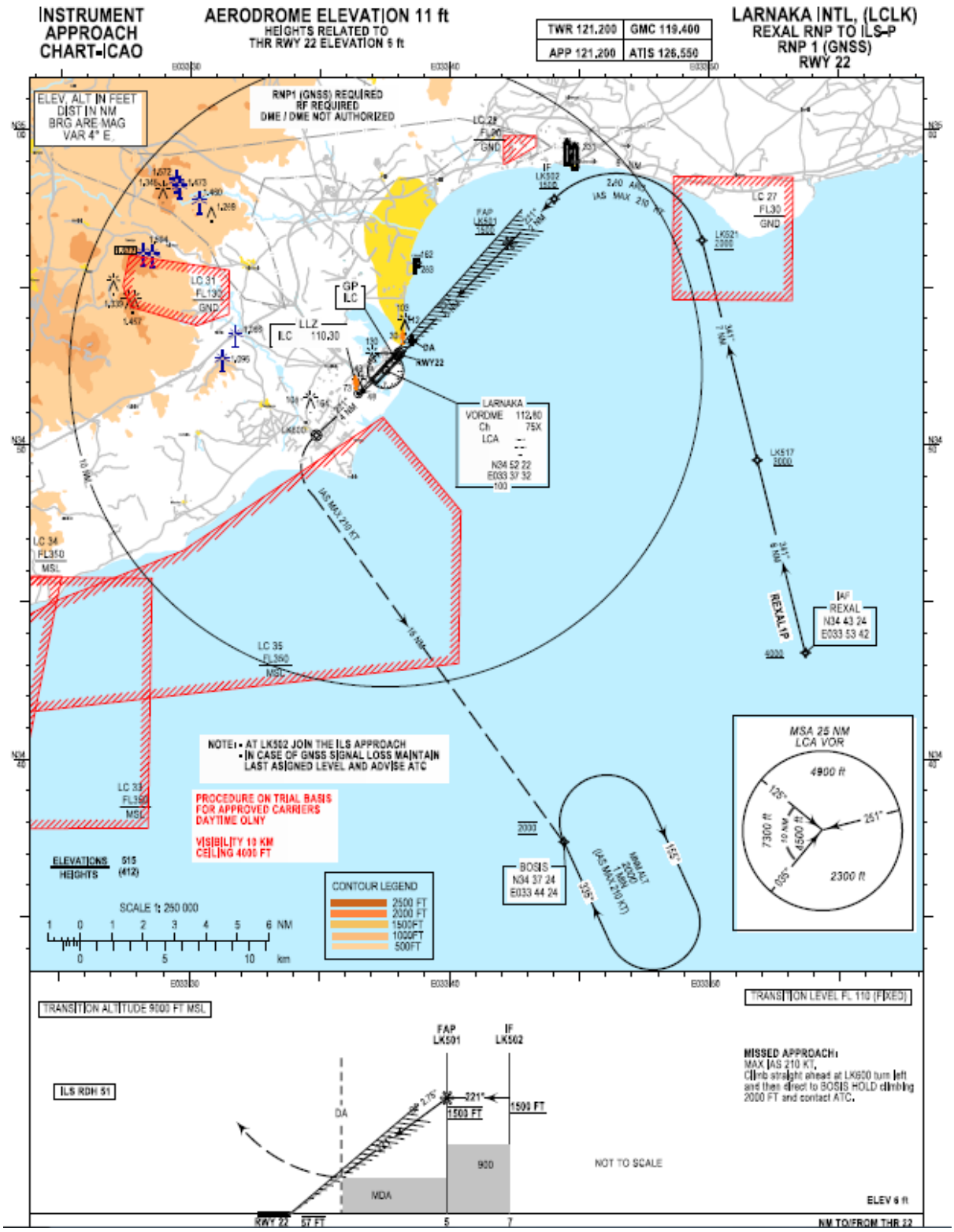


Figure 28 Chart LCLK RNP1 to ILS REXAL RWY 22

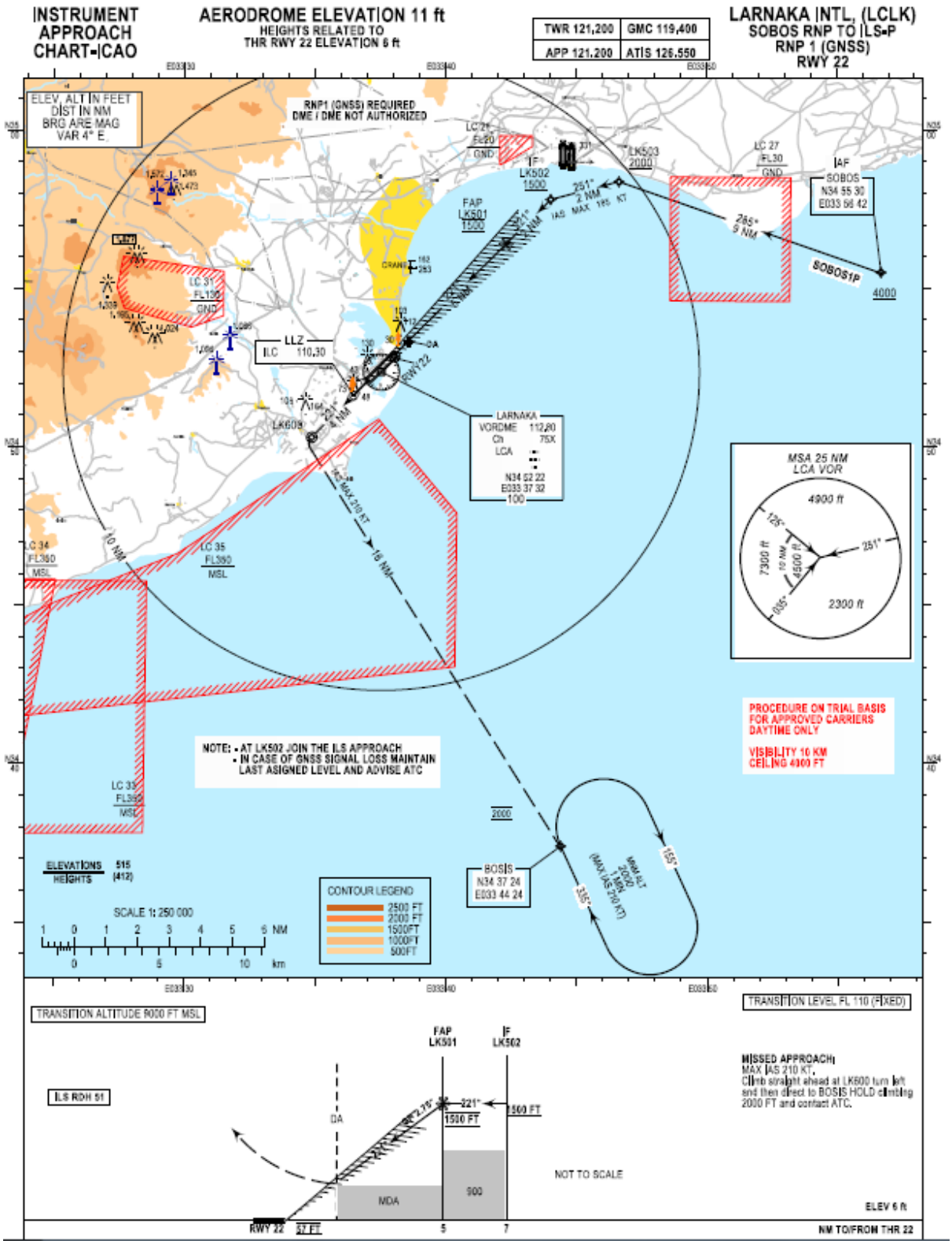


Figure 29 Chart LCLK RNP1 to ILS SOBOS RWY 22

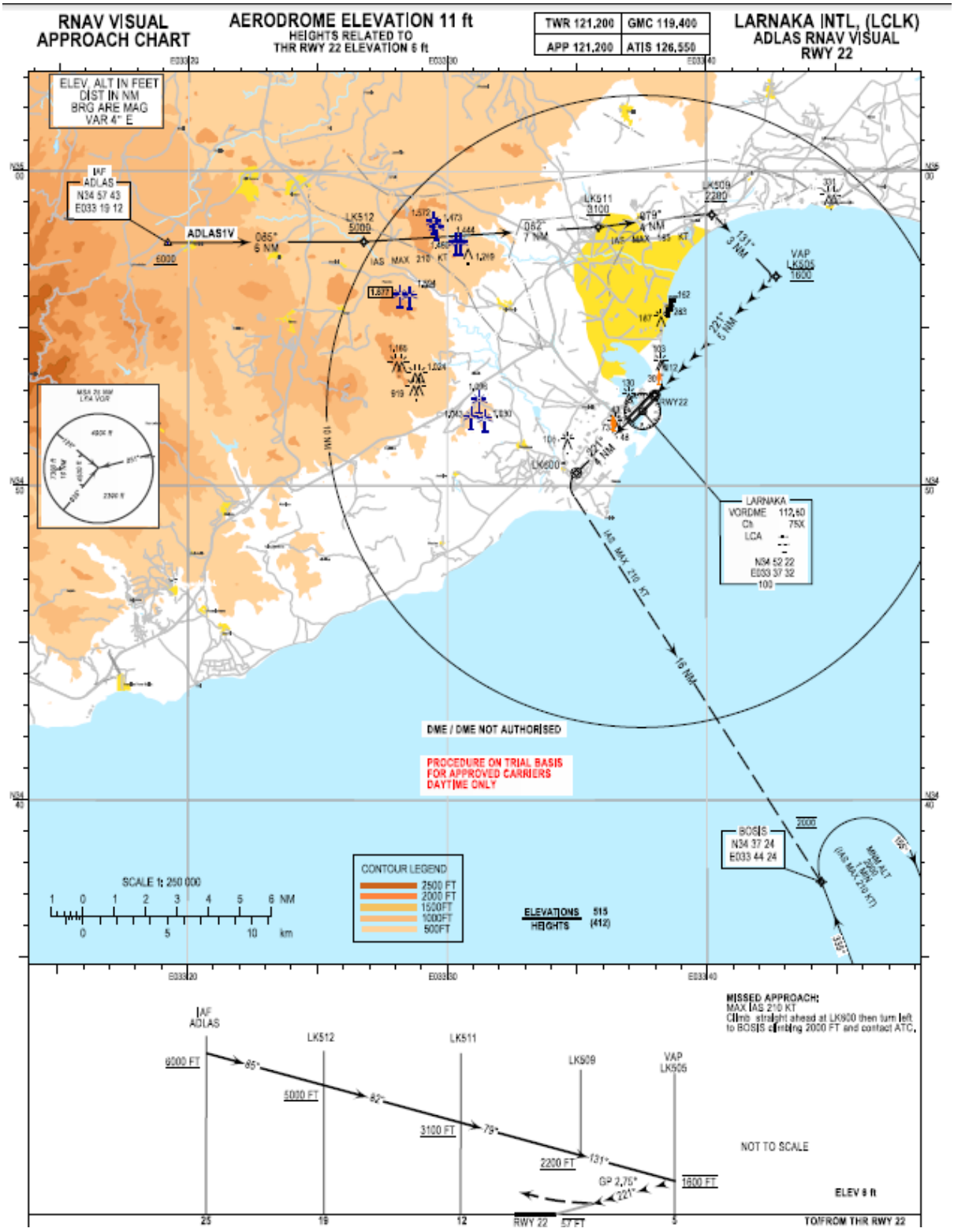


Figure 30 Chart LCLK RNAV Visual ADLAS RWY 22

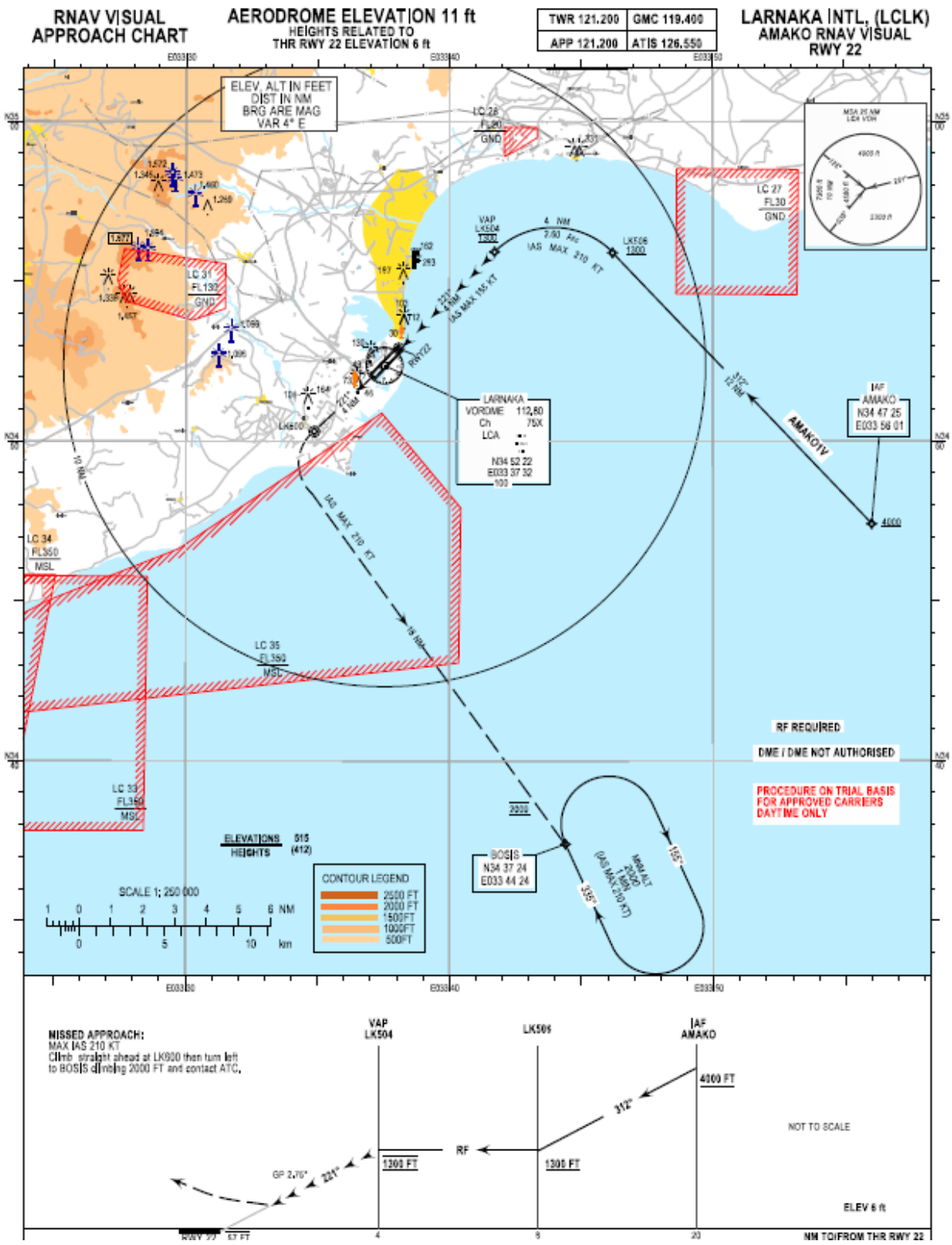


Figure 31 Chart LCLK RNAV Visual AMAKO RWY 22

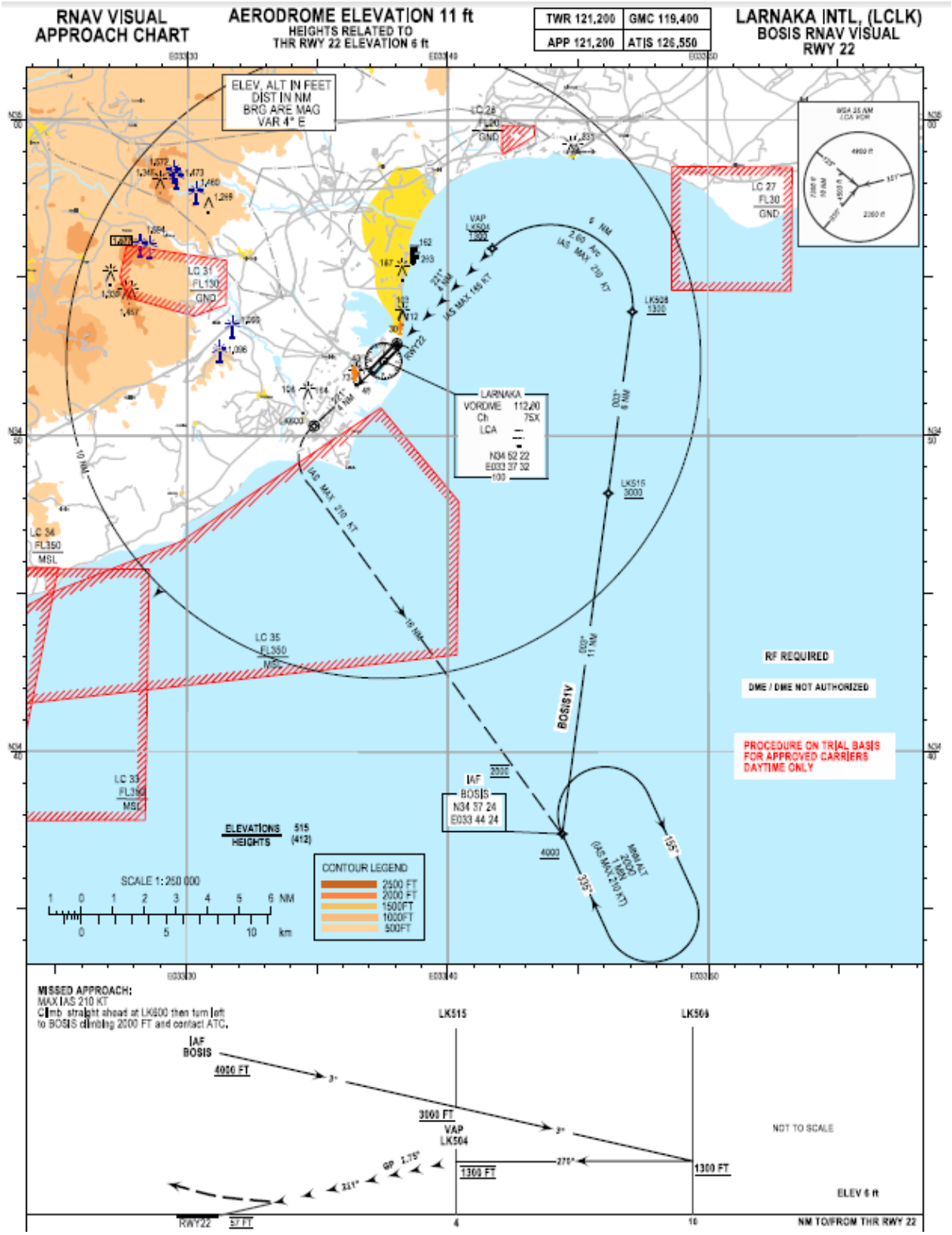


Figure 32 Chart LCLK RNAV Visual BOSIS RWY 22

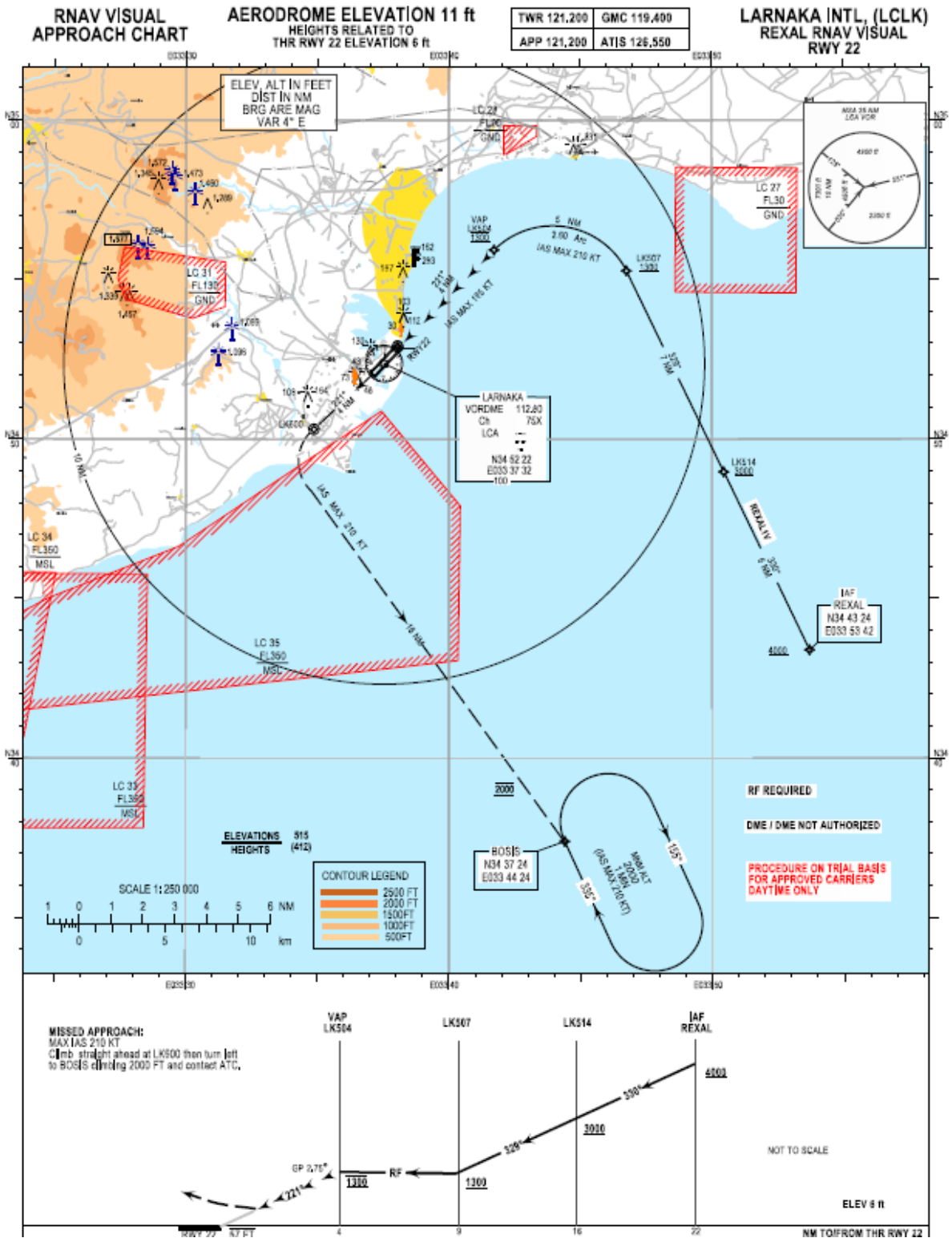


Figure 33 Chart LCLK RNAV Visual REXAL RWY 22

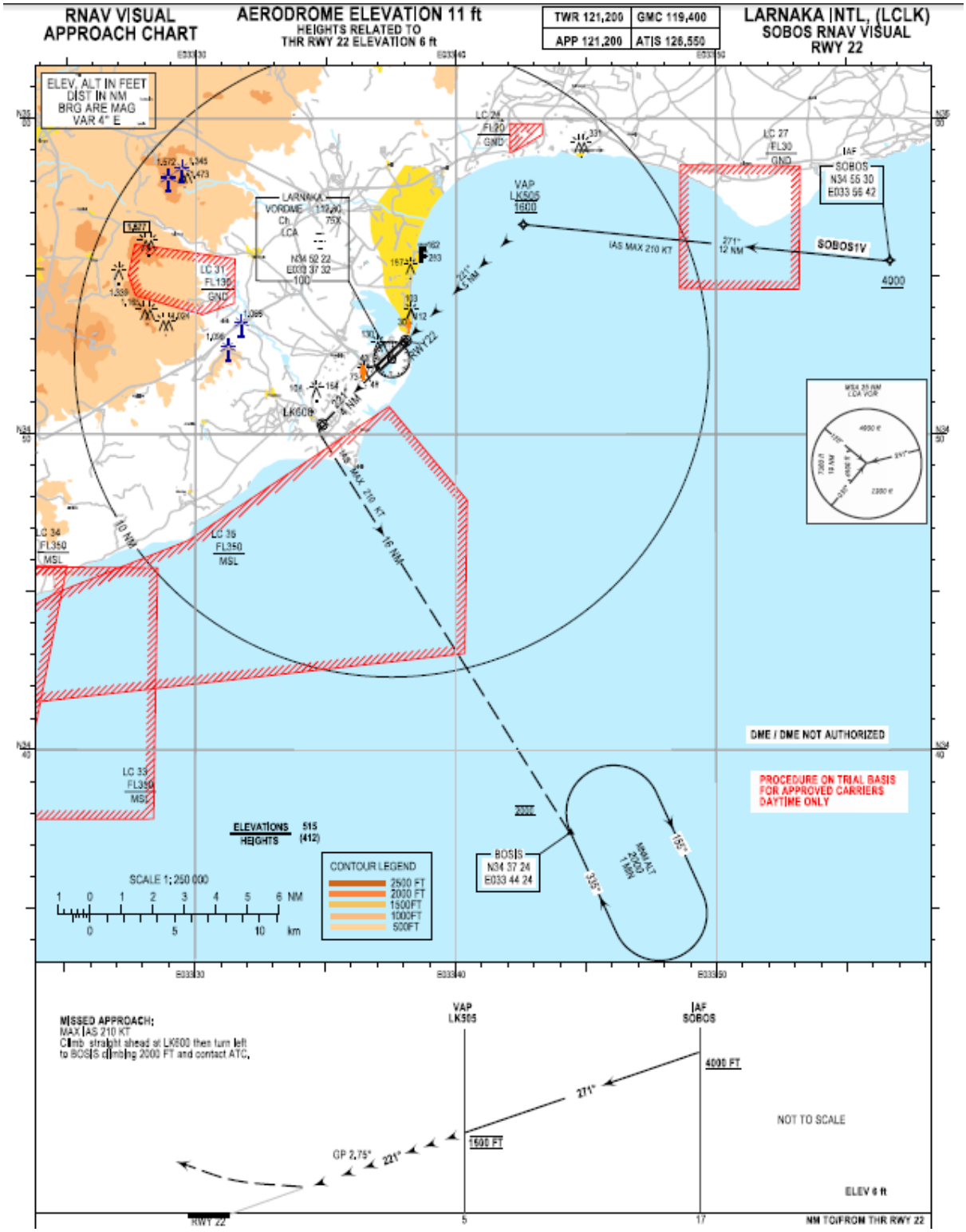


