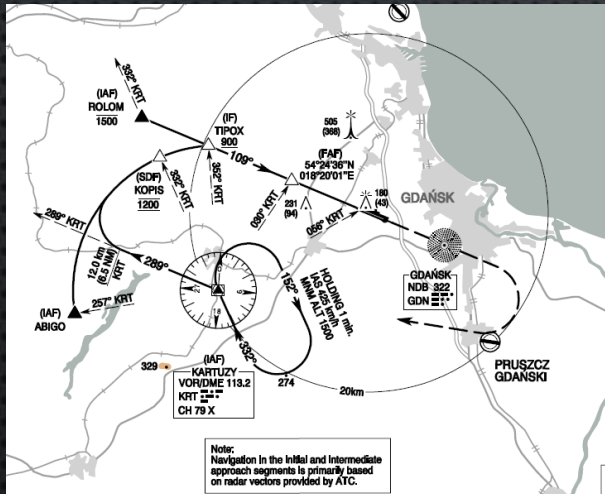


BENEFITS AND PITFALLS WHEN INTRODUCING NEW TECHNOLOGY AND CONSEPTS.

DO WE HAVE THE FULL UNDERSTANDING OF RISK WHEN CHANGING WELL
KNOWN PROCEDURES AND METHODS IN A COMPLEX INDUSTRY?

EMPIRIC DESCRIPTION OF EVENTS.
REAL FUTURE PLANS
CONCERNS..

EVENTS AT GDANSK / KJEVIK



PLANS FOR NEW AIRPORT



AIRCRAFT ENGINEER (RONoAF)

PILOT WITH SAS (1990-2014)

MD 80 INSTRUCTOR (1996-2005)

INVESTIGATOR (2006-2014)

DEPUTY DIRECTOR SAS SAFETY DEPT.

CHIEF INVESTIGATOR (2007-2012)

Now:

TECHNICAL SYSTEM MANAGER AT
OSLO CONTROL CENTRE, RØYKEN.



Knut Ø. O. Paulgaard

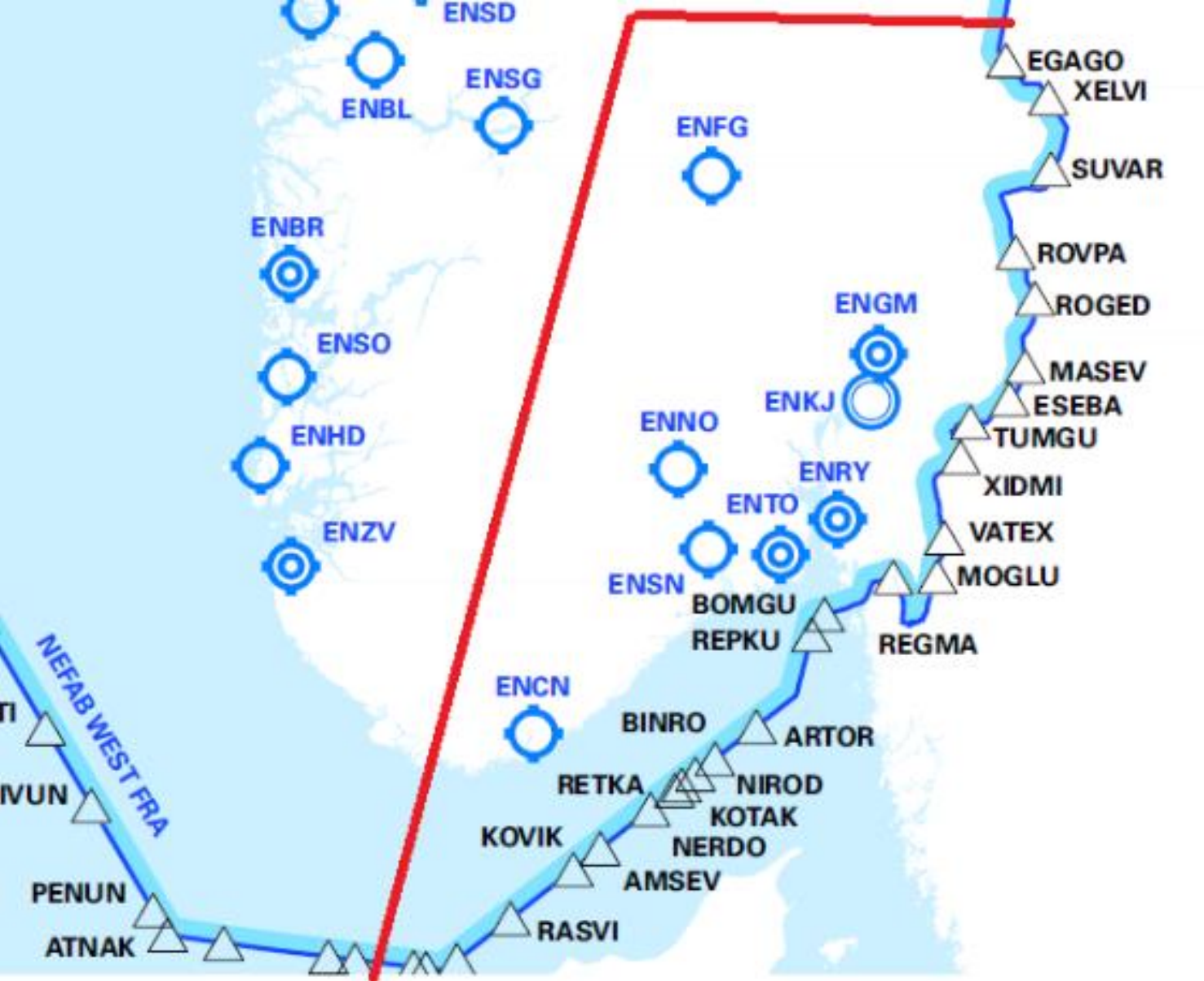
'LEO'