Figure 34 Chart LCLK RNAV Visual SOBOS RWY 22

Appendix E Mykonos (LGMK) approach charts

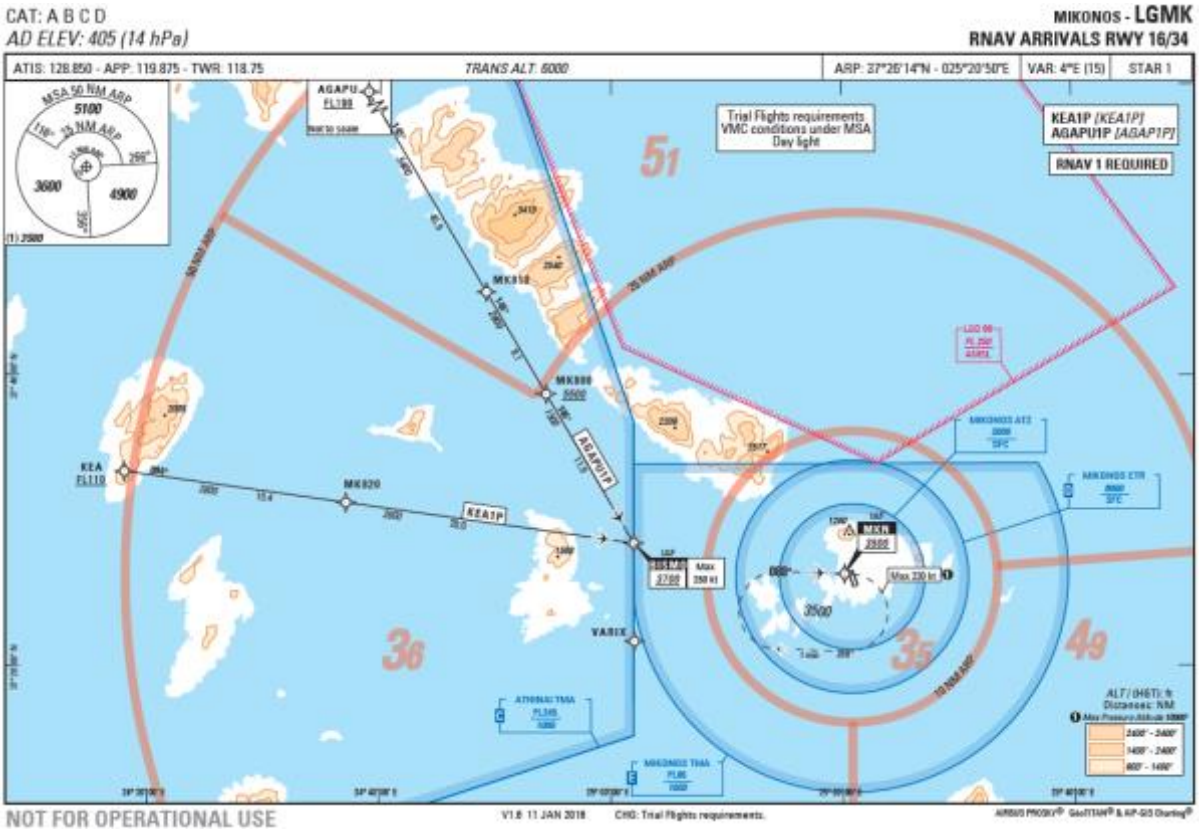


Figure 35 Chart LGMK STAR RWY 16/34

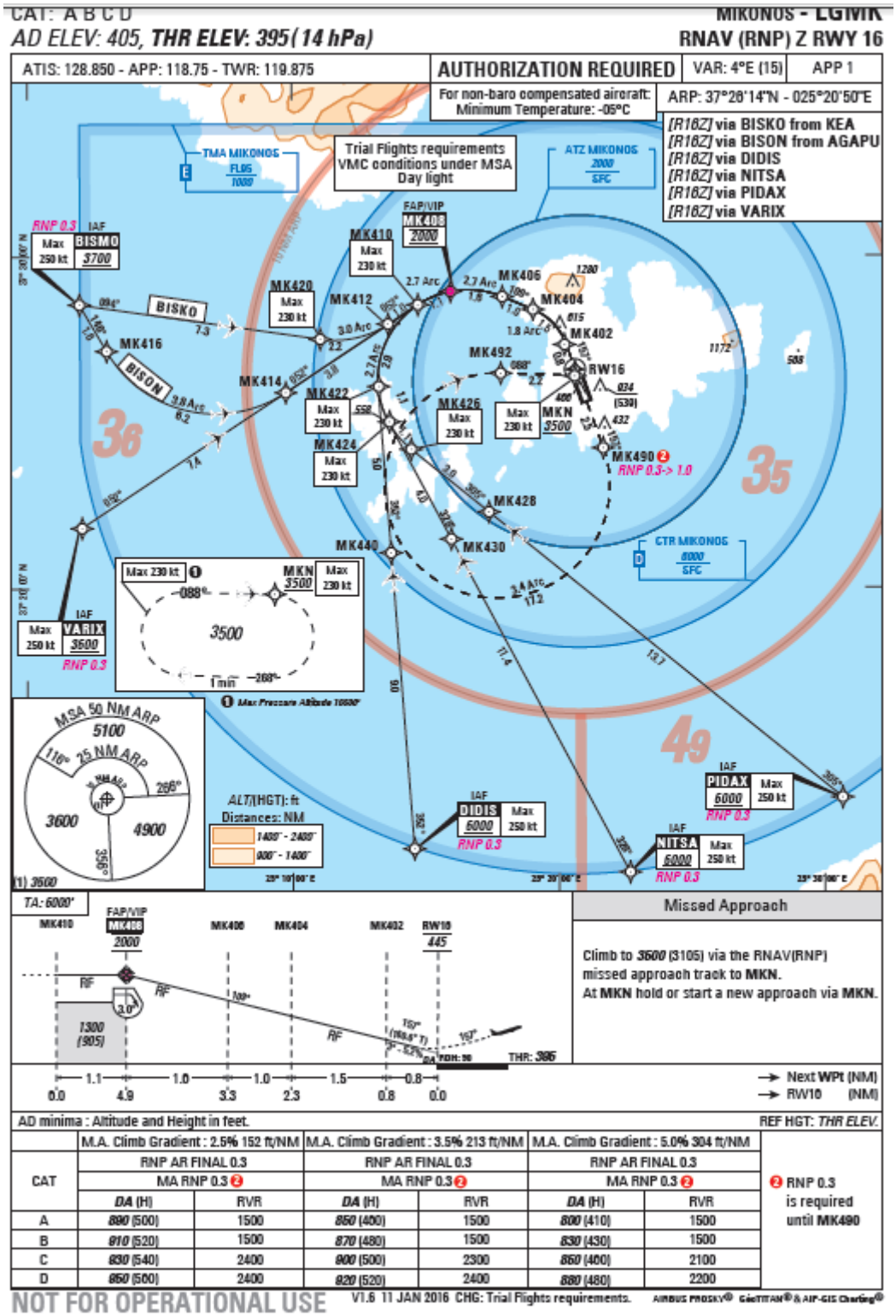


Figure 36 Chart LGMK RNAV (RNP) Z RWY 16

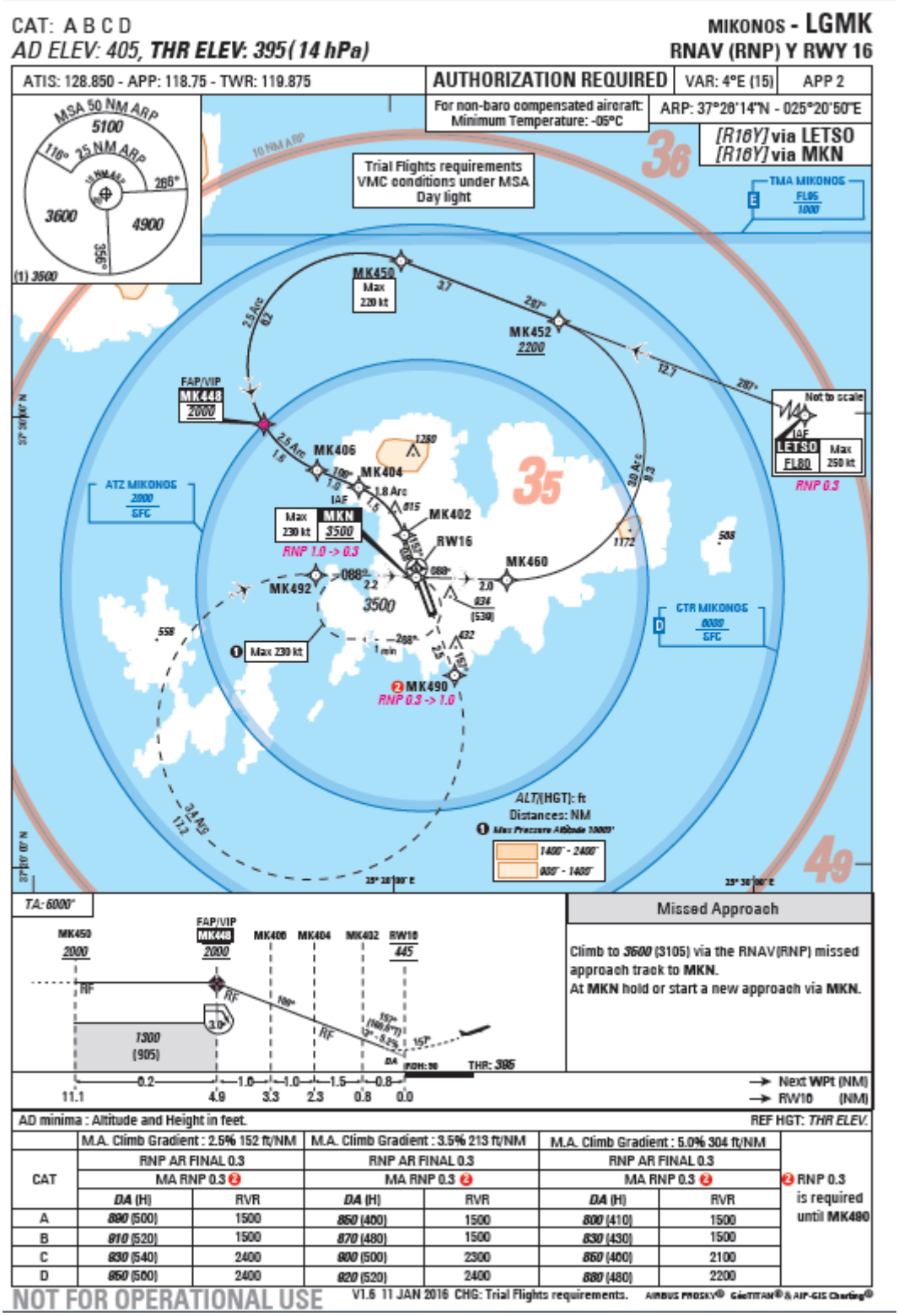


Figure 37 Chart LGMK RNAV (RNP) Y RWY 16

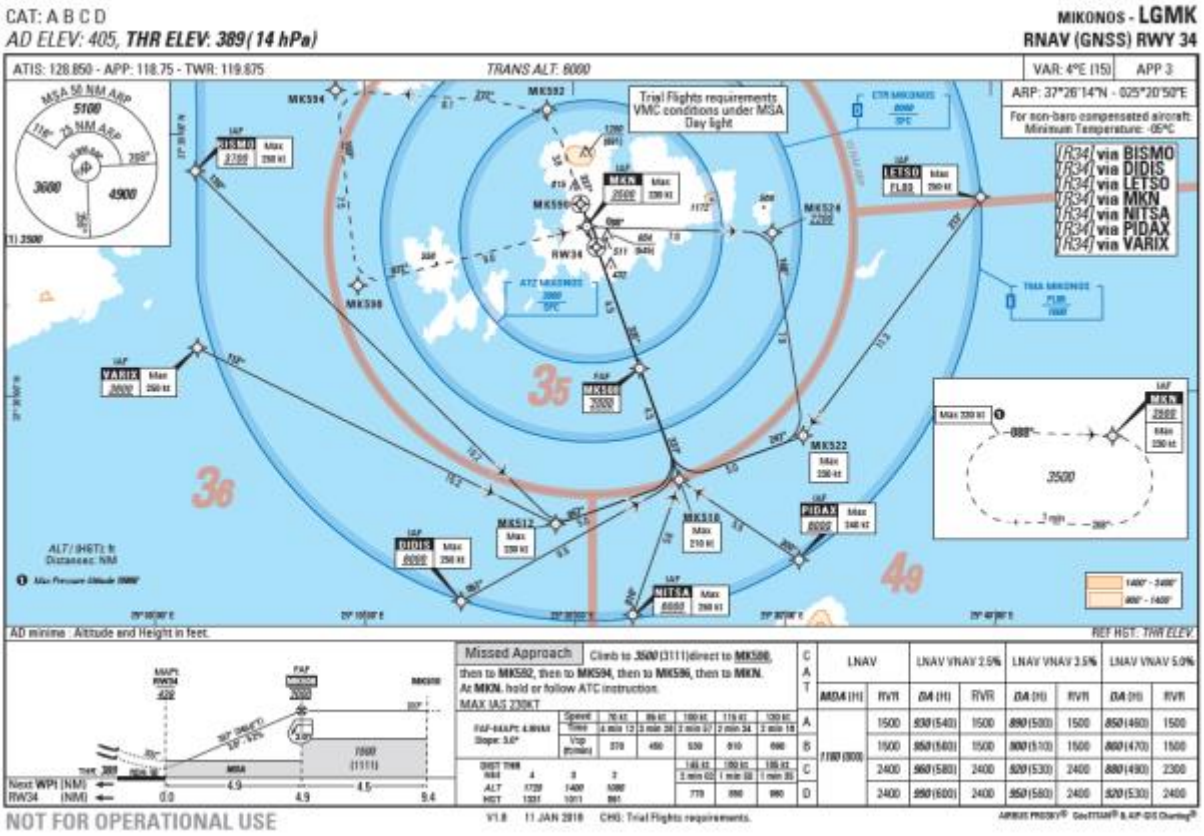


Figure 38 Chart LGMK RNAV (GNSS) RWY 34

Appendix F Santorini (LGSR) approach charts

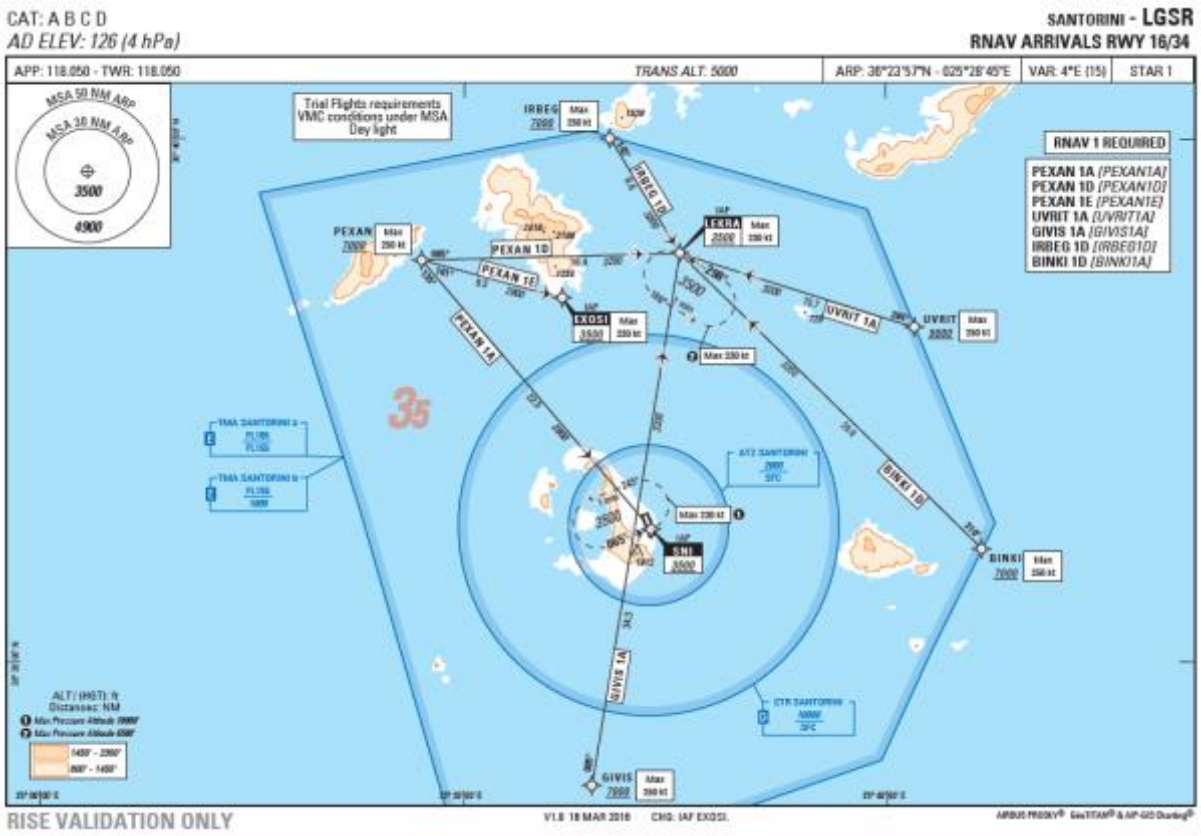


Figure 39 Chart LGSR STAR RWY 16/34

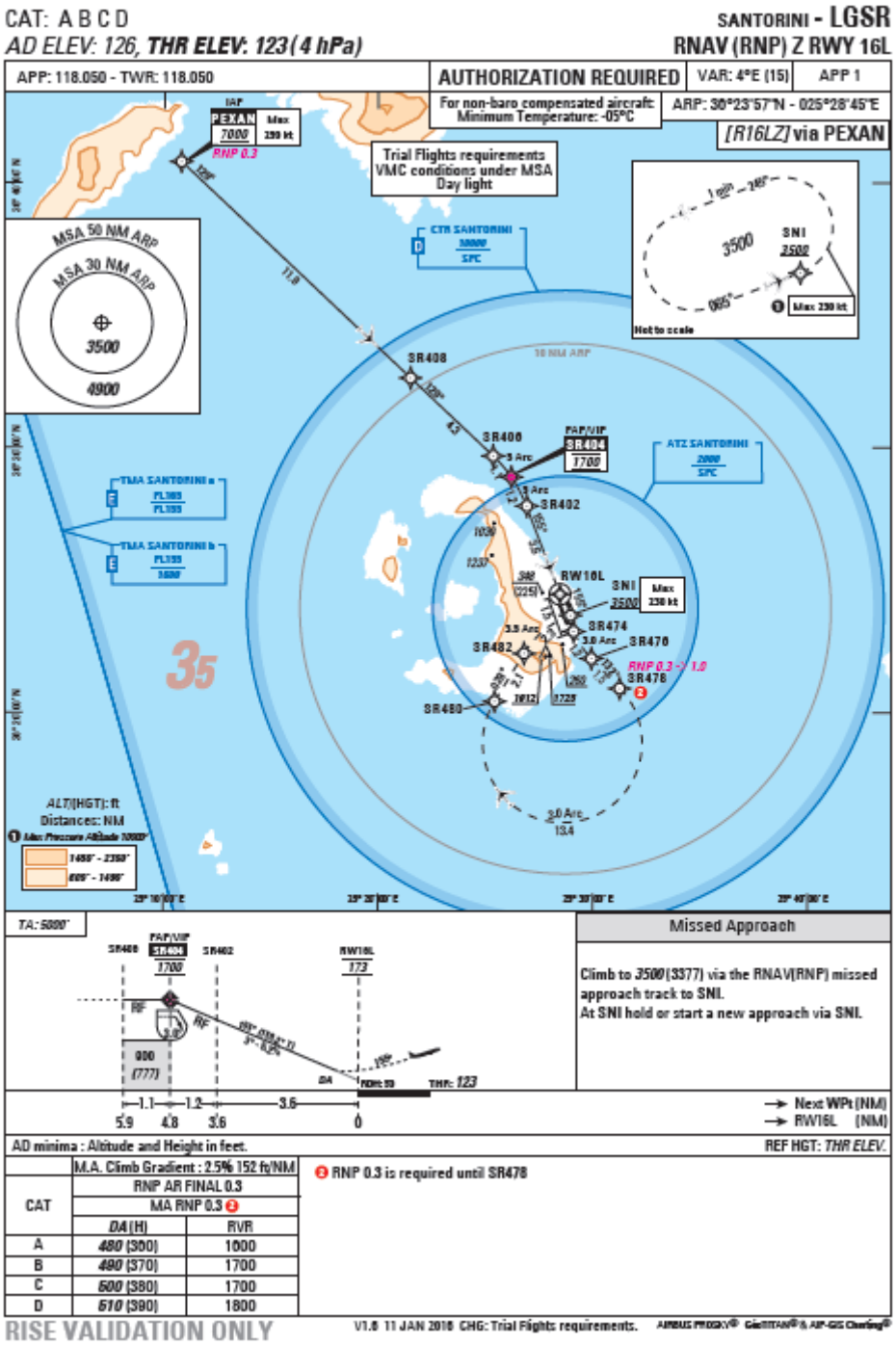


Figure 40 Chart LGSR RNAV (RNP) Z RWY 16L

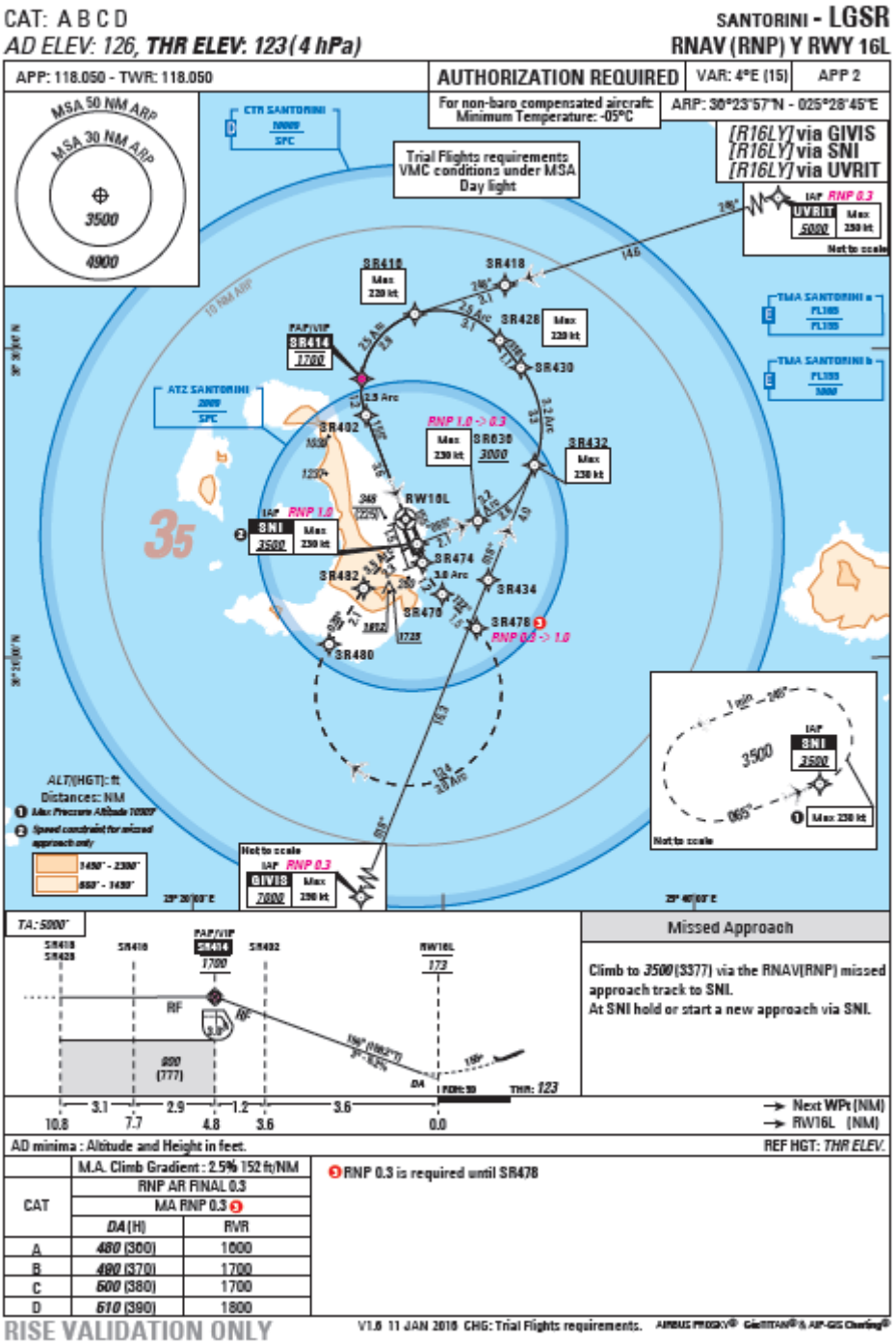


Figure 41 Chart LGSR RNAV (RNP) Y RWY 16L

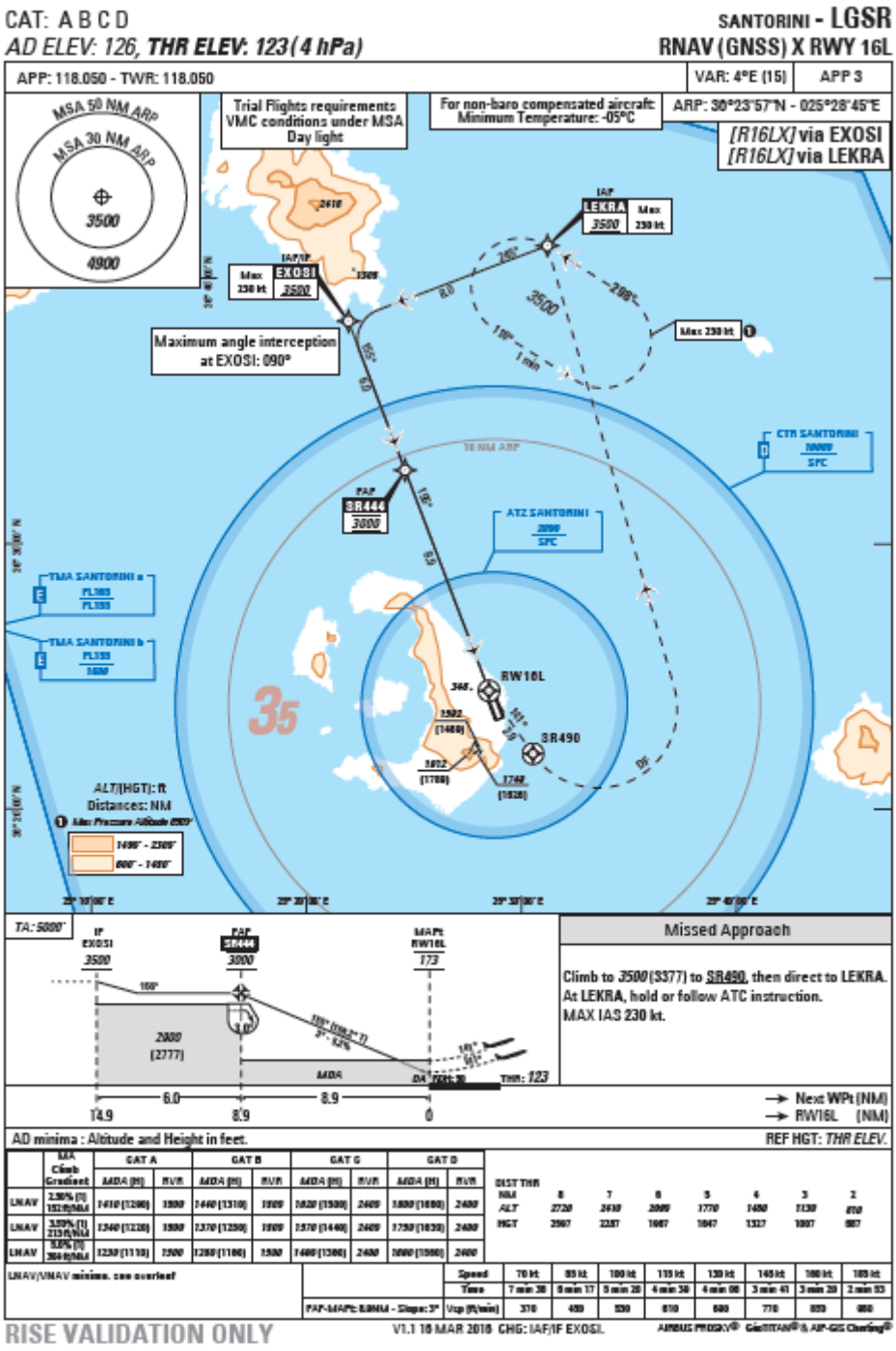


Figure 42 Chart LGSR RNAV (GNSS) X RWY 16L

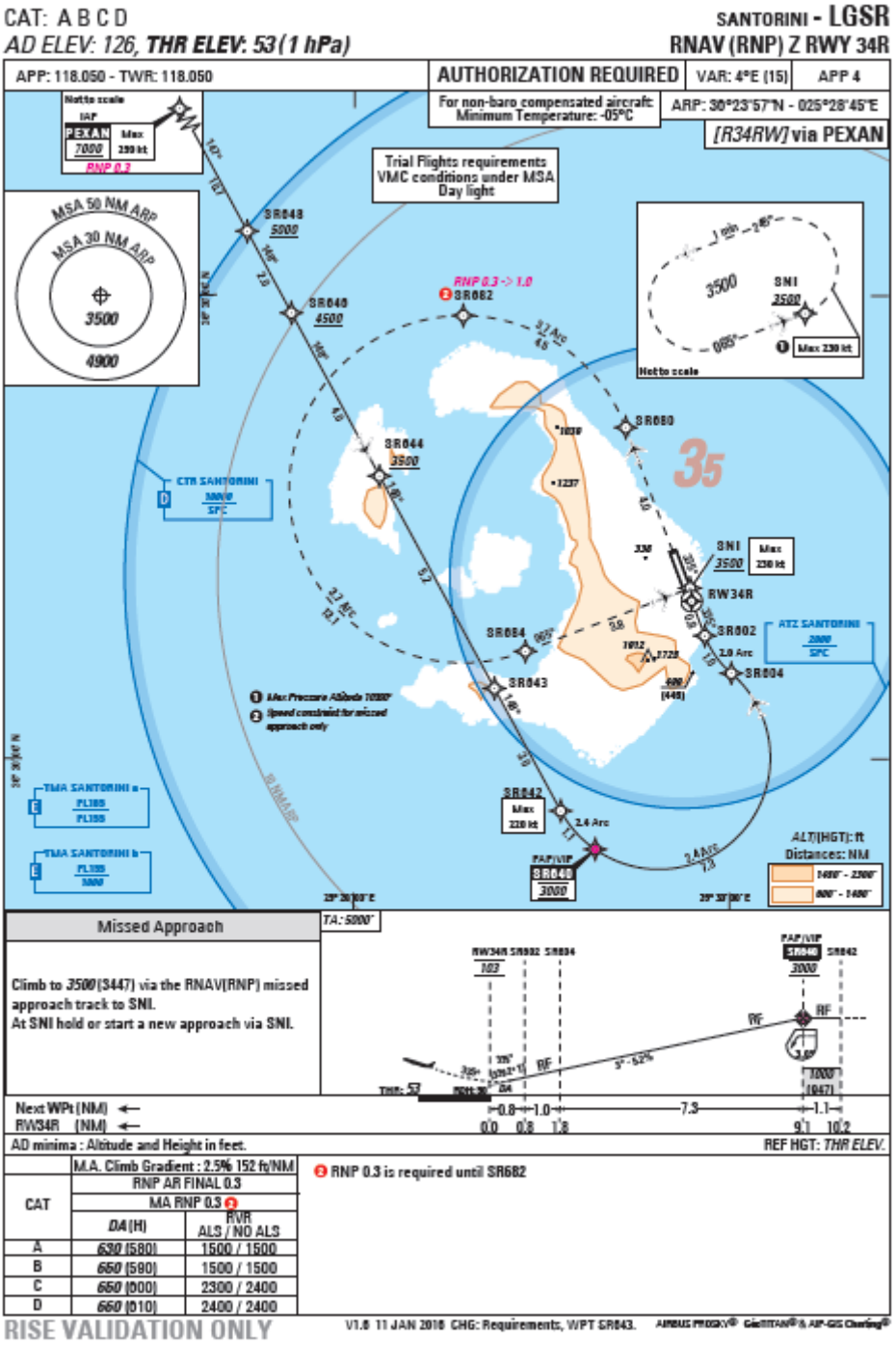


Figure 43 Chart LGSR RNAV (RNP) Z RWY 34R

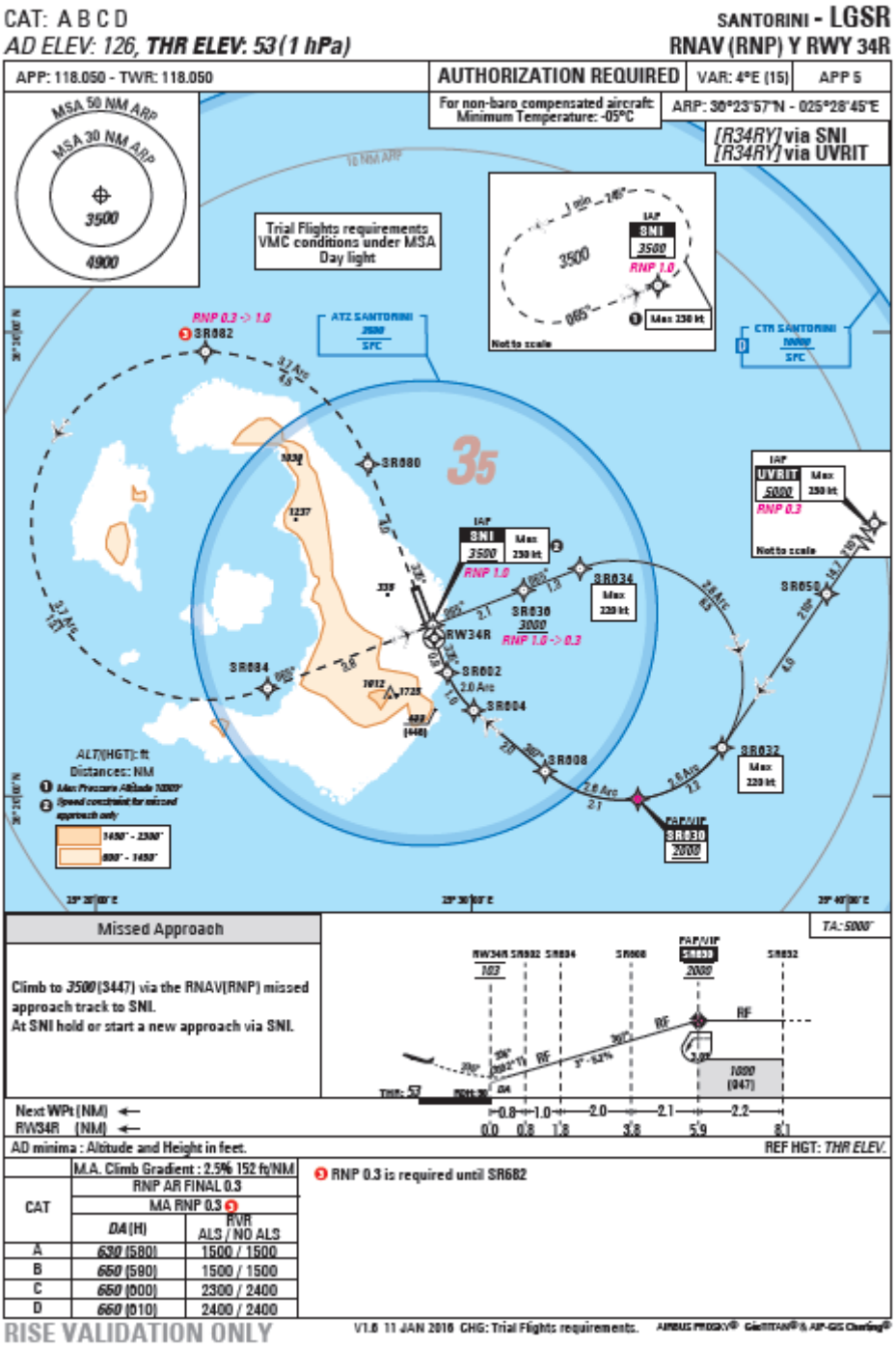


Figure 44 Chart LGSR RNAV (RNP) Y RWY 34R

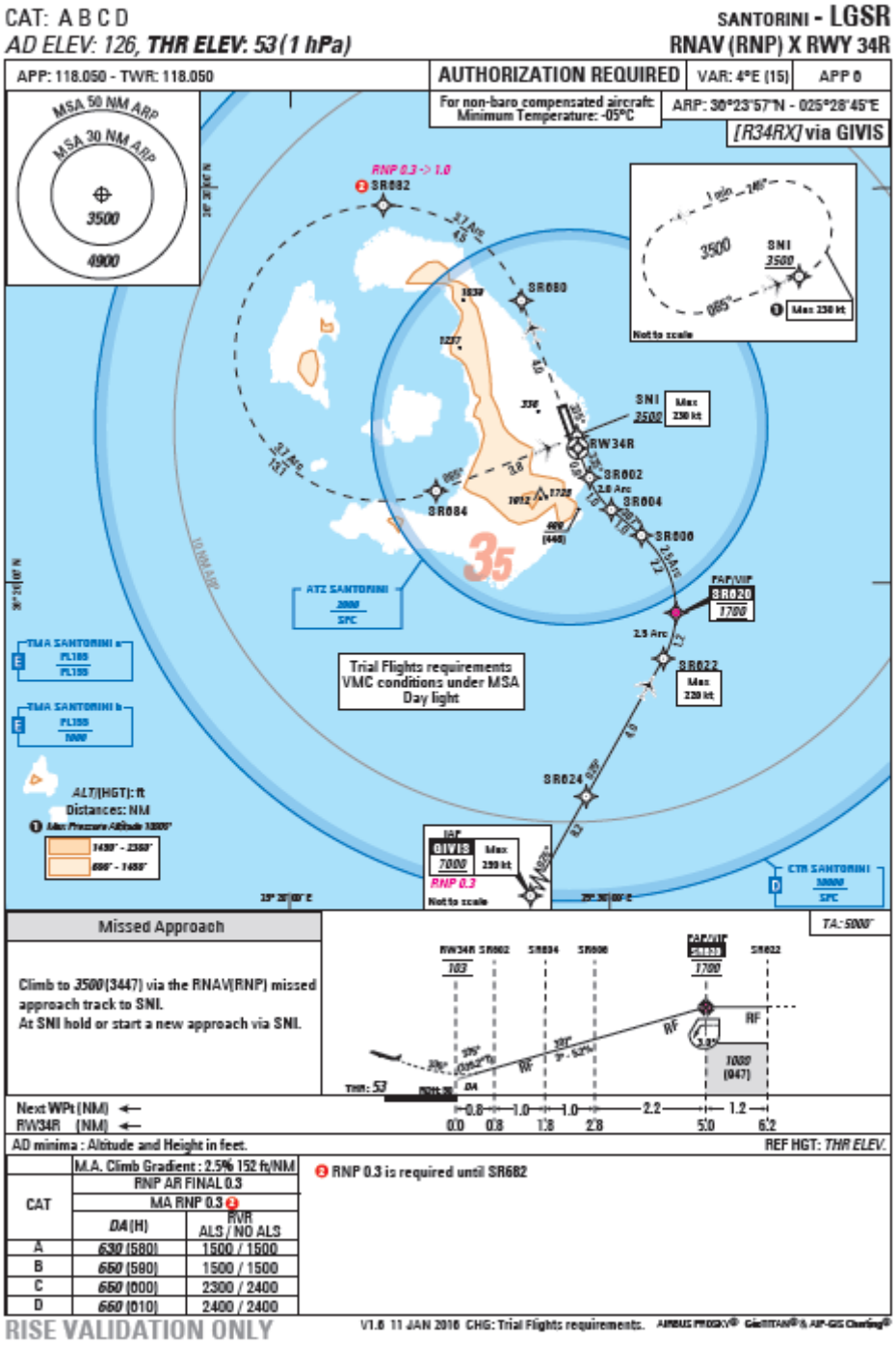


Figure 45 Chart LGSR RNAV (RNP) X RWY 34R

Appendix G Iraklion (LGIR) approach charts

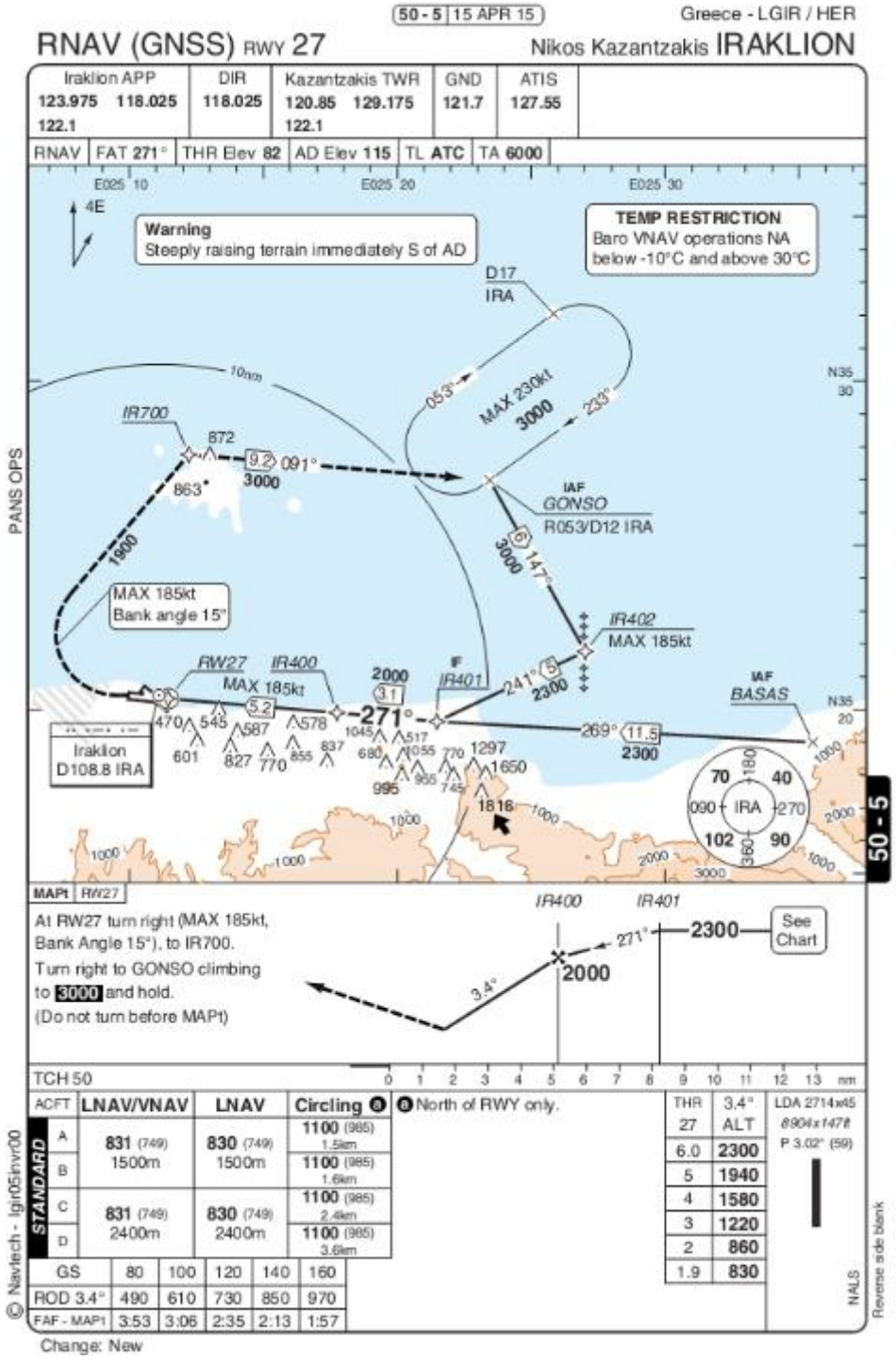


Figure 46 Chart LGIR RNAV (GNSS) RWY 27