Mountain facility
OPS room
And

Server room



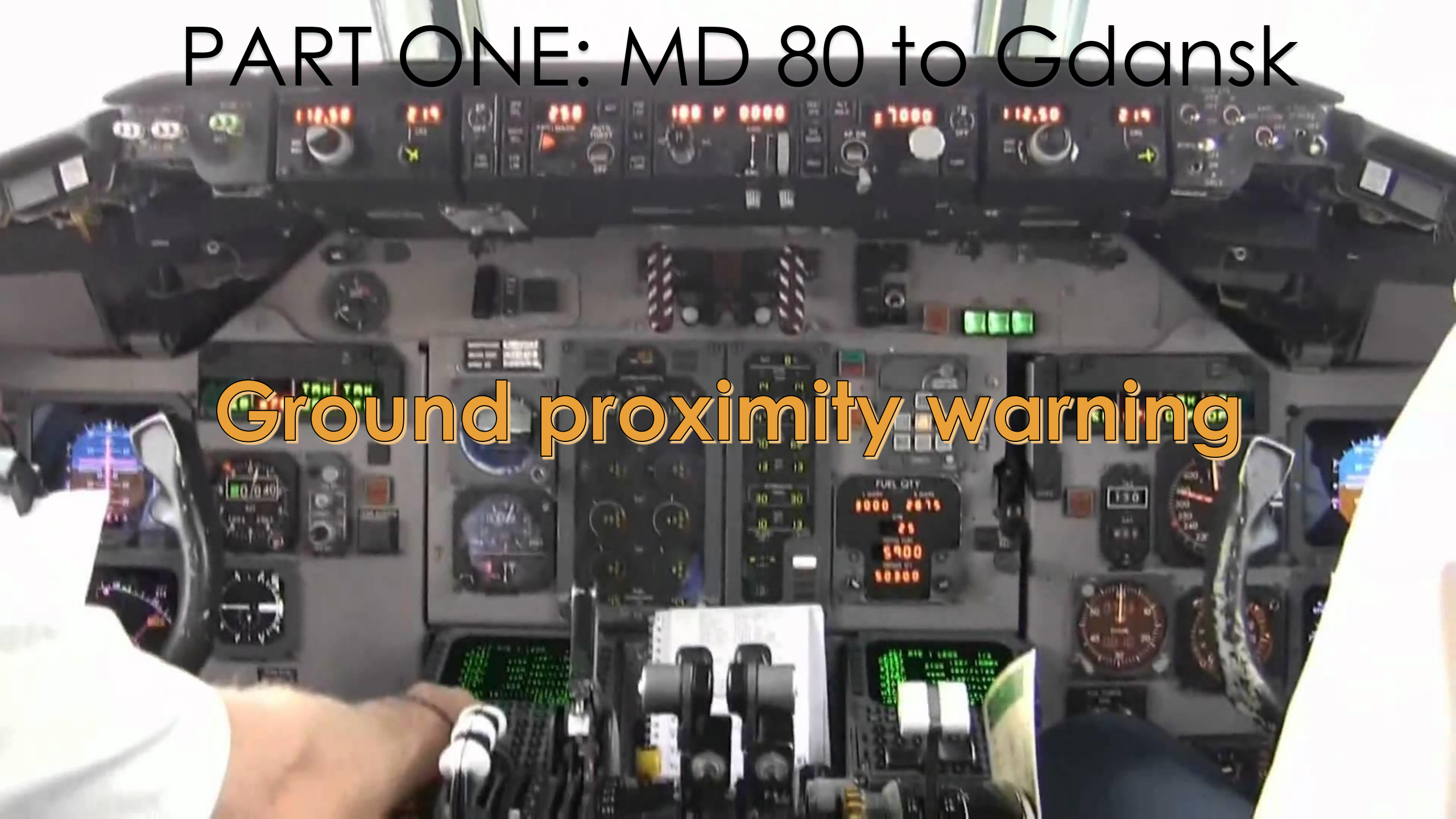
We also manage 125 radios on 25 sites
3 VORs
3 Radars (MSSR)



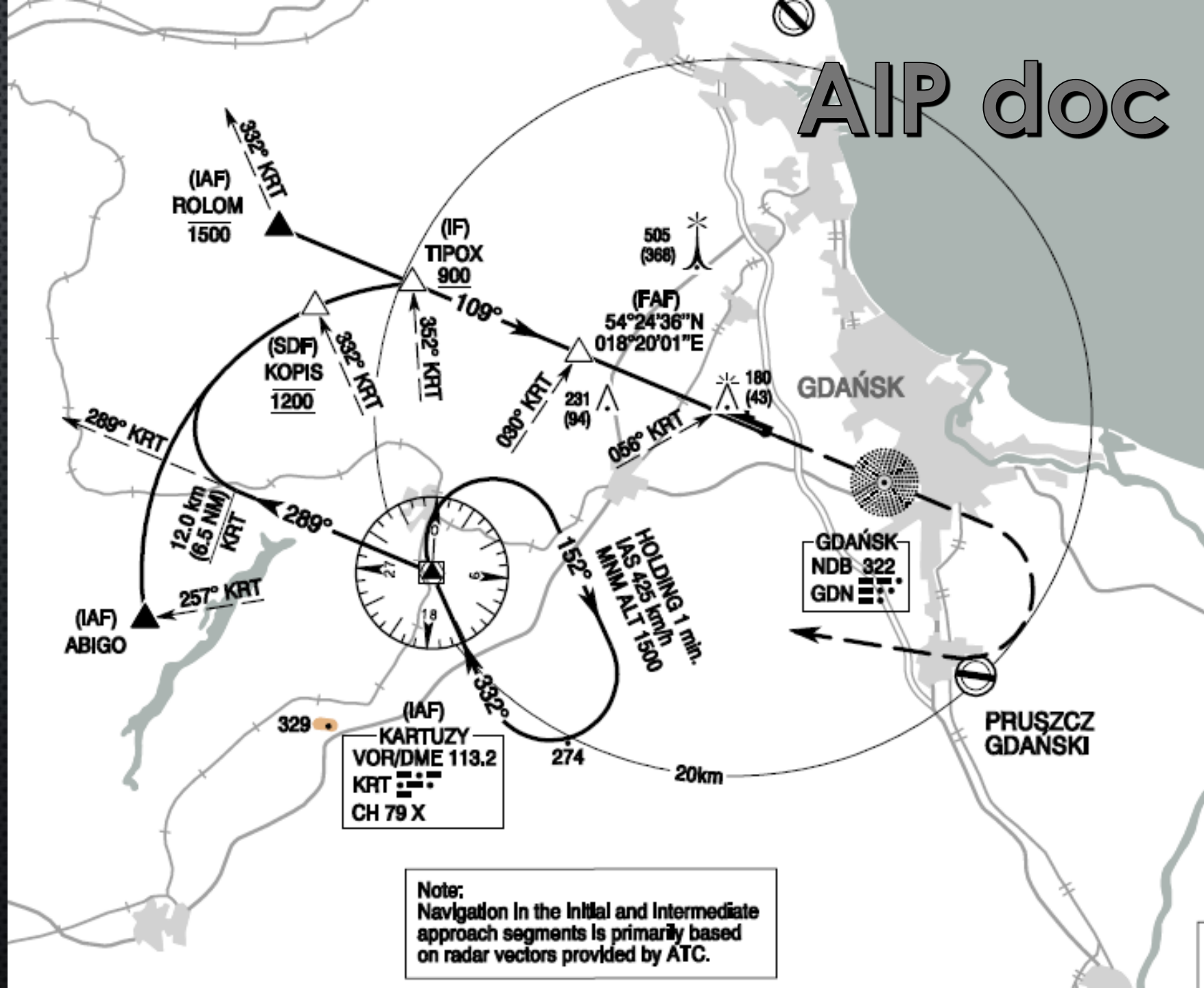
Our region

PART ONE: MD 80 to Gdansk

Ground proximity warning



AIP doc



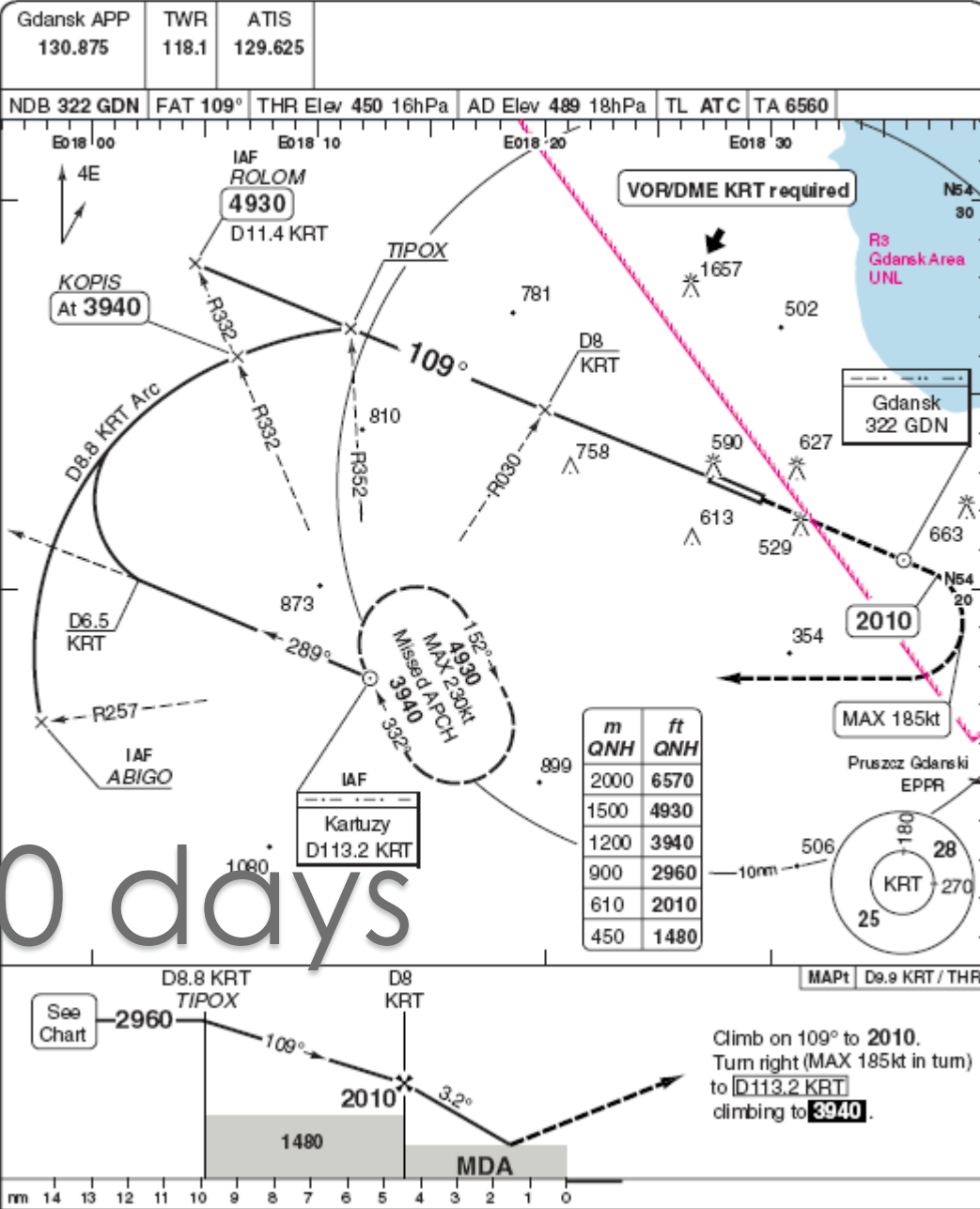
WEF 11 FEB 10