Appendix H Corfu (LGKR) approach charts

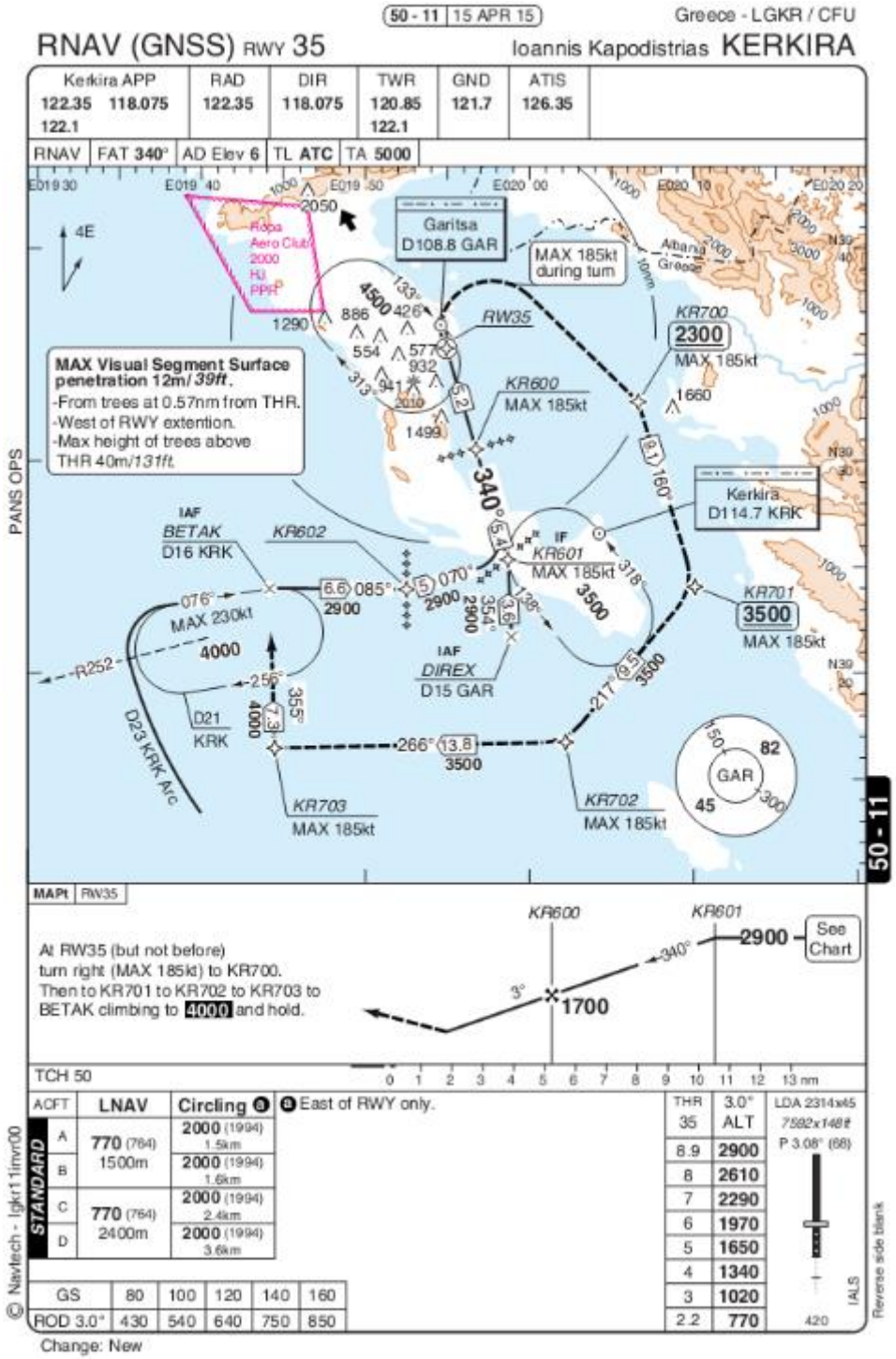


Figure 47 Chart LGKR RNAV (GNSS) RWY 35

Appendix I Madeira (LPMA) approach charts

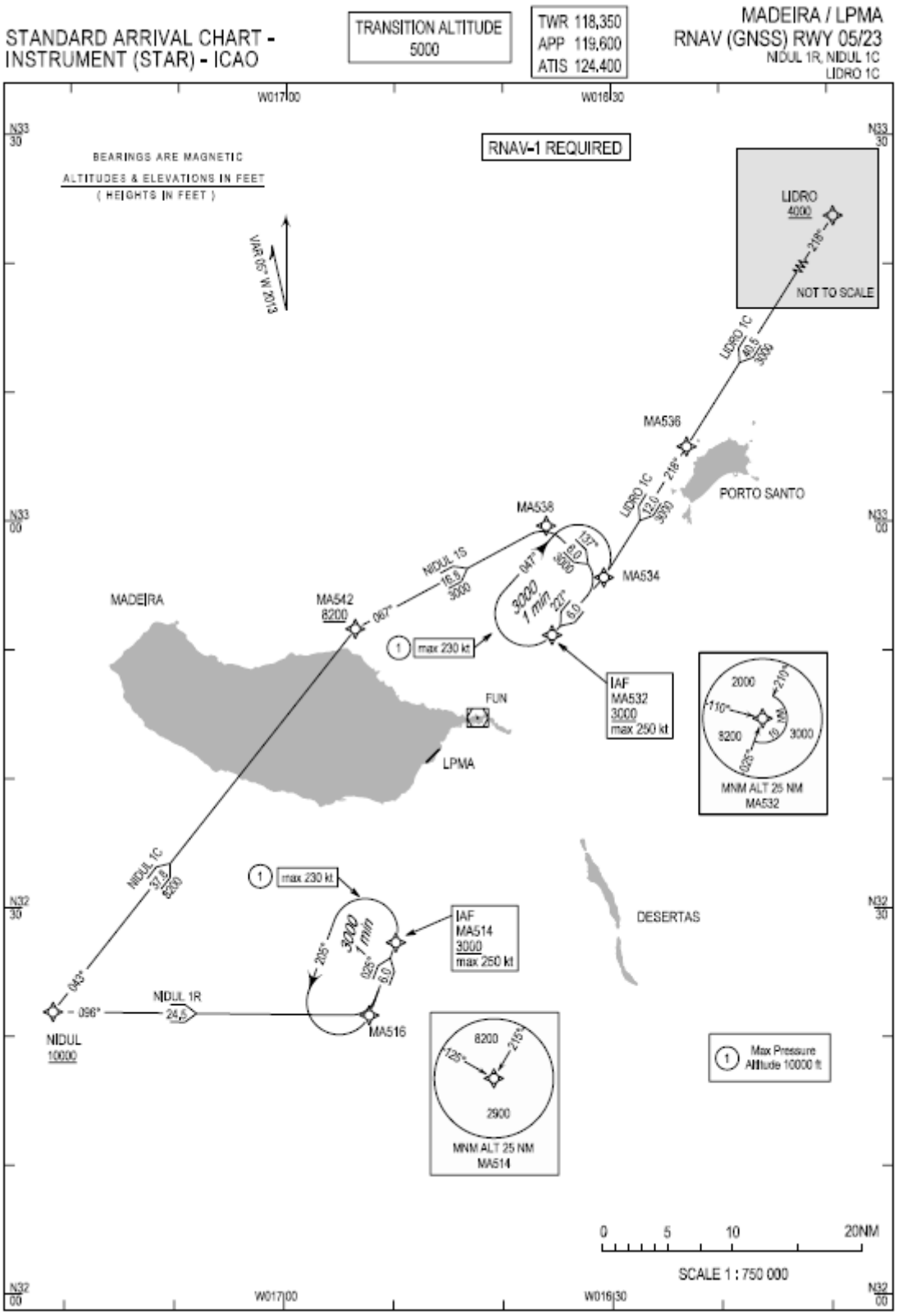
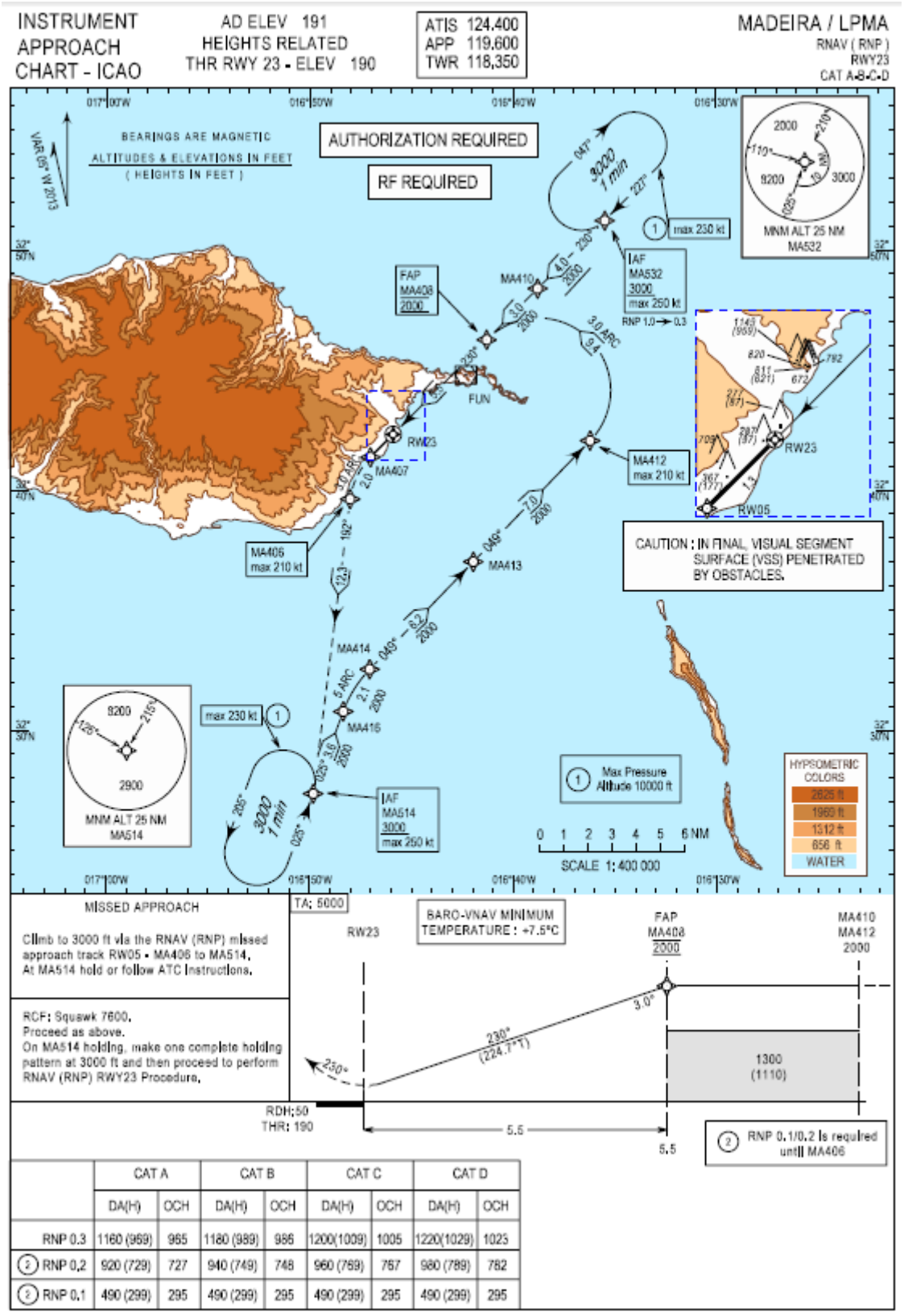


Figure 48 Chart LPMA STAR RWY 05/23



	CAT A		CAT B		CAT C		CAT D	
	DA(H)	OCH	DA(H)	OCH	DA(H)	OCH	DA(H)	OCH
RNP 0.3	1160 (959)	955	1180 (989)	986	1200(1009)	1005	1220(1029)	1023
(2) RNP 0.2	920 (729)	727	940 (749)	748	960 (769)	767	980 (789)	782
(2) RNP 0.1	490 (299)	295	490 (299)	295	490 (299)	295	490 (299)	295

Figure 49 Chart LPMA RNAV (RNP) RWY 23

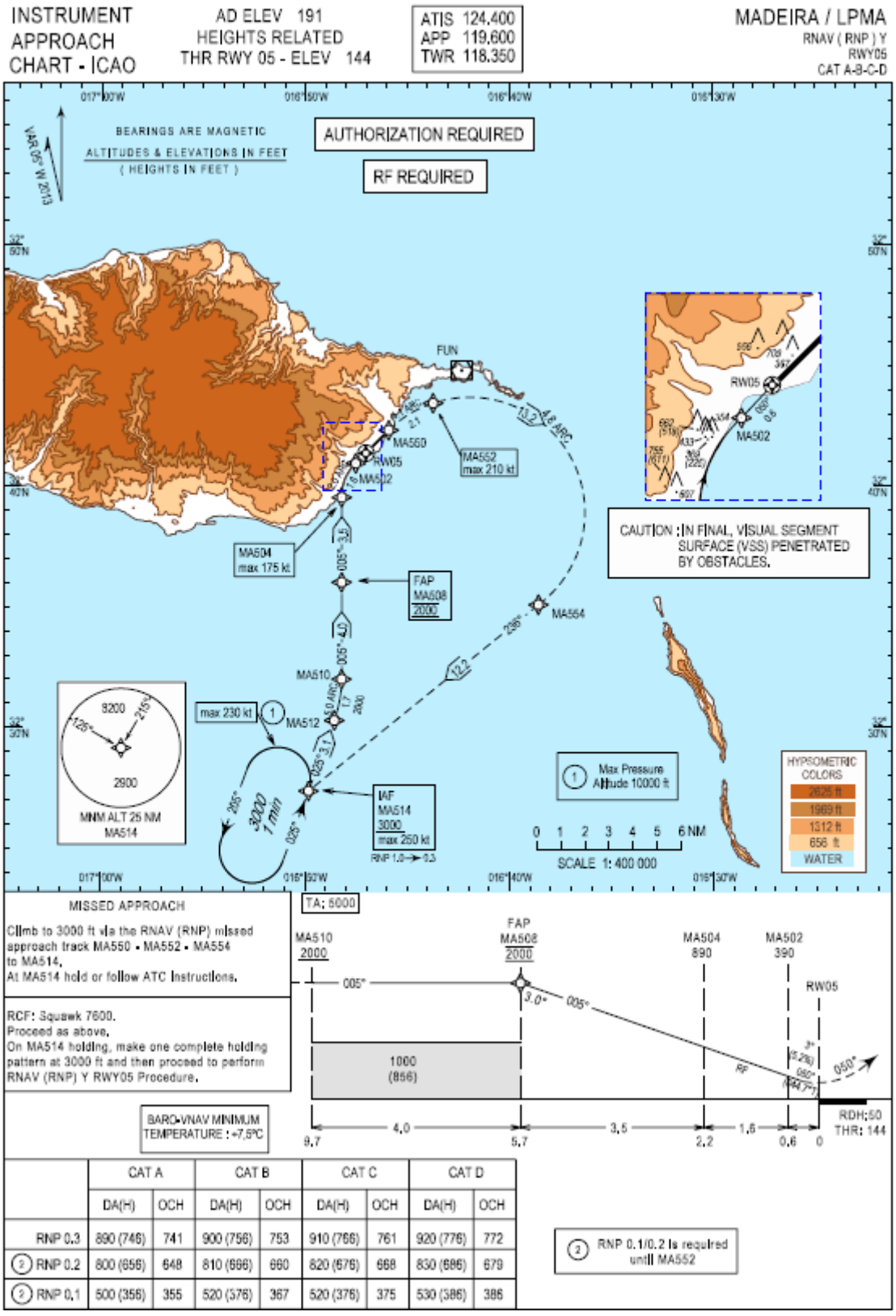


Figure 50 Chart LPMA RNAV (RNP) Y RWY 05

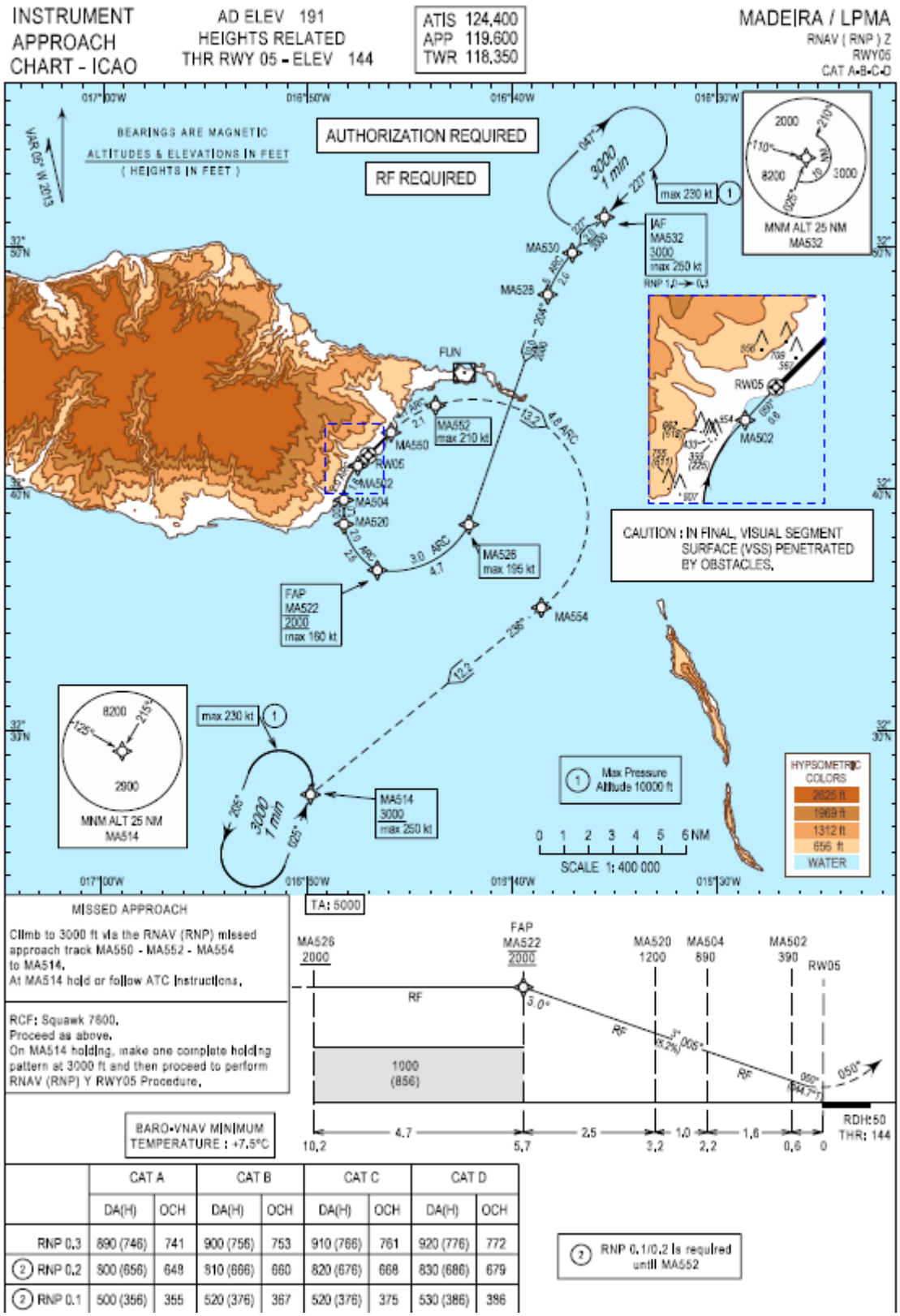


Figure 51 Chart LPMA RNAV (RNP) Z RWY 05

Appendix J Madeira (LPMA):TAP Portugal safety report

Rise Trials - Safety Report.PDF

Appendix K Horta (LPHR) approach charts

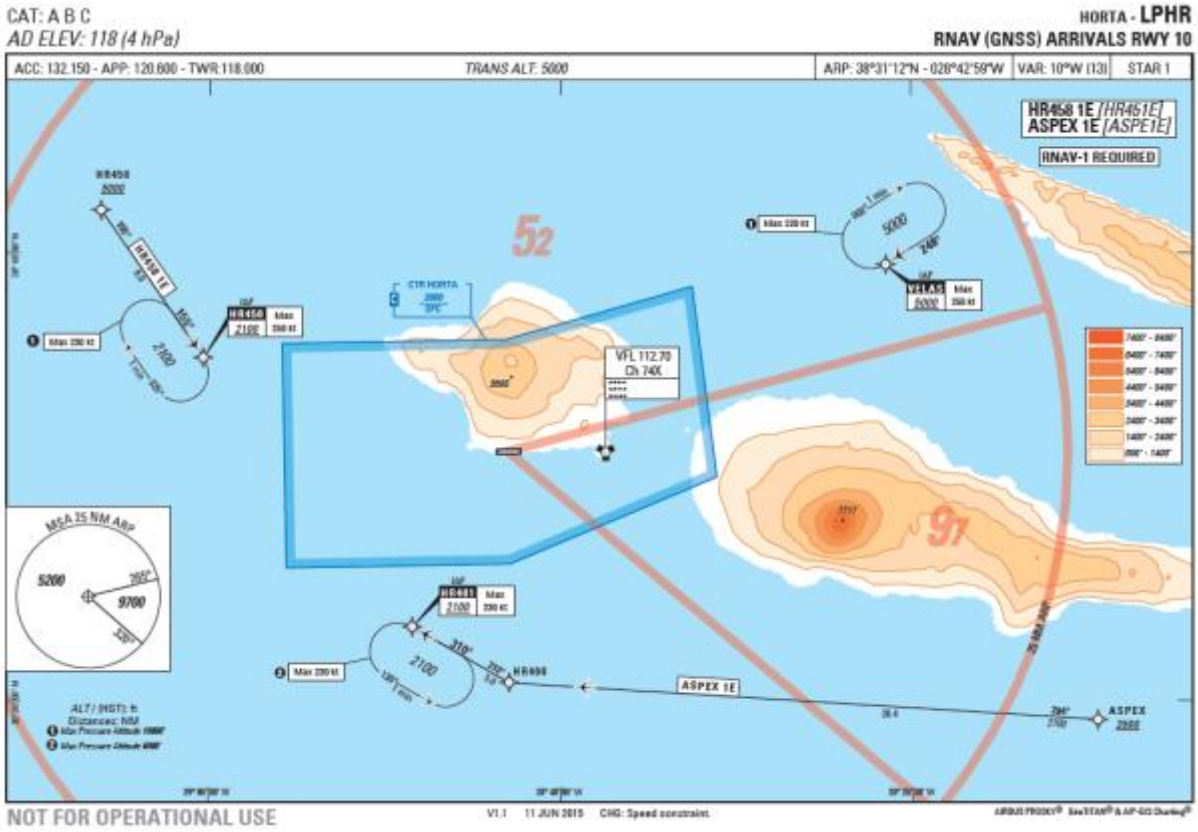


Figure 52 Chart LPHR STAR RWY 10

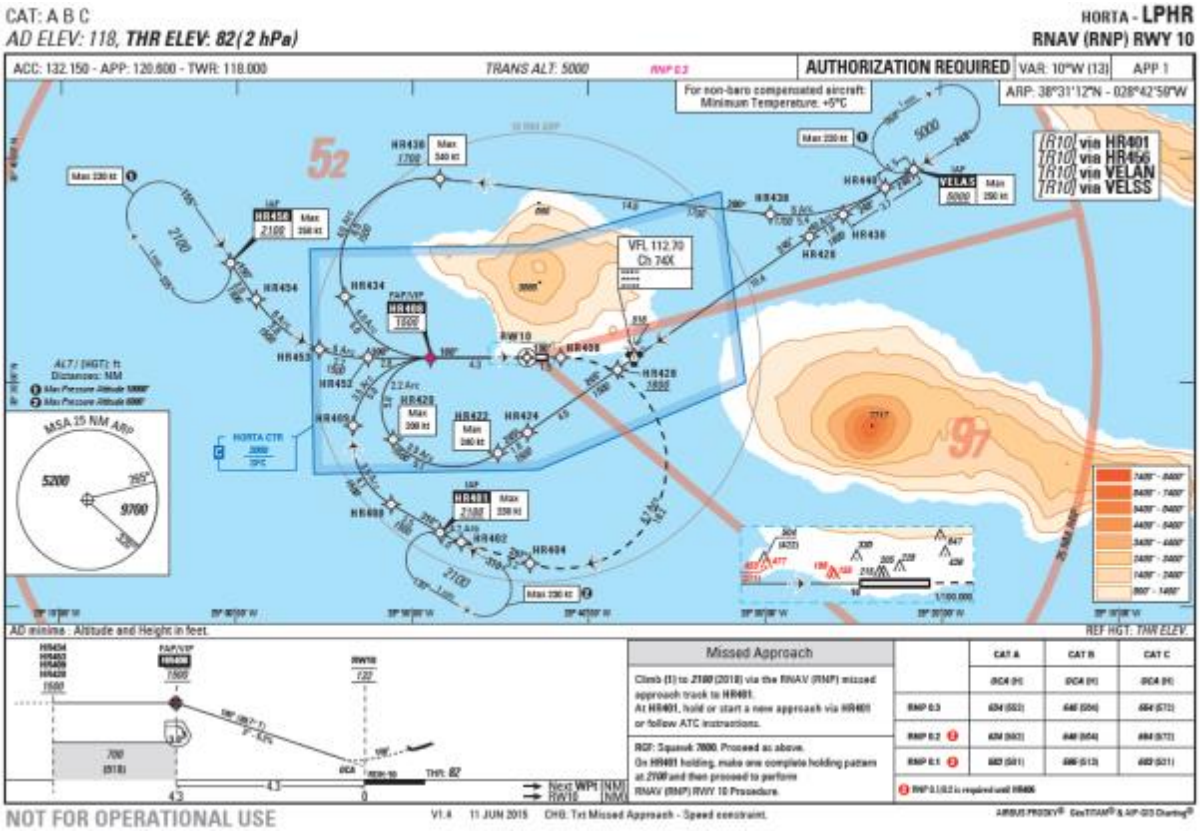


Figure 53 Chart LPHR RNAV (RNP) RWY 10

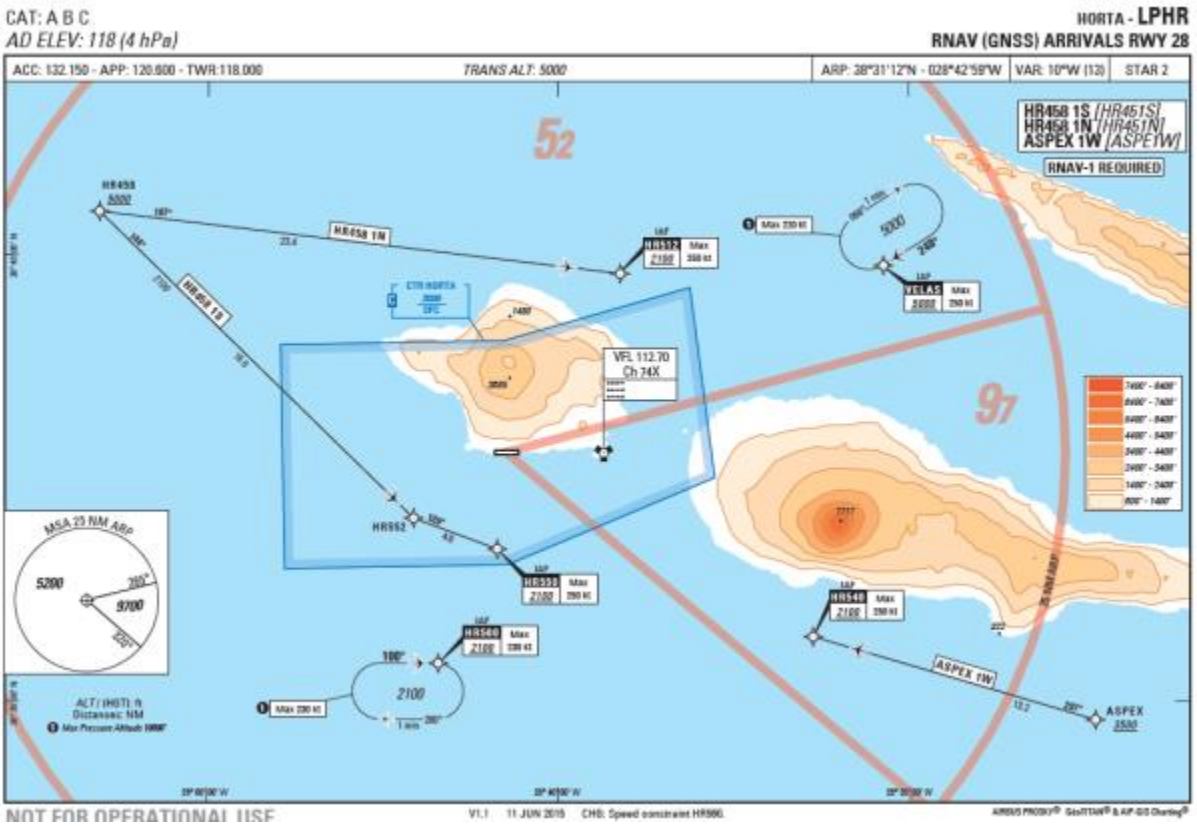


Figure 54 Chart LPHR STAR RWY 28

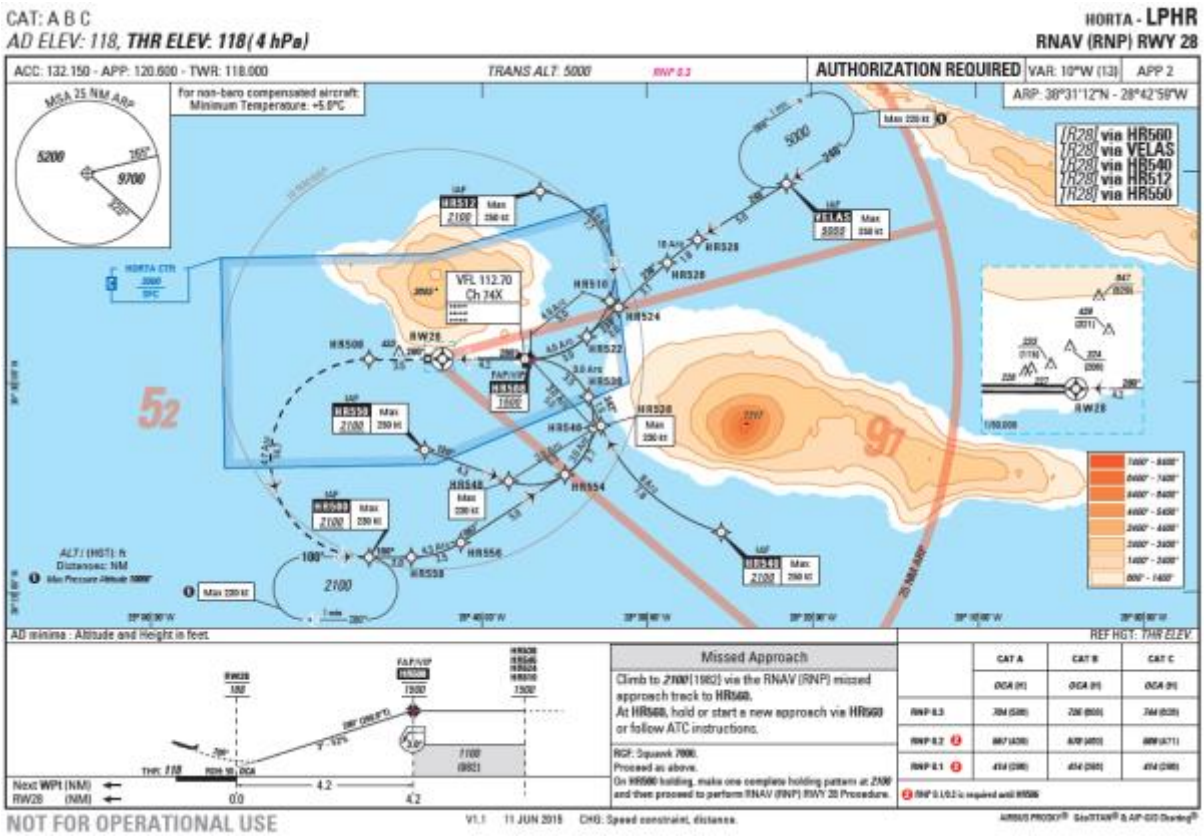
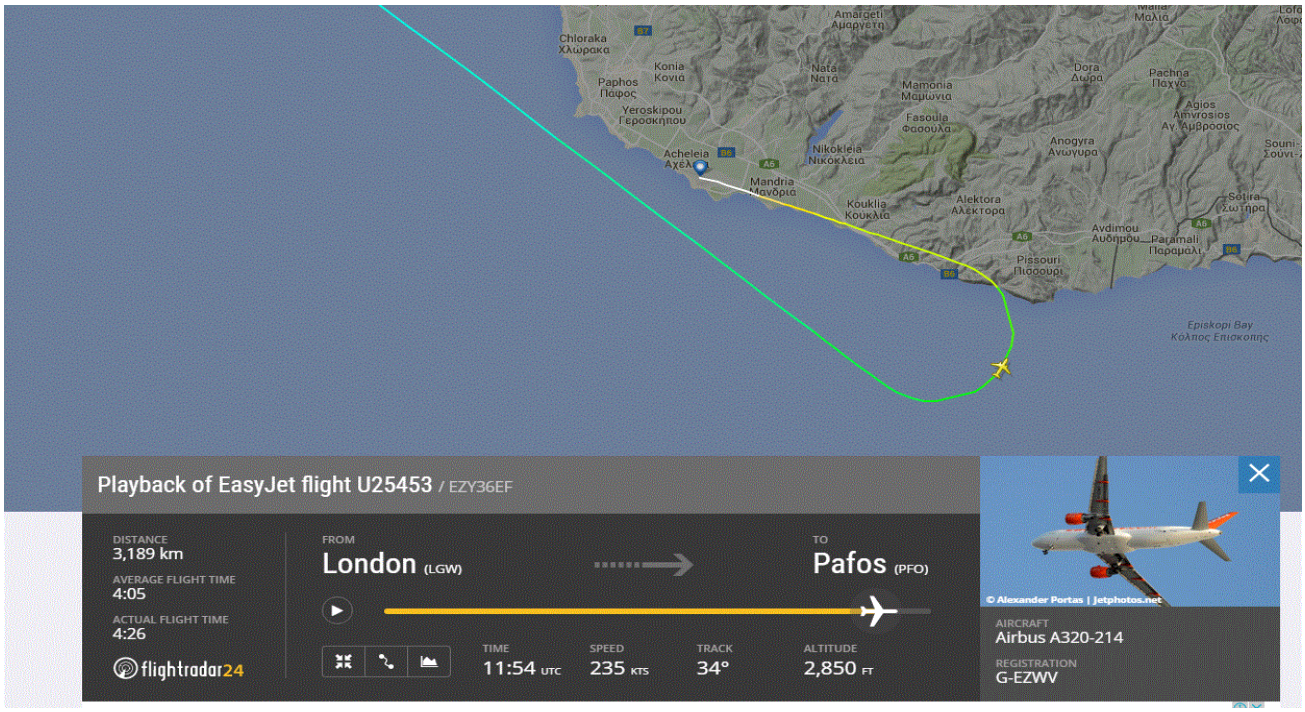
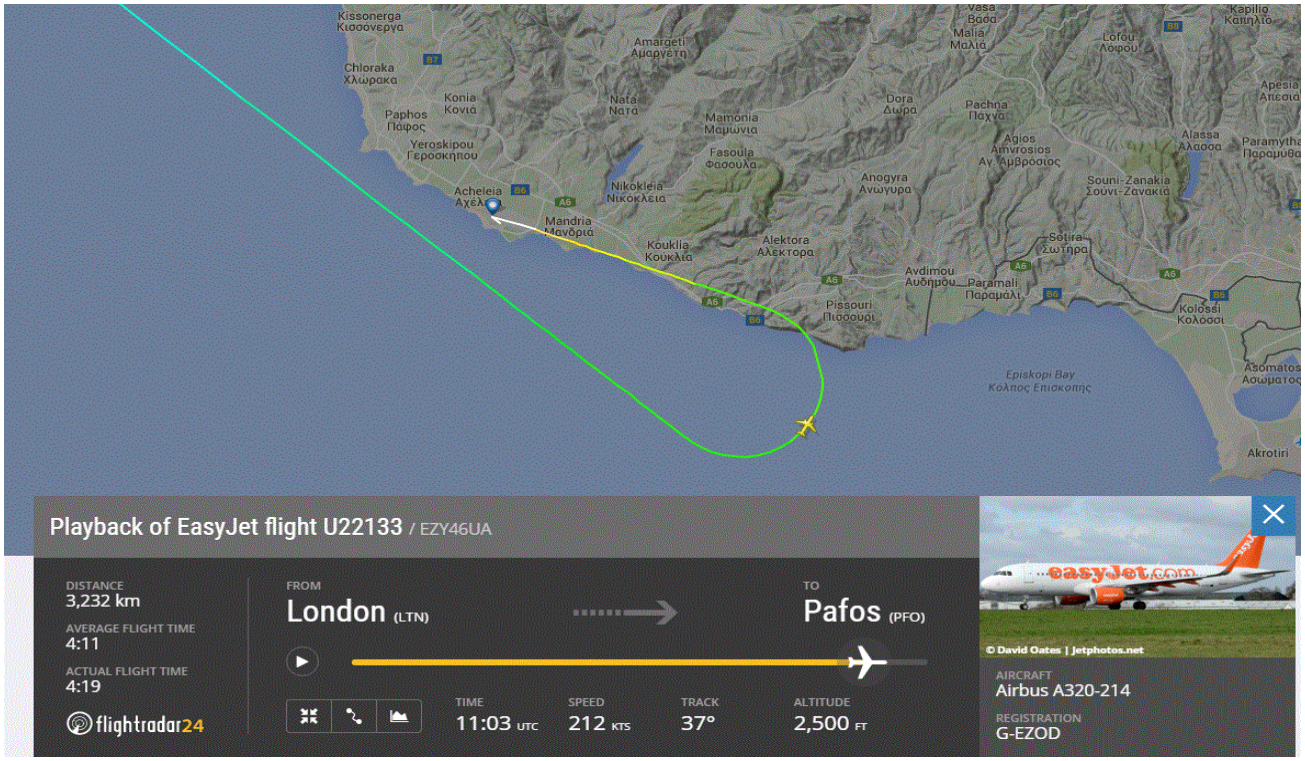


Figure 55 Chart LPHR RNAV (RNP) RWY 28

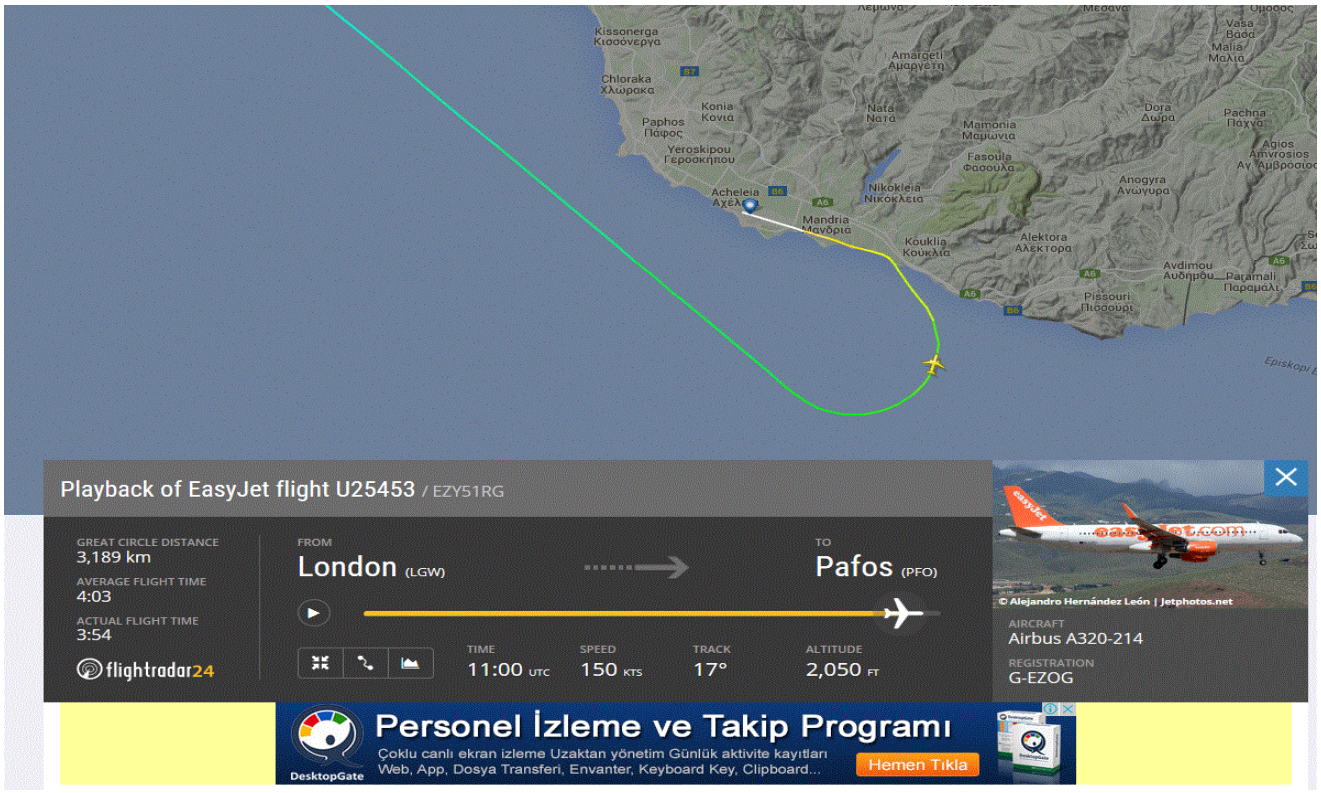
Appendix L Paphos trials – ADS-B recordings