50 - 3 21 JAN 10

Poland - EPGD / GDN

NDB RWY 11

Lech Walesa GDANSK



3 flights, 100 days

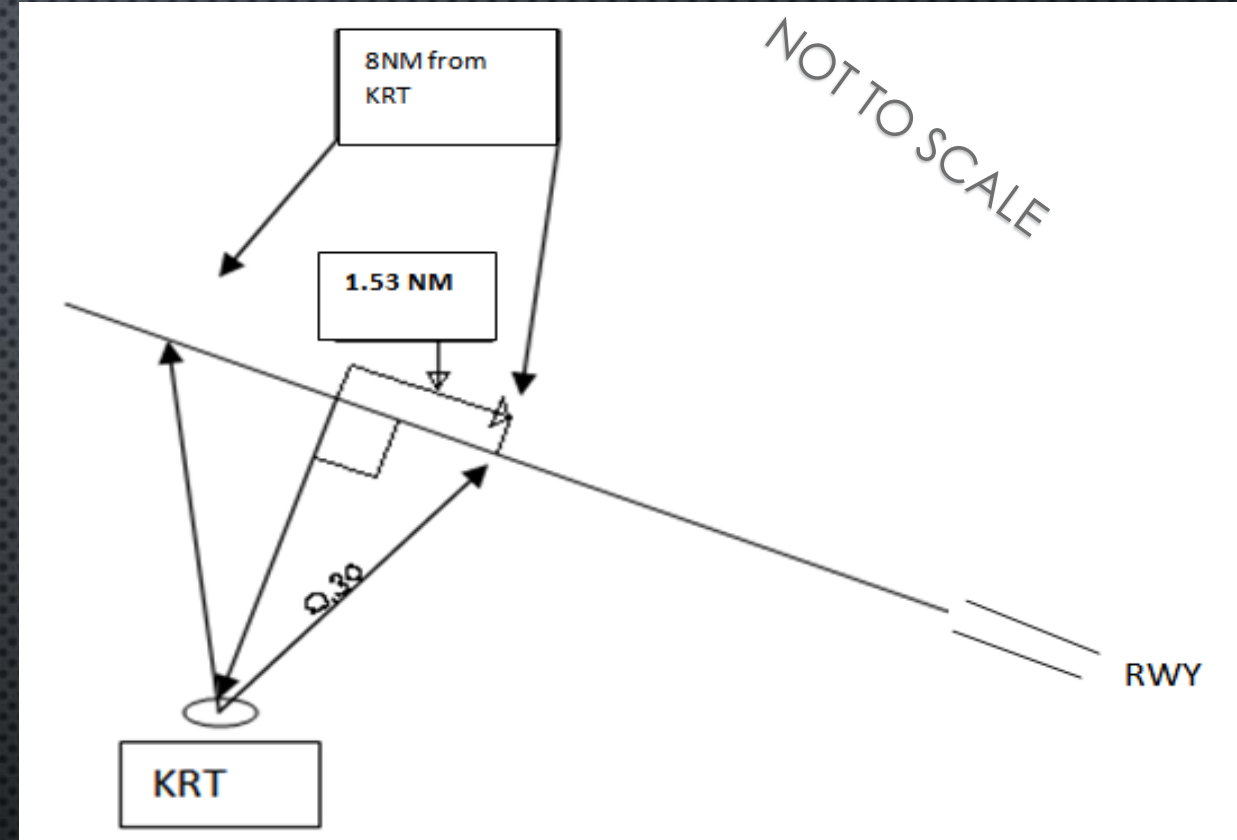
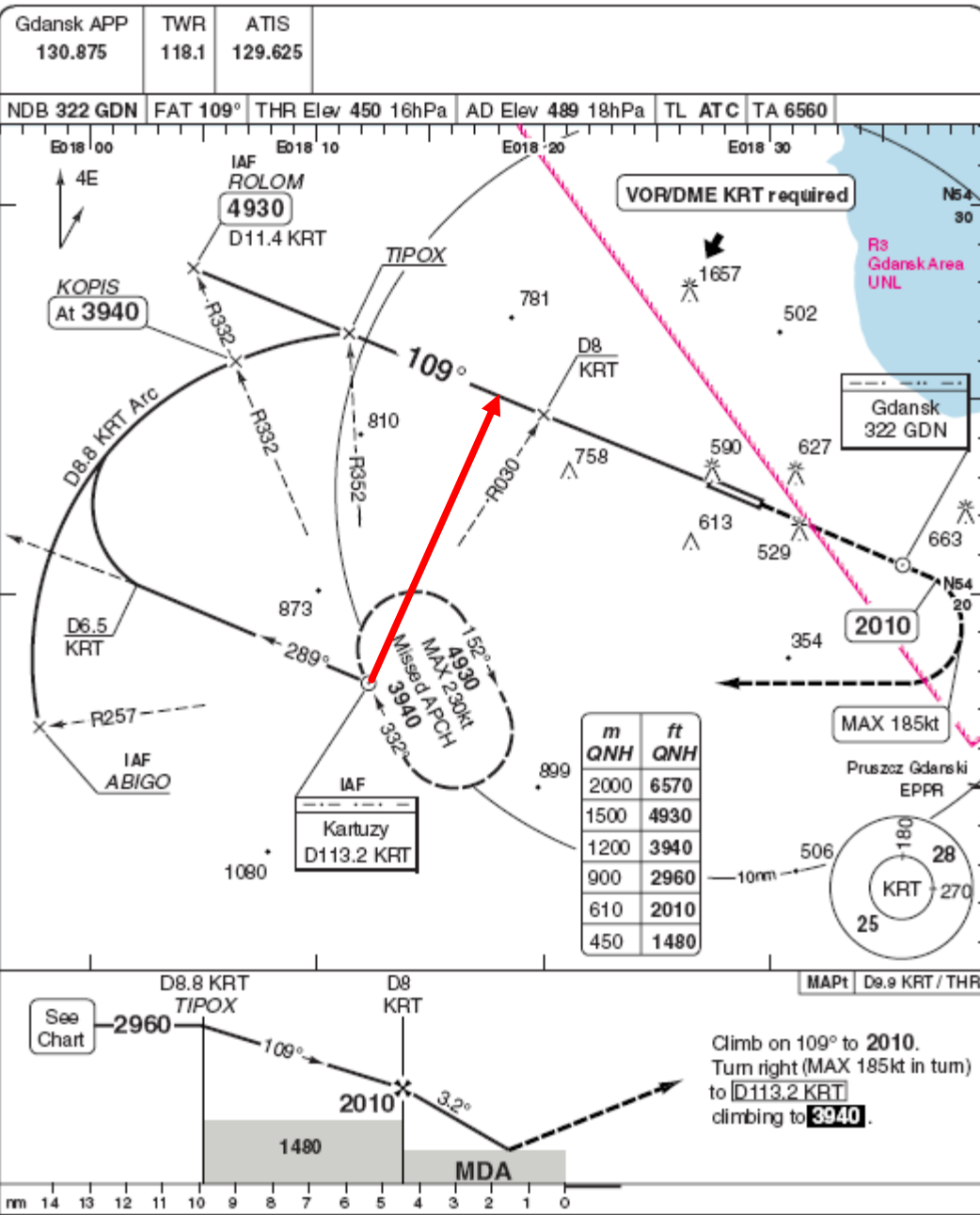
WEF 11 FEB 10