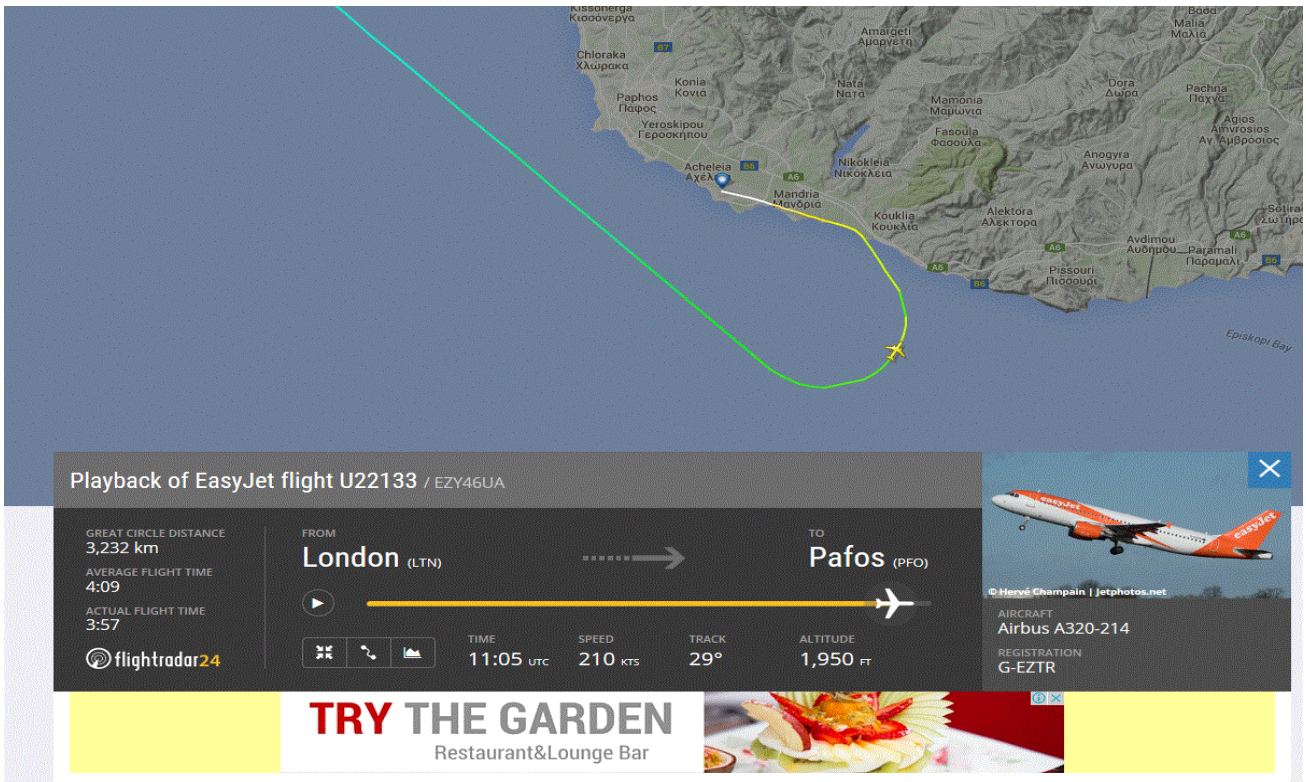
1. RNP TO ILS RWY 29 FROM TOBAL EASYJET





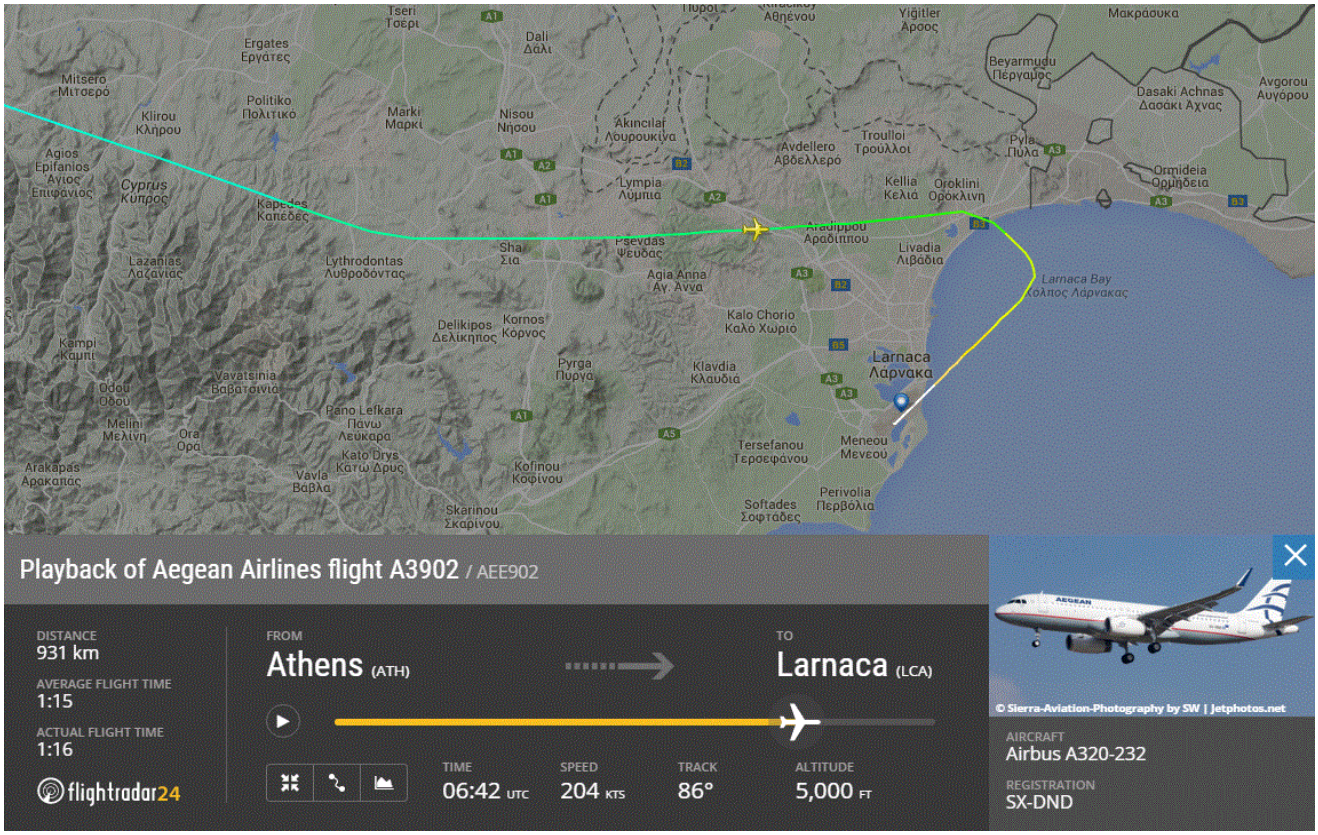
2. RNAV VISUAL RWY29 FROM TOBAL – EASYJET

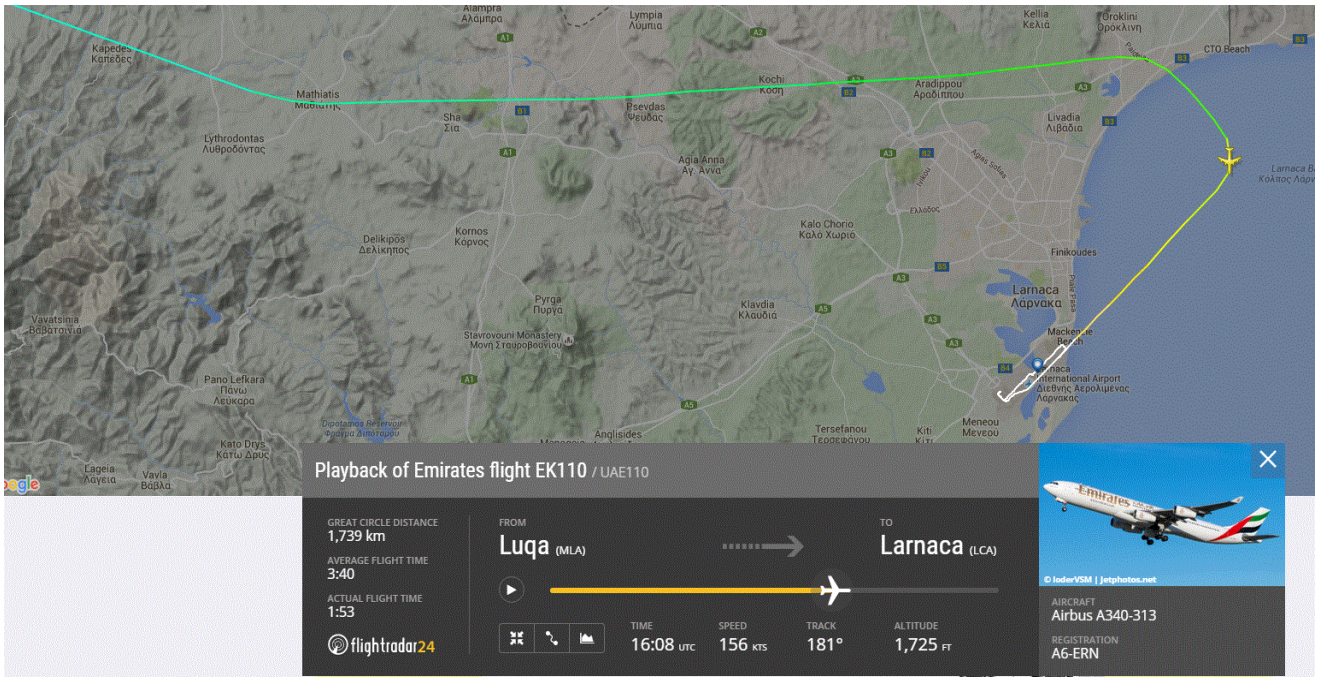


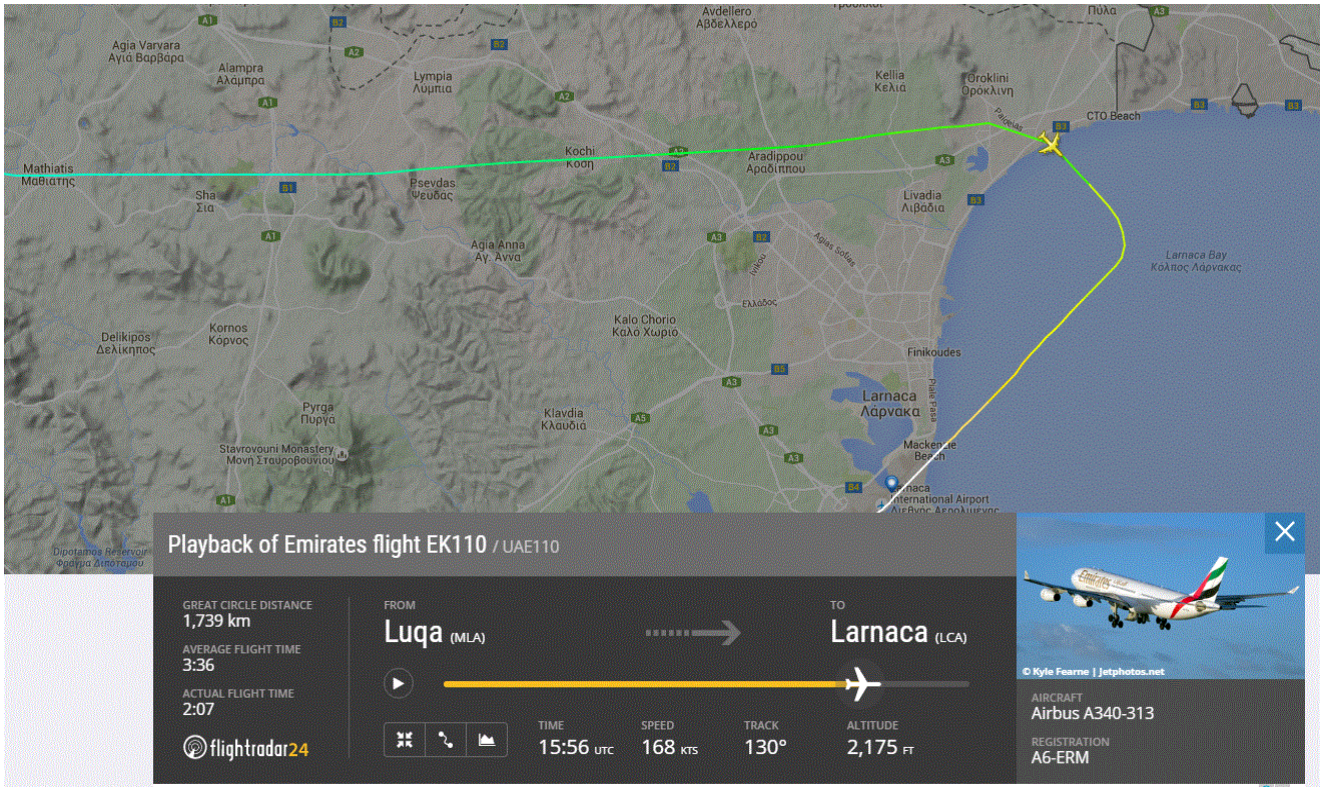


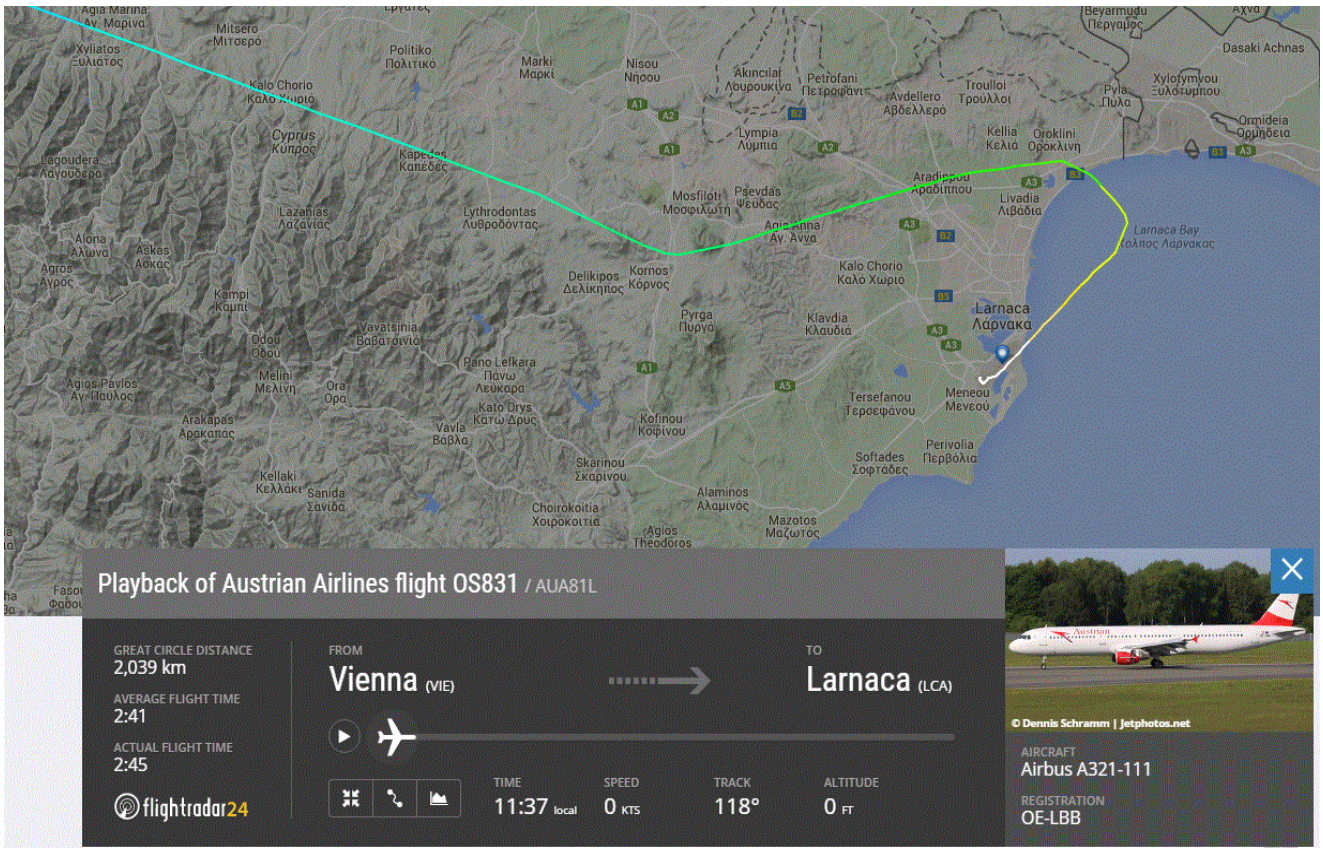
Appendix M Larnaca trials – ADS-B recordings