50 -3 21 JAN 10

Poland - EPGD / GDN

NDB RWY 11

Lech Walesa GDANSK



INVESTIGATION REVEALED: NO MALFUNCTIONS AND
NO FAULTS WITHIN EGPWS DATABASE.
POOR READING OF A COMPLICATED APPROACH
PROCEDURE AND NEGLECT OF EGPWS PROCEDURES.

- MAJOR PROBLEM: TWO FLIGHTS ELECTED TO CONTINUE THE APPROACH DESPITE EGPWS WARNINGS.
- POOR APPROACH DESIGN
- LACK OF NAV AIDS
- CPT PROC RESTRICTED USE OF VOR RADIAL..

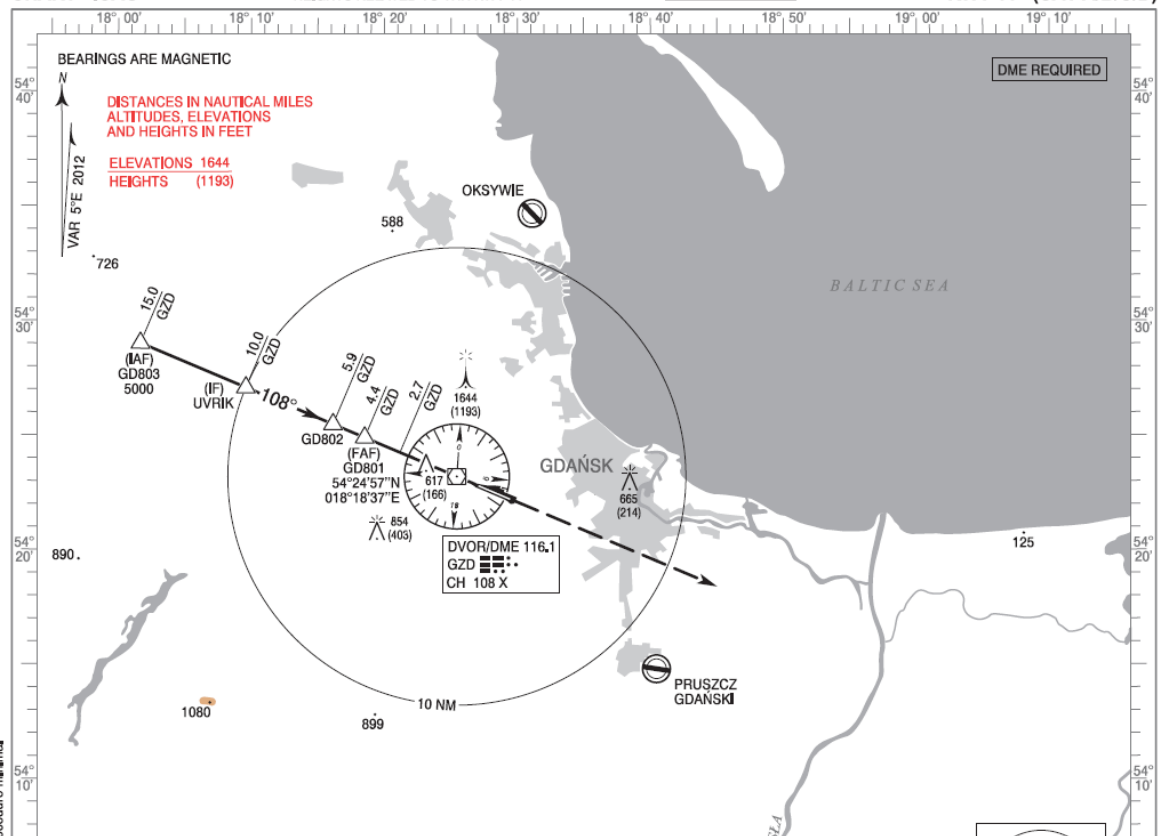
NEW GDANSK PROCEDURES

INSTRUMENT APPROACH CHART - ICAO

AERODROME ELEV 489 ft
THR RWY 11 ELEV 451 ft
HEIGHTS RELATED TO THR RWY 11

ATIS	129.625
APP	127.275
DIRECTOR	119.650
TWR	118.100

GDAŃSK / Lech Walesa
VOR
RWY 11 (CAT A/B/C/D)

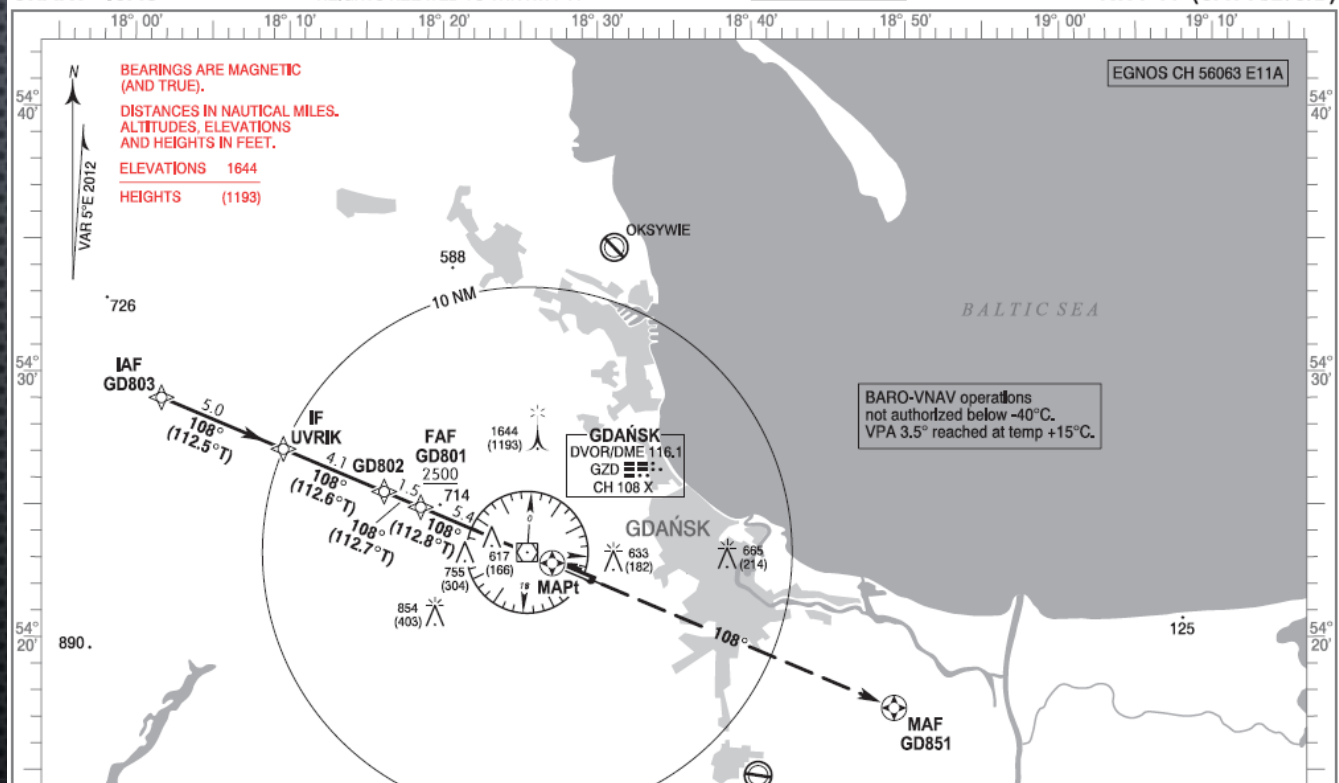


INSTRUMENT APPROACH CHART - ICAO

AERODROME ELEV 489 ft
THR RWY 11 ELEV 451 ft
HEIGHTS RELATED TO THR RWY 11

ATIS	129.625
APP	127.275
DIRECTOR	119.650
TWR	118.100

GDAŃSK / Lech Walesa
RNAV (GNSS)
RWY 11 (CAT A/B/C/D)



PART TWO...

SUSPENDED GNSS/RNAV PROC AT KJEVIK

INSTRUMENT APPROACH CHART - ICAO PLAN VIEW SCALE: 1:400 000

40 MSA 25 NM ARP	ATIS: 124.475	AERODROME ELEVATION: 57 FT	
	APP: 119.950	THR ELEVATION: 41 FT	DIST IN NM
	TWR: 119.950 118.100 (122.100)	HGT RELATED TO THR RWY 04	ELEV, ALT AND HGT IN FT
	VDF: 119.950	BEARINGS ARE MAGNETIC - VAR 1.6 ° E (2015)	
		CIRCLING HGT RELATED TO AD ELEV	
		RNAV _(GNSS) RWY 04	
		TRANSITION ALTITUDE	
		7000	