1. ADLAS RNAV VISUAL RWY 22

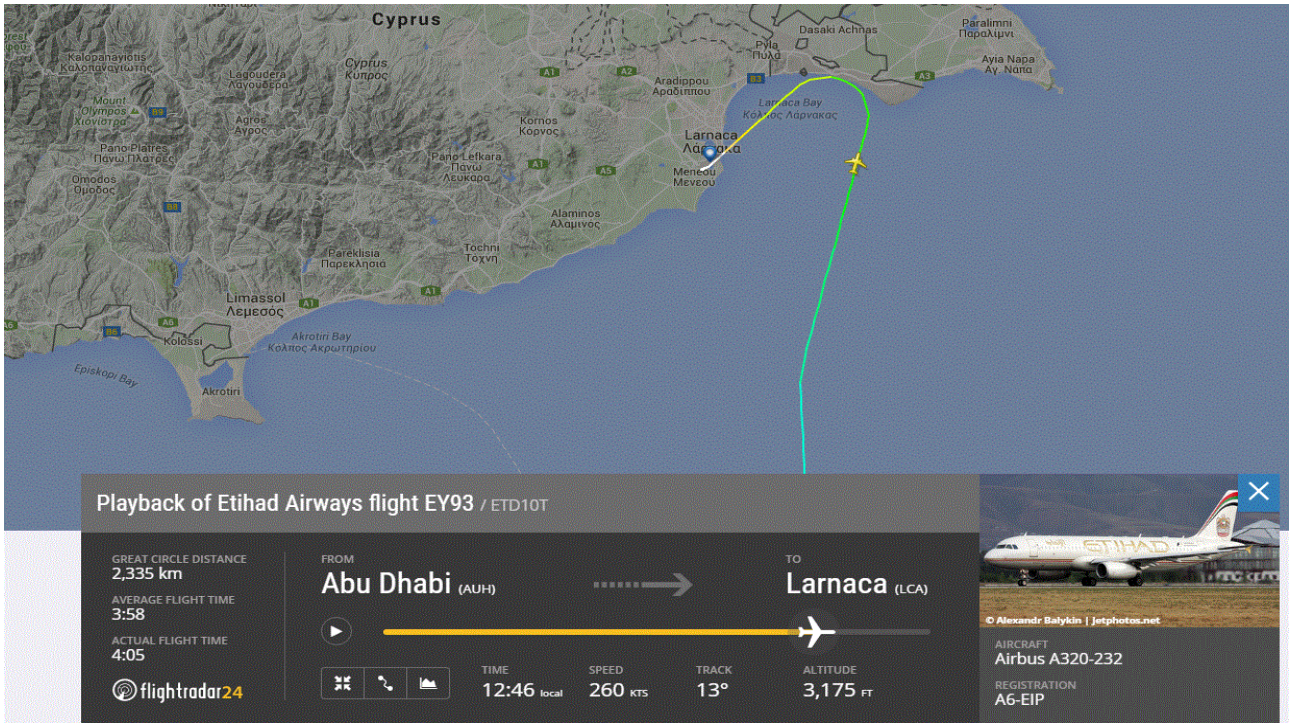


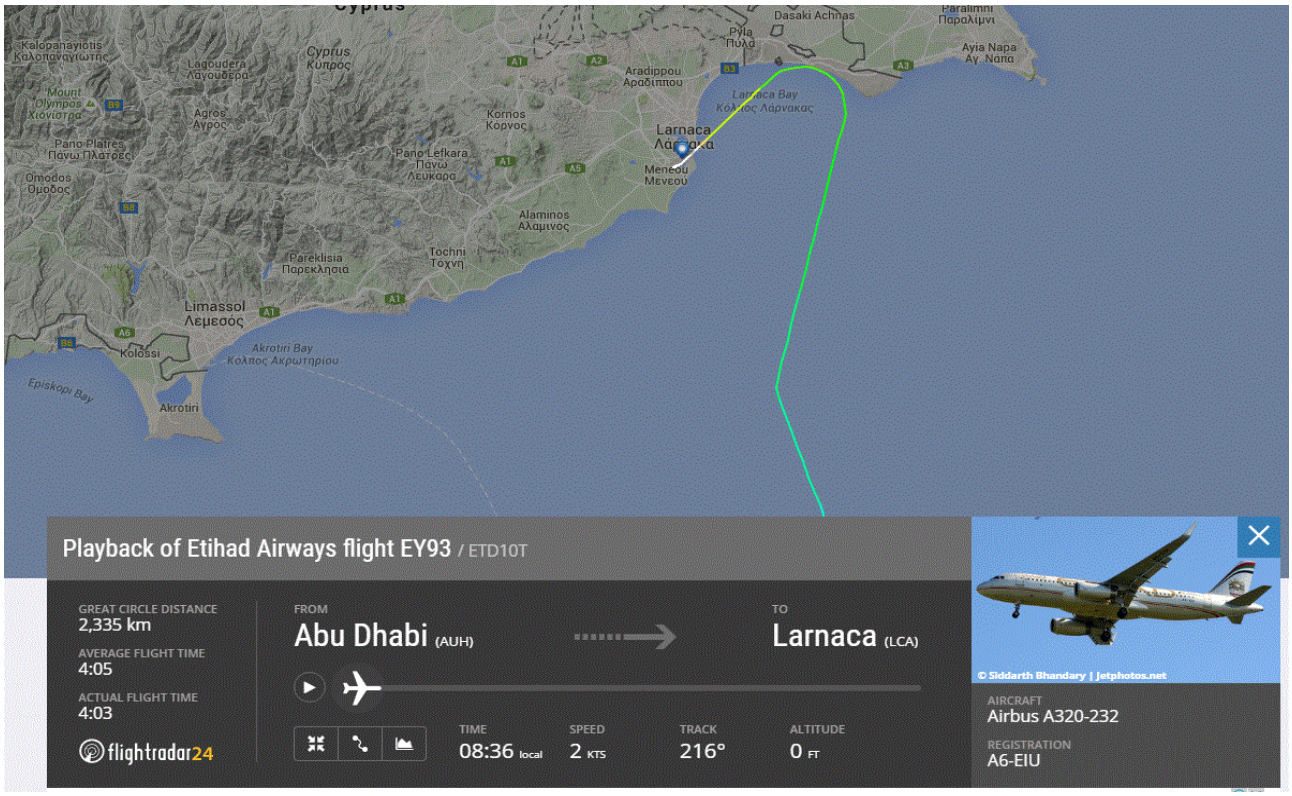


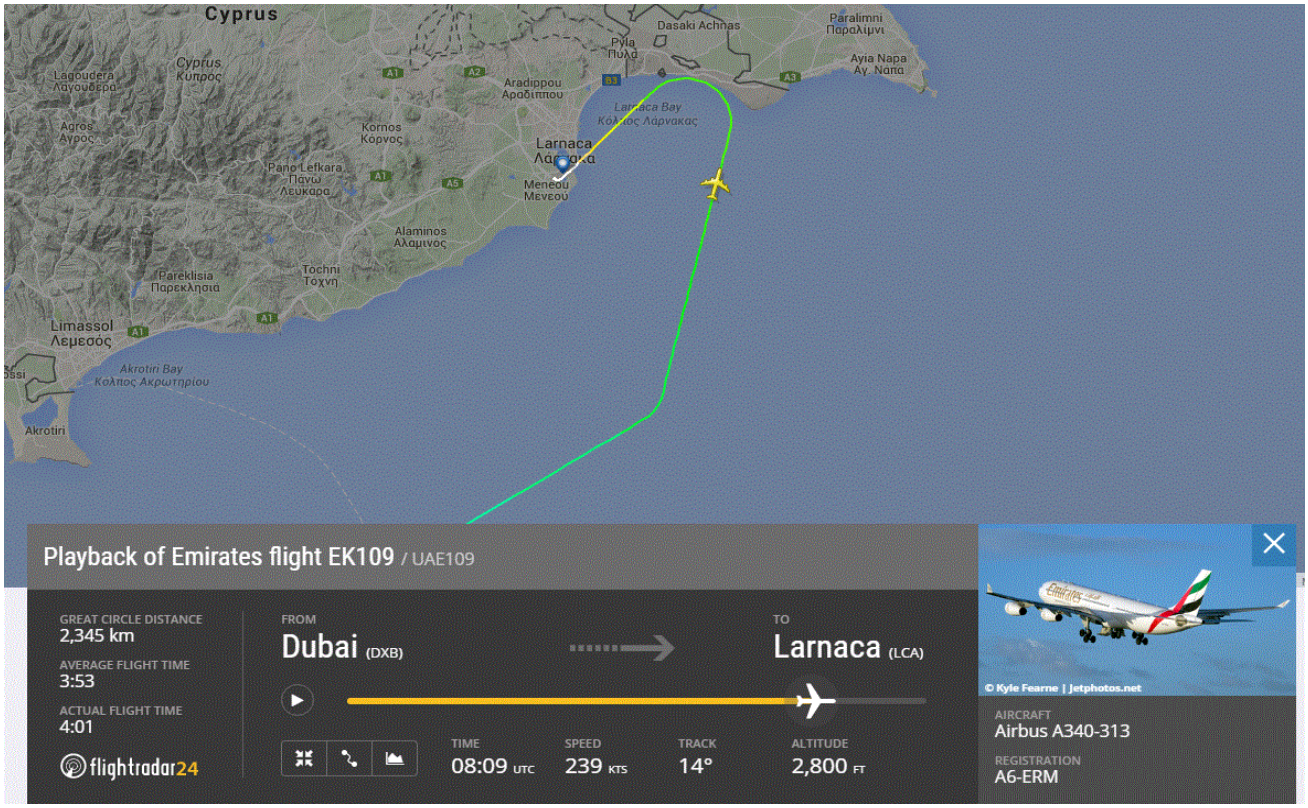


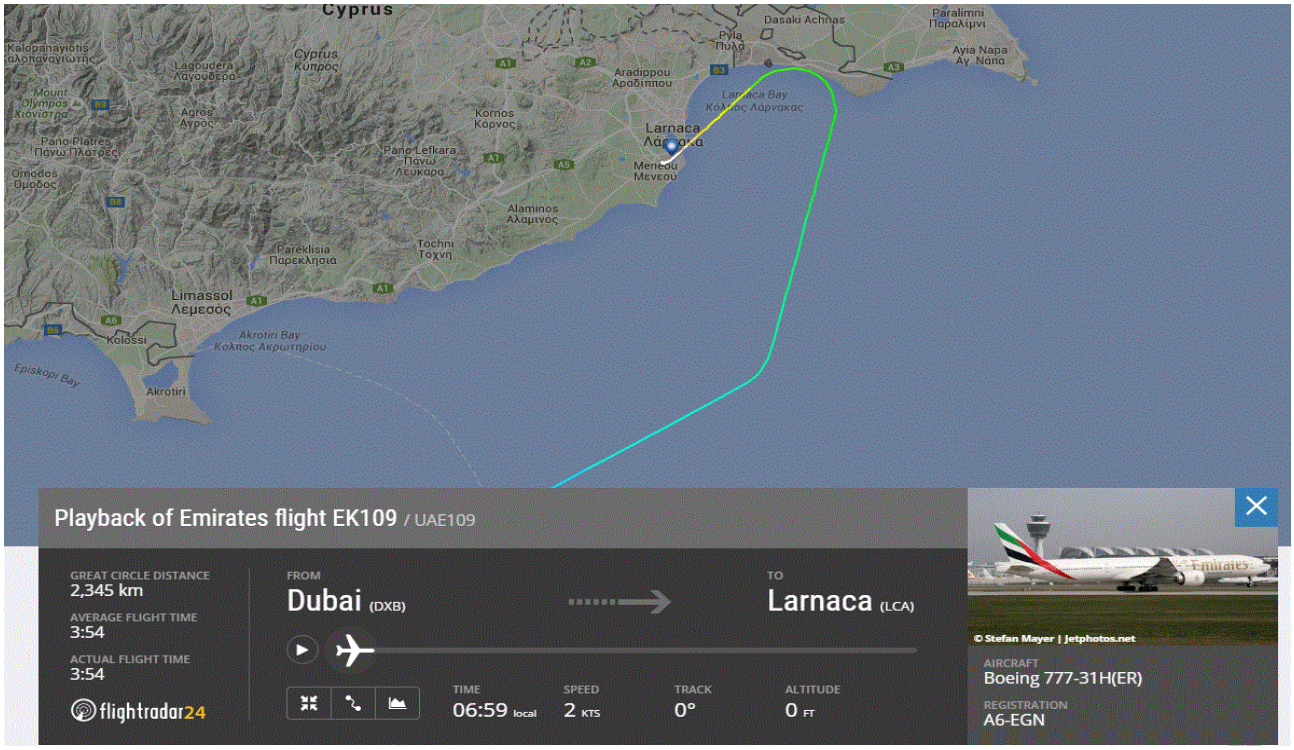


2. BOSIS RNP TO ILS RWY 22

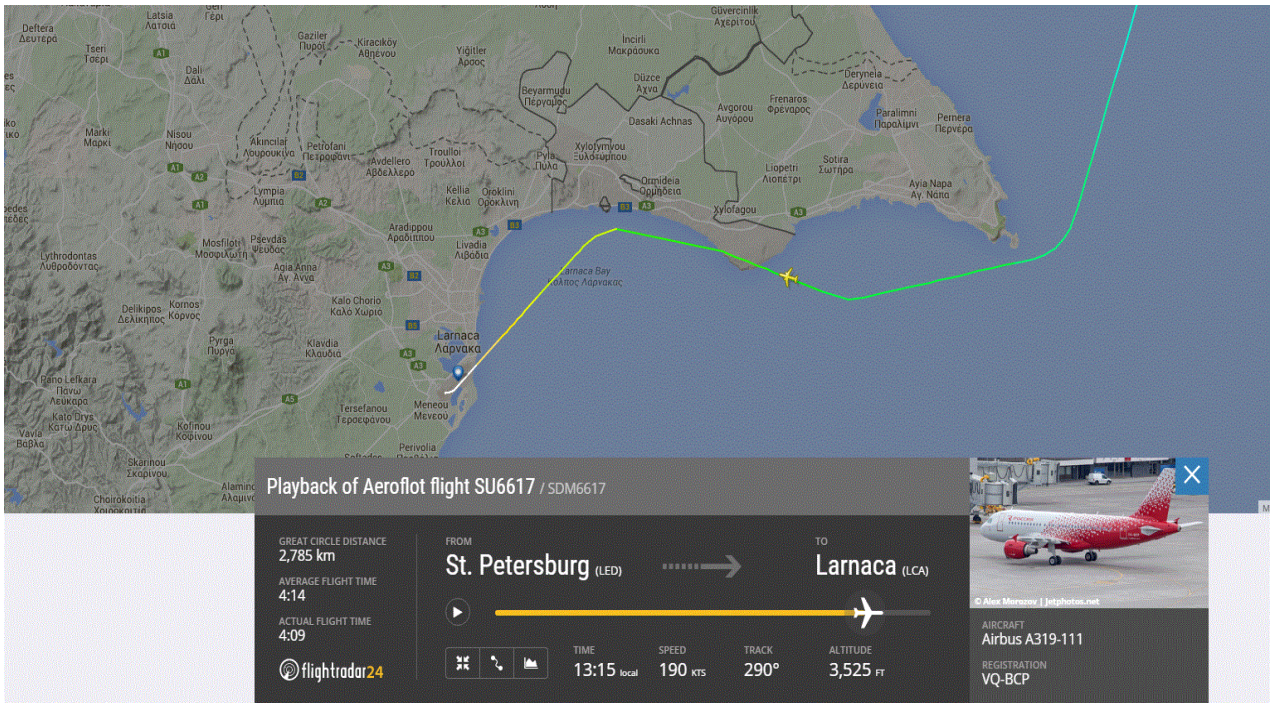








3. SOBOS RNP TO ILS RWY 22



Appendix N Larnaca trials – Emirates crew briefing

Larnaca – New Approach Procedures Rwy 22 – A330/340

Notes to Crew – *version 1.2 - 03 Feb 2016*

Authorities have developed new RNAV Visual and 'RNP-to-ILS' approaches for Rwy 22 at Larnaca. The goal is to increase traffic efficiency and reduce the requirement to pass over LCA VOR during the approach transition, when approaching the airport from the south or west.

Emirates is approved to conduct these approaches by Larnaca authorities. Refer to charts for restrictions and guidance.

Due to certain FMS constraints on A330 and A340, limited RNAV Rwy 22 and ILS Rwy 22 FMS procedures are available. When Rwy 22 is in use, crew should request RNAV Visual, or ILS P approach, VIA one of the transitions in FMS.

In addition to standard VOR and NDB approaches (which remain as before in FMS) the following Rwy 22 ILS and RNAV + transitions and approaches at Larnaca are available in A330/340 FMS;

- **ILS P 22 VIA: SOBOS, AMAKO, REXAL, BOSIS**
- **ILS 22 (straight-in, NO VIA)** *wpt LK501 on 'ILS P 22' is co-located with wpt ILC50 on 'ILS + VOR X 22'*
- **RNAV Visual 22 VIA: ADLAS, SOBOS**

NOTE: ILS + VOR X 22 (teardrop) – NOT available in FMS

Larnaca ATC has advised when possible, they will clear aircraft for the procedures we have in our FMS, however there may be rare occasions when a 'manually-built' transition to the approach (for example the ILS + VOR X 22 'teardrop-entry' must be generated by the pilot in FMS for advisory purposes and monitored with VOR raw data.

Should you be required to fly the previously-common, 'teardrop, 30-degree offset' entry procedure for the ILS Rwy 22, the offset VIA portion of the arrival would have to be manually built (based on the LCA VOR) and flown in HDG mode, prior to LOC intercept. Then, the ILS final approach can be flown in the normal manner of an ILS.

The DME for the ILS should be available. So once on the ILS 22 approach, the pilot can determine the FAF and other waypoints based on LOC and DME.

Any questions on the day, please contact the duty Technical Pilot.

Notes to Crew – *version 1.2 - 03 Feb 2016*

Appendix O Notice To Crew (NTC) easyJet for Mykonos and Santorini

easyJet	Flight Operations	Number	OPS 1/16
	Notices to Crew	Effective Date	06/01/16
	Operational	Expiry Date	06/09/16

Title	RNP Implementation in Europe – The RISE Project
Reference	
Departments Notified	EZS / OCC
Priority	Level 2

Introduction

easyJet have been involved in a SESAR funded project related to PBN introduction in Europe. The project is titled RNP Implementation Synchronised in Europe (RISE). The project has included various aspects of PBN, from RNAV and RNP arrivals, to RNAV Visual, RNP APCH and RNP AR approaches.

Operating Instructions

OFP notes will indicate when trial procedures are available and an NTC will give specific details.

You should be familiar with PBN (including RF legs) and RNAV visual procedures and provide appropriate feedback as detailed in the specific NTC.

Background Information

The following easyJet airports have been included within the project:

France: NCE, AJA

Greece: HER, CFU, JTR, JMK

Portugal: FNC

Cyprus: LCA, PFO

easyJet has been involved to varying degrees in all of these projects. Part of our commitment to the project will be involvement in the assessment of operational and environmental benefits. As part of this, the analysis of de-identified FDM material will be required.

Prepared by Dominic Haysom - Operations Technical Manager

Approved by

BrianTyrrell
Head of Flight Operations - EZY

Philippe Sutter
Postholder Flight Operations - EZS

easyJet	Flight Operations	Number	OPS 28/16
	Notices to Crew	Effective Date	23/06/16
	Operational	Expiry Date	29/10/16

Title	RISE Flight Trials - Greece - Mikonos (JMK) and Santorini (JTR)
Reference	NTC OPs 1/16, FCTM SI-110, OM-B 2.3.18.3.5
Departments Notified	OCC, EZS, Training
Priority	Level 1

Introduction

The RNP Implementation Synchronised in Europe (RISE) flight trials in JMK and JTR include the folllowing PBN procedures:

- Mikonos (JMK): RNAV1 STARs, RNAV (RNP) Z/Y RWY 16, RNAV (GNSS) X RWY 34
- Santorini (JTR): RNAV1 Transitions, RNAV (RNP) Z/Y/X RWY 34R, RNAV (RNP) Z/Y RWY 16L, RNAV (GNSS) X RWY 16L

Although easyJet is not approved for AR procedures (RNAV (RNP)), the airline has authorisation to conduct these trial procedures providing they are conducted in day VMC and are flown as RNAV Visual approaches. Temporary IAC trial charts are included with Lido/eRM database 1624.

Be familiar with:

- RNAV Visual: Refer to OM B 2.3.18.3.5 RNAV Visual Approach.
- Radius to Fix (RF) legs: Refer to FCTM SI-110 Radius to Fix (RF) Legs.

Operating Instructions

- Request the specific procedure to be flown on first contact with JMK or JTR Approach (ATC may offer these procedures). These procedures may only be flown, at ATC discretion, in day VMC and in accordance with the minimum ceiling and visibility requirements published on the charts.
- If an instrument approach is required, the appropriate NDB or VOR approach must be requested.
- In addition to the normal MEL requirements, the Greek CAA requires the following to be available in order to conduct these trial procedures: 2 GPS receivers / 2 FMGS / 2 MCDU / 2 Air Data System / Auto/Pilot and FD / 1 IRU / 2 PFD / 2 ND / EGPWS.
- Missed approach may require the use of an alternative approach, due to flight path orientation at the missed approach waypoint, if a second guided visual approach is desired e.g. JTR RNAV (RNP) Z RWY 16L followed by RNAV (RNP) Y RWY 16L, JMK RNAV (RNP) Z RWY 16 followed by RNAV (RNP) Y RWY 16.
- Please report: As a minimum – by ACARS to NAV/PERF including a simple statement of success, or a short summary of problems, if difficulties occur. Whenever any problems are encountered, and if time permits for successful approaches – by RISE PBN Flight Trial Feedback form located in Forms on the Connected Portal. By ASR if safety margins are eroded.

Background Information

NTC OPS 1/16 provides background to the RISE project.

Prepared by Dominic Haysom - Operations Technical Manager

Approved by

Appendix P Notice To Crew (NTC) easyJet for Paphos and Larnaca

easyJet	Flight Operations	Number	OPS 1/16
	Notices to Crew	Effective Date	06/01/16
	Operational	Expiry Date	06/09/16

Title	RNP Implementation in Europe – The RISE Project
Reference	
Departments Notified	EZS / OCC
Priority	Level 2

Introduction

easyJet have been involved in a SESAR funded project related to PBN introduction in Europe. The project is titled RNP Implementation Synchronised in Europe (RISE). The project has included various aspects of PBN, from RNAV and RNP arrivals, to RNAV Visual, RNP APCH and RNP AR approaches.

Operating Instructions

OFP notes will indicate when trial procedures are available and an NTC will give specific details.

You should be familiar with PBN (including RF legs) and RNAV visual procedures and provide appropriate feedback as detailed in the specific NTC.

Background Information

The following easyJet airports have been included within the project:

France: NCE, AJA

Greece: HER, CFU, JTR, JMK

Portugal: FNC

Cyprus: LCA, PFO

easyJet has been involved to varying degrees in all of these projects. Part of our commitment to the project will be involvement in the assessment of operational and environmental benefits. As part of this, the analysis of de-identified FDM material will be required.

Prepared by Dominic Haysom - Operations Technical Manager

Approved by

BrianTyrrell
Head of Flight Operations - EZY

Philippe Sutter
Postholder Flight Operations - EZS

easyJet	Flight Operations	Number	OPS 4/16
	Notices to Crew	Effective Date	07/03/16
	Operational	Expiry Date	07/09/16

Title	RISE Flight Trials - Cyprus - Pafos (PFO) and Larnaka (LCA)
Reference	NTC OPs 1/16, FCTM SI-110, OM-B 2.3.18.3.5
Departments Notified	OCC, EZS, Training
Priority	Level 1

Introduction

The RISE Flight Trials in PFO and LCA include the folllowing PBN procedures:

- RNP transition to ILS

  RNP to ILS is the approach where the initial approach segment is defined by an RNP1 route, using RNP systems for track guidance. The RNP route is terminated at IF. The IF is located on the LOC course and the inbound intermediate segment is defined by the LOC. After the IF the pilot will follow the ILS for landing. The aircraft is protected from obstacles throughout the procedure.

- RNAV Visual

  RNAV VISUAL APPROACH is the approach where the initial approach segment is defined by an RNAV1 route, using RNAV systems for track guidance. The RNAV route is terminated at the VAP (Visual Approach Point) which is located at the start of the final leg, or at any other identified point from where the pilot will continue his approach visually with reference to ground (obstacles) and having the airport in sight at all times. The aircraft is protected from all obstacles until the VAP (Visual Approach Point). In order to descend lower than the altitude of the VAP, the pilot has to have aerodrome and ground visual at all times and has the responsibility to avoid any obstacles (visual part of the procedure).

Operating Instructions

Clearance

The trial procedures available are:

Pafos (PFO):
ILS P Runway 29 (RNP to ILS)
RNAV Visual Runway 29

Larnaka (LCA):
ILS P Runway 22 (RNP to ILS)
RNAV Visual Runway 22

Request the specific procedure to be flown on first contact with PFO or LCA Approach. ATC may offer these procedures.

These procedures may only be flown, at ATC discretion, in day VMC and in accordance with the minimum ceiling and visibility requirements published on the charts.

If an instrument approach is required, the appropriate non-trial ILS or VOR approach must be requested.

Procedure

ILS P (RNP to ILS):
NAV/DES or NAV/VS should be used for the transition and APPR selected as normal for the ILS. NAV will transition to LOC* when within the capture envelope.

RNAV Visual:
Refer to OM B 2.3.18.3.5 RNAV Visual Approach.

Radius to Fix (RF) legs:
Refer to FCTM SI-110 Radius to Fix (RF) Legs.

Reporting

Please report:

- As a minimum – by ACARS to NAV/PERF including a simple statement of success, or a short summary of problems, if difficulties occur.
- Whenever any problems are encountered, and if time permits for successful approaches – by RISE PBN Flight Trial Feedback form located in Forms on the Crew Portal.
- By ASR if safety margins are eroded.

Background Information

NTC OPS 1/16 provides background to the RISE project.

Prepared by Dominic Haysom - Operations Technical Manager

Approved by

BrianTyrrell
Head of Flight Operations - EZY

Philippe Sutter
Postholder Flight Operations - EZS

Appendix Q Communication - Press releases and articles

Press Release

AIRBUS

POWERED BY SESAR JOINT UNDERTAKING

December 19, 2014

Airbus ProSky and its SESAR JU partners launch RISE Project to Increase Airspace Efficiency

Toulouse, France – December 19, 2014 – To enhance safety, improve flight efficiency and airport accessibility, Airbus ProSky and its partners are proud to announce the kick-off of the RISE Project (RNP Implementation Synchronized in Europe). Together, with SESAR Joint Undertaking (SJU), they will implement Performance Based Navigation (PBN) procedures at eight airports located in southern Europe.

Led and co-financed by **SJU**, the project is managed by **Airbus ProSky**, in collaboration with four air navigation service providers (ANSPs) – **DCAC, NAV Portugal, DSNA, HCAA** – and three airline operators - **Air France, Novair** and **TAP Portugal**. These partners will conduct over 160 flight trials, demonstrating a range of PBN procedures, such as Required Navigation Performance (RNP) Approach, RNP Arrival, Visual RNAV, and RNP to Instrument Landing System (ILS) procedures.

Florian Guillermet, Head of SESAR JU Programs remarked, "The RISE project offers an important opportunity to demonstrate more widely the significant efficiency, safety and environmental benefits that are possible with PBN procedures. In doing so, the project will further convince the broader community that the first SESAR solutions are fit for wider scale implementation."

PBN procedures, RNP standards, are about freeing airplanes' reliance on ground-based navigational aids and allowing more flexible and optimum routing using satellite navigation. While these procedures have existed for some time, implementation in Europe has been slow due to a number of operational factors.

Bringing together expertise of the ANSPs and Airlines operators, Airbus ProSky will coordinate the implementation of PBN procedures and air traffic controllers training. Flight trials will be performed in airports in France (Nice, Ajaccio), Cyprus (Paphos and Larnaca), Portugal (Madeira and Horta), and Greece (Corfu, Iraklion, Santorini and Mykonos). The implementation of RNP procedures is expected to significantly reduce fuel consumption in descent and arrival phases, thereby reducing environmental impact.

The two-year project will improve airport access and enhance safety of operations by removing the Circle-to-Land approaches, without relying on the ground navigation infrastructure, lowering the weather minima and allowing shorter tracks resulting in track miles savings and Continuous Descent operations.

Paul-Franck Bijou, Airbus ProSky CEO, remarked: "This project is a great example for the entire aviation community. It will establish a clear benchmark for the benefits of the new navigation technologies and efficient flight operations."

Airbus ProSky will support each partner in the design phase as well as the safety and environmental Assessments. In particular, each procedure will be validated in a full flight simulator to test all nominal and non-nominal operations, firstly by pilots with PBN-expertise from Airbus ProSky and then by expert airline pilots. Air traffic controllers from each of the participating airports will also receive an intensive PBN training in order to ensure the highest clearance rate.

Airbus ProSky
17 av Didier Daurat, Algorithmes – Socrate
31700 Blagnac, France

Phone +33 (0)5 3460 5050
Fax +33(0)5 8205 0000

airbusprosky.com

Project Launch Press Release (APS,SJU Dec 2014)

Press Release

AIRBUS

POWERED BY SESAR JOINT UNDERTAKING

January 13, 2016

SESAR partners demonstrate benefits of satellite-based navigation in Corfu, Iraklion and Santorini

Toulouse, France – January 13 – Airbus, HCAA and Novair have successfully achieved a flight trial on Required Navigation Performance (RNP) procedures in Corfu, Iraklion and Santorini, a key milestone in the two year project which will help Greece improve airport access and enhance operations. To enhance safety, improve flight efficiency and airport accessibility, Airbus ProSky, part of "Services by Airbus," and its partners launched the RISE project (Required Navigation Performance Implementation Synchronised in Europe) throughout southern Europe, including Greece, last fall. Without relying on the ground navigation infrastructure, these procedures will result in shorter tracks and track miles savings as well as Continuous Descent operations.

Co-financed by the SESAR Joint Undertaking, the RISE project, with its partners, successfully ran the first flight trials with Novair's Airbus A321 in Greece. In May, two RNP Approaches procedures to Corfu and Iraklion airports were successfully flown, followed by two RNP AR Approach Procedures to Santorini in September. Novair also operated the RNP AR Approach at Santorini followed by RNP AR Approach at Göteborg on the way back, a city pair flown in Europe with RNP AR at both airports, which increases accessibility among the city pairs.

Henrik Ekstrand, Novair Captain remarked: "The RISE project and trials in Corfu, Iraklion and Santorini, Greece are very important to us. We're delighted to be working in partnership with our fellow RISE stakeholders and the SESAR JU on this project. There are many benefits by using Satellite based navigation at these sites, leading to improved flight operation in terms of airport accessibility and efficiency."

In advance of the demonstration flight, Airbus ProSky, in partnership with HCAA, intensively trained the Air Traffic Controllers on the PBN procedures of all three airports. This prepared them for the trials as well as for future publication of the procedures to ensure the highest clearance rate.

Thomas Lagaillarde, Airbus ProSky General Manager added, "The stakeholders of the projects and SESAR JU are very proud to support aviation projects in Greece. This project will allow more efficiency of flight operations and will set the standards for future implementation in this country."

HCAA is anticipating a publication in the AIP of these procedures in the near future, to be accessible to the national and foreign aircraft operators.

In addition, more than 160 flight trials will be conducted in collaboration with the partner airlines and ANSPs through September 2016 at the following locations: Mykonos, Santorini (Greece), Nice, Ajaccio (France), Paphos, Larnaca (Cyprus) and Madeira (Portugal). These trials will capture feedback from flight crew and air traffic controllers on the procedures in terms of fly-ability, safety, crew and ATC workload, as well as assess savings in CO_2 emissions and fuel consumption reduction.

Airbus ProSky
17 av Didier Daurat, Algorithmes – Socrate
31700 Blagnac, France

Phone +33 (0)5 34 60 50 50
Fax +33 (0)5 62 05 00 00

airbusprosky.com

Trials in Greece Press Release (APS,SJU Jan 2016)

Press Release

March 10, 2016

Madeira Embodies Benefits of Performance-Based Navigation in Latest SESAR Demonstration Flights

Madrid, Spain - March 10 – The SESAR JU RISE project carried out the latest in successful demonstration flights as TAP Portugal, in partnership with NAV Portugal and Airbus ProSky, conducted flight trials at Madeira. The RISE Project, which seeks to improve airport accessibility, enhance safety and reduce environmental impact at airports throughout Europe, is co-financed by SESAR Joint Undertaking and its partners. In Madeira specifically, these procedures will enhance safety by providing fully managed and repeatable procedures and improve airport accessibility by lowering approach minima and thus reducing weather related diversions.

To enhance safety, improve flight efficiency and airport accessibility, Airbus ProSky, part of "Services by Airbus," and its partners launched the RISE project (Required Navigation Performance Implementation Synchronised in Europe) throughout southern Europe in autumn 2015.

Antonio Aguiar, TAP Portugal Flight Operations - Technical Support Director, and RISE coordinator within TAP Portugal, remarked: "So far we've performed more than 40 flight trials at Madeira. We are very pleased with the outcome of these trials since the procedures are easy to fly, leading consistently to zero deviation from the intended track, clearly improving overall efficiency."

In advance of the demonstration flight, Airbus ProSky, in partnership with NAV Portugal, intensively trained the Air Traffic Controllers on the PBN procedures and following the flights have captured controller feedback.

Thomas Lagaillarde, Airbus ProSky General Manager added, "We are pleased to hear the feedback on the procedures at Madeira. It represents how this project will allow more efficiency of flight operations."

Airbus ProSky
17 av Didier Daurat, Algorithmes – Socrate
31700 Blagnac, France

Phone +33 (0)5 34 60 50 50
Fax +33(0)5 82 05 00 00

airbusprosky.com

Trials in Madeira Press Release (APS,SJU March 2016)

Press Release

AIRBUS

POWERED BY SESAR JOINT UNDERTAKING

June 9, 2016

Sustainability Benefits Showcased in Performance-Based Navigation Demonstration Flights

Toulouse, France – June 9 – The SESAR JU RISE project continues to prove the benefits of performance-based navigation (PBN) in Cyprus over the past two months. Since February, more than 30 flight trials have been conducted in Larnaca, with 20 additional trials in Paphos. The RISE Project, which seeks to improve airport accessibility, enhance safety and reduce environmental impact at airports throughout Europe, is co-financed by SESAR Joint Undertaking and its partners.

Mr Nicos Nicolaou, Acting Director of DCAC stated, "We're pleased to see the new procedures from design to implementation. We believe the decrease in track miles will result in considerable reductions in fuel burn and CO2 emissions. The benefits of PBN go beyond improving our airspace, but also enhance the environment in which we live."

In Cyprus, SESAR JU has been working with Airbus ProSky, part of "Services by Airbus," and airline partners Novair, easyJet, Emirates and Aegean to design and implement PBN procedures. DCAC, the air navigation service provider (ANSP) of Cyprus, has designed RNP1 to ILS and RNAV visual procedures for both airports. In particular, the RNAV procedures facilitate more stable approaches, fewer go-arounds and fewer diversions, which increase airline schedule reliability. It also results in greater airport ground operations efficiency and a reduced workload for air traffic controllers.

In Larnaca, the most utilized procedure, which was thoroughly tested by the operators coming from the west, (ADLAS entry waypoint) and using the RNAV VISUAL procedure is 12 nautical miles shorter than the existing conventional VOR procedure. If replaced entirely, it will save approximately 500 miles per day. In addition, other procedures for arrivals coming from the East have been flight tested (RNP TO ILS from SOBOS and BOSIS entry waypoints) with very positive reports.

At Paphos airport, the western arrivals are using the RNP TO ILS from TOBAL and the RNAV visual from TOBAL, offers great savings as well as more smooth approach.

Before the demonstration flights, Airbus ProSky had validated the designed procedures on a full flight simulator. The DCAC trained the Air Traffic Controllers on the new procedures and published them in an AIP supplement to support the RISE flight trials.

Thomas Lagaillarde, Airbus ProSky General Manager added, "The RISE project continues to see success. The potential sustainability benefits of PBN are showcased in Cyprus. When we are able to see substantial reductions in track miles, we know the new procedures will be seen as useful to all stakeholders."

The procedures will be published in AIP at the end of the trials. The Cyprus flight trials are a portion of the more than 160 flight trials will be conducted in collaboration with the partner airlines and ANSPs through September 2016 in

Airbus ProSky
17 av Didier Daurat, Algorithmes – Socrate
31700 Blagnac, France
Phone +33 (0)5 34 60 50 50
Fax +33(0)5 82 05 00 00

airbusprosky.com

Trials in Cyprus Press release (APS,SJU June 2016)

NAVBLUE
AN AIRBUS COMPANY

PRESS RELEASE N°02

France Continues SESAR JU's RISE Project Performance Based Navigation

September 2016

POWERED BY SESAR JOINT UNDERTAKING

The SESAR JU RISE project continues to prove the benefits of performance based navigation (PBN) throughout Europe. In the latest set of flight trials, DSNA, the civil aviation authority of France, and Air France, Air Corsica and easyJet have assessed the PBN procedures designed for Ajaccio and Nice through a series of demonstration flight trials. The RISE Project, which seeks to improve airport accessibility, enhance safety and reduce environmental impact at airports throughout Europe, is co-financed by SESAR Joint Undertaking and its partners.

DSNA stated, "The trials in Nice and Ajaccio prove that PBN holds the key to improving airport accessibility and enhancing safety in our airspace. In Nice, not only were we able to lower the approach minima nearly 900 feet, we were also able to restrict the flight path in order to provide a fully repeatable path."

SESAR JU has been working with NAVBLUE, formerly Airbus ProSky, part of "Services by Airbus", DSNA and Air France, Emirates, EasyJet, Air Corsica to design and test PBN procedures. In Nice and Ajaccio, the procedures designed by DSNA enhance safety by providing a fully managed approach down to the runway threshold. Previously there were only visual prescribed track (VPT) procedures in place at Ajaccio RWY20 and at Nice RWY22. The new approaches will improve airport accessibility by lowering the minima. It could also reduce the noise impact on the city of Ajaccio, compared to the current procedure.

The Nice and Ajaccio flight trials are part of the more than 330 flight trials conducted so far in collaboration with the partner airlines and ANSPs since September 2015 in France, Greece, Cyprus and Portugal. These trials allowed capturing feedback from flight crew and air traffic controllers on the procedures in terms of fly-ability, safety, crew and ATC workload, as well as assess savings in CO_2 emissions and fuel consumption reduction.

About NAVBLUE:

NAVBLUE is an integrated Flight Operations and Air Traffic Management Services company providing end-to-end, innovative and integrated flight operations solutions for a wide-range of customers around the world.

ABOUT RISE:

Lead and co-financed by SJU, the project is managed by NAVBLUE, in collaboration with four air navigation service providers (ANSPs) – DCAC, NAV Portugal, DSNA, HCAA – and three airline operators - Air France, Novair and TAP Portugal. Together, these partners have conducted over 330 flight trials, demonstrating a range of PBN procedures, such as Required Navigation Performance (RNP) Approach, RNP AR, Visual RNAV, and RNP to Instrument Landing System (ILS) procedures, in France (Nice and Ajaccio); Portugal (Madeira and Horta), Greece (Corfu, Iraklion, Santorini, Mykonos) and Cyprus (Paphos, Larnaca).

About SESAR:

SESAR (Single European Sky Air Traffic Management Research) was set up to modernise and harmonise ATM systems through the definition, development and deployment of innovative technological and operational solutions. Established in 2007, the SESAR Joint Undertaking (SJU) is a public-private partnership which pools the knowledge and resources of the entire ATM community in order to define, research, develop and

Reach for the skies

Media Contact — Janet Grondin | janet.grondin@navblue.aero | +519 747 1170 ext 290

Trials in France Press release (September 2016)

COLLABORATION THROUGH THE LENS OF RISE

MARIE IOAN
She is the Customer Affairs Manager for Europe and Africa for Airbus ProSky. Marie is also a pilot.

CHRISTELLE LEDAUPHIN
She is the Project Manager for Airlines and Airspace at Airbus ProSky. She specialises in Performance-Based Navigation (PBN) and is the Project Manager for RISE.

The RISE (RNP Implementation Synchronized in Europe) project is the next step in ensuring Performance-Based Navigation (PBN) integration and air traffic management (ATM) transformation in the region. Its success will be key to incorporating additional carriers and airports into the PBN ecosystem throughout the next decade. Furthermore, it is a model that could be replicated in other regions, transforming today's skies for tomorrow's air traffic.

In order to effectively – and efficiently – handle expected worldwide air traffic growth, aircraft operators, civil aviation authorities (CAAs), air service navigation providers (ANSPs), and airports must continue to work more collaboratively to adopt new technologies and solutions.

PBN is a prime example of an area that benefits from increased collaborative efforts. By eliminating an aircraft's reliance on ground-based navigational aids, PBN increases airport accessibility by lowering approach minima and allows for the definition of more direct routes, thus reducing fuel consumption and enhancing safety. It also allows for more flexible routing, avoiding penetration in non-authorized zones.

The global PBN landscape is varied. In the United States nearly all planned Next Generation Air Transportation System (NextGen) PBN approaches have been implemented. Throughout the rest of the world the story is not as positive. In Europe, for example, only 41% of planned PBN operations have been implemented. Adoption has been slow: aircraft operators have a tough time building a business case for seemingly cost-intensive retrofits, while ANSPs and CAAs dislike the time-intensive process of integrating new approaches into their current procedures.

COLLABORATING TO MAKE PBN AN EU SUCCESS STORY

Launched in 2014, the RISE project is a beacon of hope for PBN in Europe and an exemplary case of stakeholder collaboration. Led and co-financed by Single European Sky ATM Research Joint Undertaking (SESAR JU), the project is managed by Airbus ProSky, in collaboration with four ANSPs – Department of Civil Aviation of Cyprus (DCAC), *Navegação Aérea de Portugal* (NAV Portugal), *Direction des services de la Navigation aérienne* (DSNA), France, and Hellenic Civil Aviation Authority (HCAA), Greece – and six airport operators – Air France, Novair, TAP Portugal, Aegean Airlines, Emirates, and easyJet. The partners have initiated a demonstration phase to highlight the airport accessibility, flight efficiency, sustainability (noise and CO_2 emissions), and safety benefits of PBN.

Through 160 flight trails, RISE is demonstrating a large range of PBN procedures – Required Navigation Performance (RNP) and RNP Arrival (AR) approaches, Visual Area Navigation (RNAV) and RNP-to-Instrument Landing System (ILS) procedures. These new procedures are being implemented at 10 airports – Nice and Ajaccio in France, Paphos and Larnaca in Cyprus, Madeira and Horta in Portugal, plus Corfu, Iraklion, Mykonos, and Santorini in Greece. These airports have historically been impacted by high rates of un-stabilized approach diversions and non-optimized trajectories in terms of environmental impact.

All parties are involved in every step of the design and implementation process. From design to simulator validation to demonstration flights, the voice of the airlines, ANSPs, and air traffic controllers (ATC) are taken into account. This ensures that the final procedures are accepted by all those impacted and will be utilized beyond the demonstration period.

RISE: CONFRONTING THE CHALLENGES

PBN implementation, in general, is a complex process, and the RISE project is pushing those in the EU region to realize the benefits and make the necessary investments. A great deal of collaboration is required by CAAs.

Beyond necessary technology investments, controllers must be retrained on new procedures. Particularly when there are mixed operations – those using PBN and those who are not – ATCs require a great deal of knowledge when managing the airspace. Airbus ProSky provides in-depth training on these new procedures as well as incorporating controller feedback from the flight trails into PBN procedure design.

ANSPs and aircraft operators are the key players during the flight trials phase as they collect feedback from crews and ATC in terms of procedures fly-ability and impact on safety, as well as controller and flight crew workload. Once trials are completed, it is expected that the procedures will be fully implemented and will benefit all users. ■

Extract of RISE Article in ICAO Journal (Issue 02 2016)

Lettre d'information de la Direction des services de la Navigation aérienne • n° 48 • Septembre 2016

ENVIRONNEMENT

Paris-CDG : descentes « douces » pendant le cœur de nuit (0h30 - 5h) depuis le 16 septembre 2016

Avec le **projet « Cœur de nuit »**, les avions desservant Paris CDG suivent des procédures d'arrivée satellitaires conçues pour limiter l'impact sonore au sol : les trajectoires sont publiées jusqu'à la piste, de telle sorte que les avions peuvent procéder à des descentes « douces » minimisant les paliers. La Commission locale Consultative de l'Environnement et l'ACNUSA, autorité indépendante en matière de contrôle de nuisances aéroportuaires, ont donné un avis favorable à la mise en service de ce dispositif.

Dans le cadre du programme technologique européen SESAR, la DSNA va mener, à partir de 2017, des simulations au centre d'Eurocontrol à Brétigny-sur-Orge pour étudier les conditions d'un dispositif qui, à l'horizon 2020, permettrait le développement des descentes « douces » au-delà de la nuit. L'utilisation d'une navigation plus précise en zone terminale associée à de nouvelles procédures de gestion des vols à l'arrivée devrait contribuer à diminuer la zone de régulation de contrôle des avions, et donc le nombre de personnes survolées.

LA CONSTRUCTION EUROPÉENNE

FABEC : évaluation opérationnelle de procédures de gestion civile-militaire innovantes sur la liaison Paris > Munich

Du 12 novembre 2015 au 6 février 2016, un exercice opérationnel impliquant la DSNA, la DFS et les deux autorités militaires franco-allemande a permis d'évaluer de nouvelles règles de gestion de zones militaires transfrontalières afin d'optimiser la planification des vols au départ de Paris-CDG à destination de Munich. Ce *city-pair* est situé dans une des zones de trafic les plus fréquentées au monde : 74 vols ont ainsi pu utiliser une route directe entre le FL 245 (7 500 mètres) et le FL 355 (10 800 mètres), raccourcissant ainsi leurs trajectoires de plus de 40 Nm (72 km), sans remettre en cause l'activité militaire. Ce résultat est le fruit de procédures de coordination très abouties entre les cellules civiles-militaires de gestion de l'espace aérien française et allemande. Un outil partagé offrait une représentation graphique commune des activités civiles et militaires. Les besoins des compagnies aériennes étaient transmis par le CRNA Est. Avec la mise en œuvre temporaire d'une route directe traversant la zone militaire TSA 22A à haute altitude, les compagnies aériennes ont pu planifier un itinéraire le plus court possible et bénéficier d'un gain significatif d'emport carburant. De plus, grâce à un processus de publication de mise à jour réduit à 30 minutes quant à l'activation/désactivation de cette zone militaire, elles ont pu suivre cette route directe dès qu'elle était disponible. Au final, une utilisation de l'espace aérien très optimisée, réalisée en partenariat avec Eurocontrol (Network Manager), au bénéfice de toutes les compagnies qui exploitent cette liaison !
À terme, cette route directe sera mise en place de façon pérenne avec des règles de gestion adaptées.

SESAR : évaluations opérationnelles de nouveaux types de procédures d'approche satellitaires (projet RISE)

Les équipes du SIA et du SNA/SE qui ont conçu les procédures d'approche RNP AR à Nice et à Ajaccio

Certains aéroports européens ont des configurations locales très contraintes en termes d'obstacles. En cas de mauvaises conditions météorologiques, leur accessibilité devient problématique et les déroutements peuvent devenir fréquents. Dans le cadre des *Very Large Scale Demonstrations* du programme européen SESAR, le projet RISE (*RNP Implementation Synchronized in Europe*) a permis d'évaluer différents types de procédures d'approche PBN (*Performance Based Navigation*) sur huit terrains répondant à ces caractéristiques, dont Nice et Ajaccio (France), Madère (Portugal), Santorin et Mykonos (Grèce), et Larnaca (Chypre).

Pour Nice en piste 22 et Ajaccio en piste 20, le SIA et le SNA Sud-Est ont conçu des procédures d'approche spécifiques, très précises à +/- 0,3 Nm de l'axe, avec un virage à rayon constant guidé en approche finale, permettant de mieux prendre en considération les obstacles, et donc de baisser les minima. Après avoir été testées sur simulateur en conditions météorologiques dégradées, ces procédures ont été évaluées en opérationnel de décembre 2015 à juin 2016 par les organismes de contrôle de Nice et d'Ajaccio en partenariat avec Air France, Air Corsica, easyJet et Emirates en conditions de vol à vue, avec un trafic normal, par des avions équipés Baro VNAV. Ces évaluations ont montré que ces trajectoires d'approche codées dans le système de gestion de vol (FMS) de l'avion étaient parfaitement suivies. Pour les contrôleurs, ces procédures n'ont pas induit de charge de travail supplémentaire. À ce stade, les gains théoriques en matière d'environnement sont encore à démontrer.

En parallèle à cet exercice SESAR, un groupe de travail DGAC a élaboré une réglementation française adaptée aux critères RNP AR APCH. Elle complète le manuel de conception des procédures IFR et sera publiée fin 2016. Avant toute mise en service à Nice et à Ajaccio, des études complémentaires vont se poursuivre, notamment en matière d'environnement et d'homologation de la piste pour ce type d'approche. De leur côté, les compagnies devront équiper leurs avions de systèmes certifiés RNP-AR et disposer d'une approbation opérationnelle.

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Letter of information RISE (DSNA, Sept 2016)

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DSNA customer newsletter View this email in your browser

July 2016 # 6

Listening & inform

Performance Based Navigation benefits are proven. In collaboration with its customers and partners, DSNA is involved in a significant number of actions to take advantage of the PBN improvements and possibilities still to come.
This issue of DSNA&Vous is about PBN commitments, to tell you where we stand for and what we are looking into.

Enjoy your reading.

Any feedback and suggestion are always welcomed; feel free to share your views: dsna-customer-bf@aviation-civile.gouv.fr

Do not hesitate to forward this newsletter to whoever could be interested. Thank you for your cooperation.

For a quicker access to either one of DSNA&Vous sections, click below

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PBN baseline wording...

GNSS (Global Navigation Satellite Systems), such as GPS, notably contributes to PBN

DSNA&vous July Newsletter

ATC

RISE trials flexible approach paths in the Mediterranean

Jenny Beechener - IHS Jane's Airport Review

10 November 2015

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Air France began flight trials at Nice Côte d'Azur Airport in November to validate new performance-based navigation curved approaches that reduce noise impact and improve airport accessibility.

Nice is one of 10 airports introducing Required Navigation Performance (RNP) procedures under the RNP Implementation Synchronised in Europe (RISE) programme, which is co-funded by the SESAR Joint Undertaking.

Airbus ProSky leads the two-year RISE project in collaboration with air navigation service providers from Cyprus (DCAC), France (DSNA), Greece (HCAA), and Portugal (Nav Portugal), as well as three airline operators: Air France, Novair, and TAP Portugal.

"Nav Portugal was the first to publish Madeira RNP AR [Required Navigation Performance with Authorization Required] approach paths on its website to support the RISE trials before conducting the first flights in October 2015," Airbus ProSky project manager Christelle Ledauphin told *IHS Jane's* .

Extract of IHS Airport 360 Article

The full content of the article is available below:

IHS Jane's RISE.pdf

Novair först med att genomföra satellitbaserade inflygningar i Grekland

Pressmeddelande • Dec 17, 2015 10:49 CET

Novair har tillsammans med bl.a. Airbus och grekiska flygtrafikledningen genomfört satellitbaserade inflygningar till flera öar i Grekland under sommaren och hösten 2015. En teknik som innebär att man kan navigera med högre precision och därmed korta flygvägen, minska bränsleförbrukningen samt öka tillgängligheten till dessa flygplatser.

Novair är tillsammans med bl.a Airbus ProSky och grekiska flygtrafikledningen med i ett EU-initiativ inom ramen för moderniseringsprojektet av flygtrafiksystemen i Europa (SESAR) som kallas RISE. Det handlar om att införa satellitbaserade inflygningar till Korfu, Santorini och Heraklion på Kreta.

Satellitbaserade inflygningar kan vara både raka och kurvade inflygningar. Båda typerna baseras på att man helt navigerar med hjälp av GPS satelliter, utan någon hjälp av radiofyrar som står på marken. Det innebär att man kan flyga med högre precision och därmed korta flygvägen, minska bränsleförbrukningen men även öka tillgängligheten till flygplatserna.

I slutet av september började Novair flyga till Santorini där kurvad inflygningsteknik användes. Vid hemkomst till Skandinavien har även denna teknik används på Göteborg Landvetter flygplats vilket gör dessa tur- och retur flygning unika från ett Europeiskt perspektiv.

-Vi på Novair är förstås stolta över att vara en del av detta projekt. Det finns många fördelar med satellitbaserade inflygningar. De möjliggör ökad effektivitet i form både kortare flygvägar och möjligheten att göra gröna inflygningar, säger Henrik Ekstrand, pilot på Novair och ansvarig för genomförandet av dessa unika flygningar mellan Göteborg Landvetter flygplats och Santorini.

Inom ramen för projektet så skall även Aegean Airlines och EasyJet göra denna typ av inflygningar i Grekland, men Novair är alltså först med att genomföra detta.

RISE projektet pågår även i andra länder, bl.a. gör Air France valideringar i Nice, TAP ska flyga kurvade inflygningar på Madeira.

Novair Press release for trials in Greece

Appendix R Communication - RISE Presentations

Event	Who	When	Document
APS Seminar, Toulouse	APS	Jan 2015	RISE.pdf
Salon du Bourget, Paris	DSNA	June 2015	Extract présentation RISE Le Bourget 201
PBN Workshop in Portugal	NAV Portugal, TAP Portugal, ANAVCS, APS	Aug 2015	2015_08_25 RISE Portugal presentation
Aerodays London	SJU, APS	Oct 2015	Aerodays_21Oct_Session3A_8h30.pdf
RAISG meeting (Eurocontrol), Brussels	DCAC	Nov 2015	RAiSG9_Item 052_RISE project in C
APS Seminar, Bangkok	Novair, APS	Nov 2015	Airbus ProSky Regional Symposium I
DSNA Forum , Athis Mons	DSNA, APS	Nov 2015	2015_12_10 RISE France presentation_
Airbus fuel seminar, Toulouse	Novair, APS	June 2016	2016_05_30 RISE pres for fuel efficienc

Appendix S RNAV Visual CONOPS (DSNA)

RISE DSNA Visual RNAV CONOPS .pdf

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