KRISTIANSAND

KJEVIK

RNAV_(GNSS) RWY 04

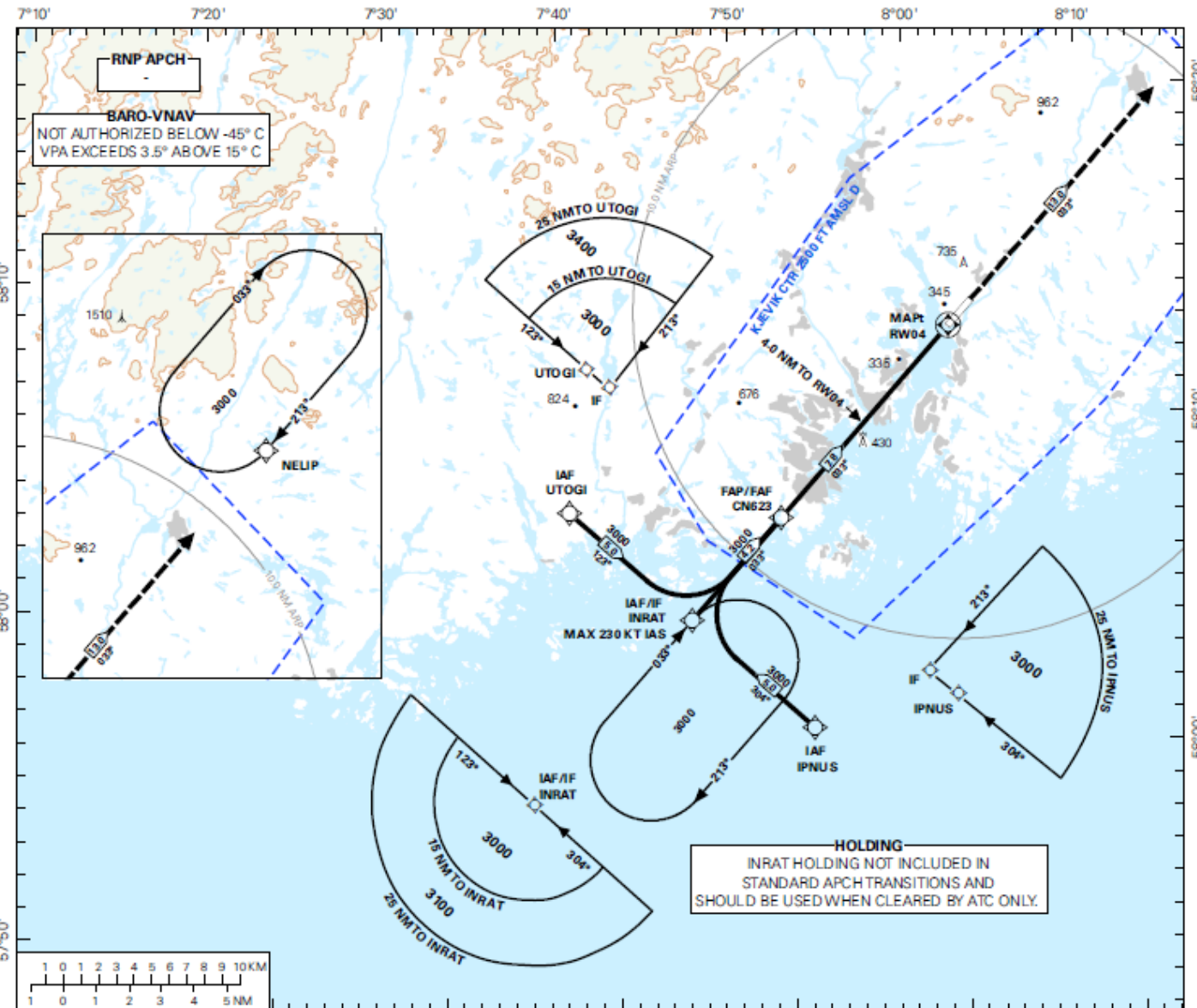
TRANSITION ALTITUDE

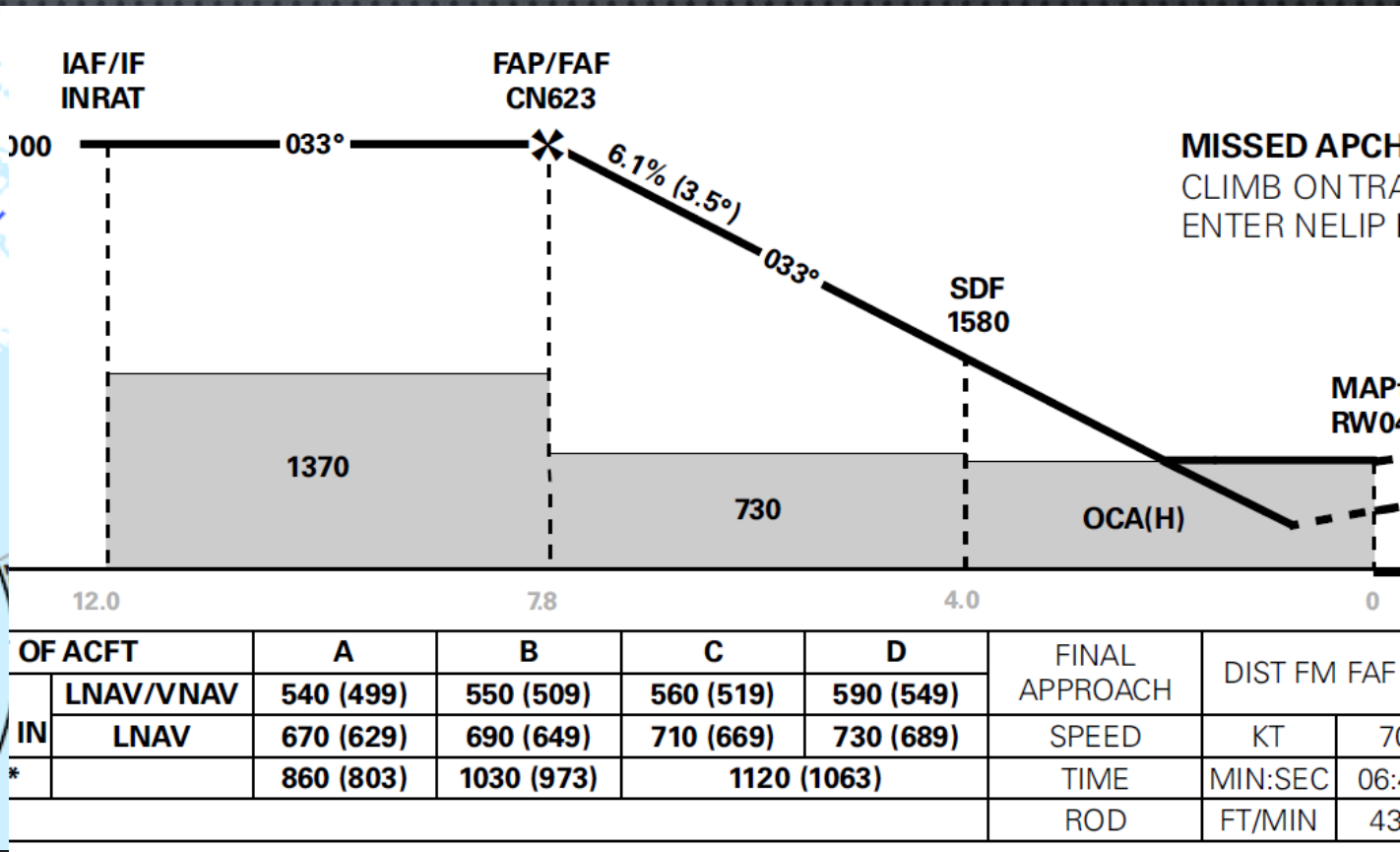
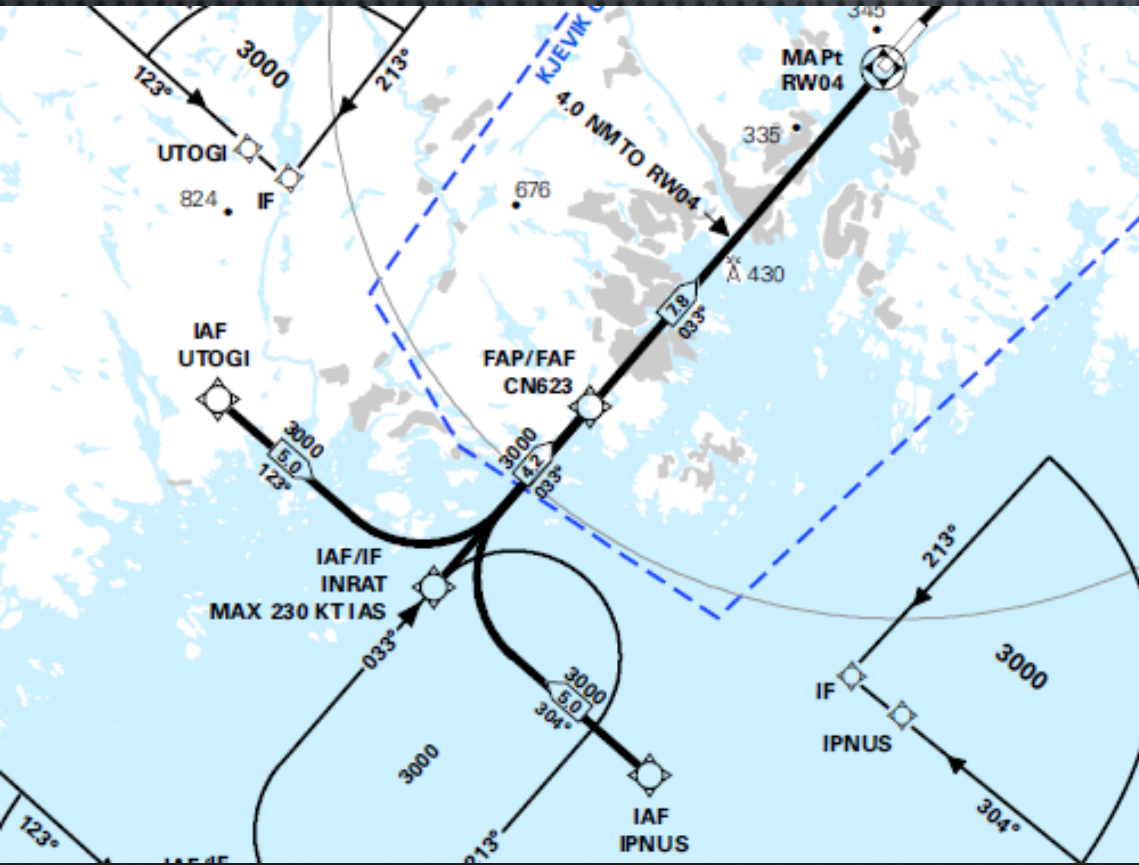
7000

LOSS OF GPS SIGNALS

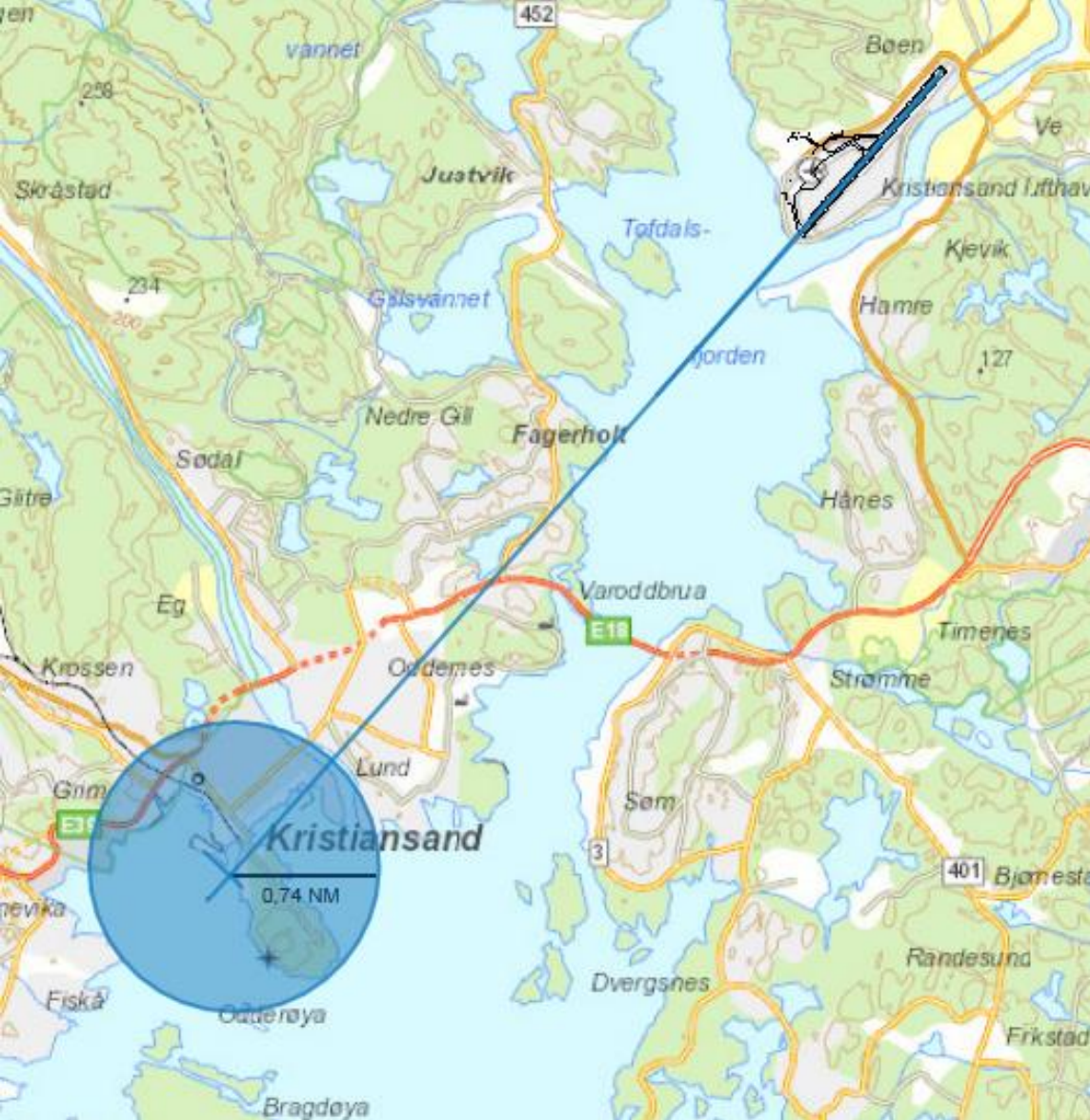
- SEVERAL AIRCRAFT REPORTED LOSS OF GPS RECEPTION OVER KRISTIANSAND

JANUARY 2015!





RCLING E OF AD ONLY

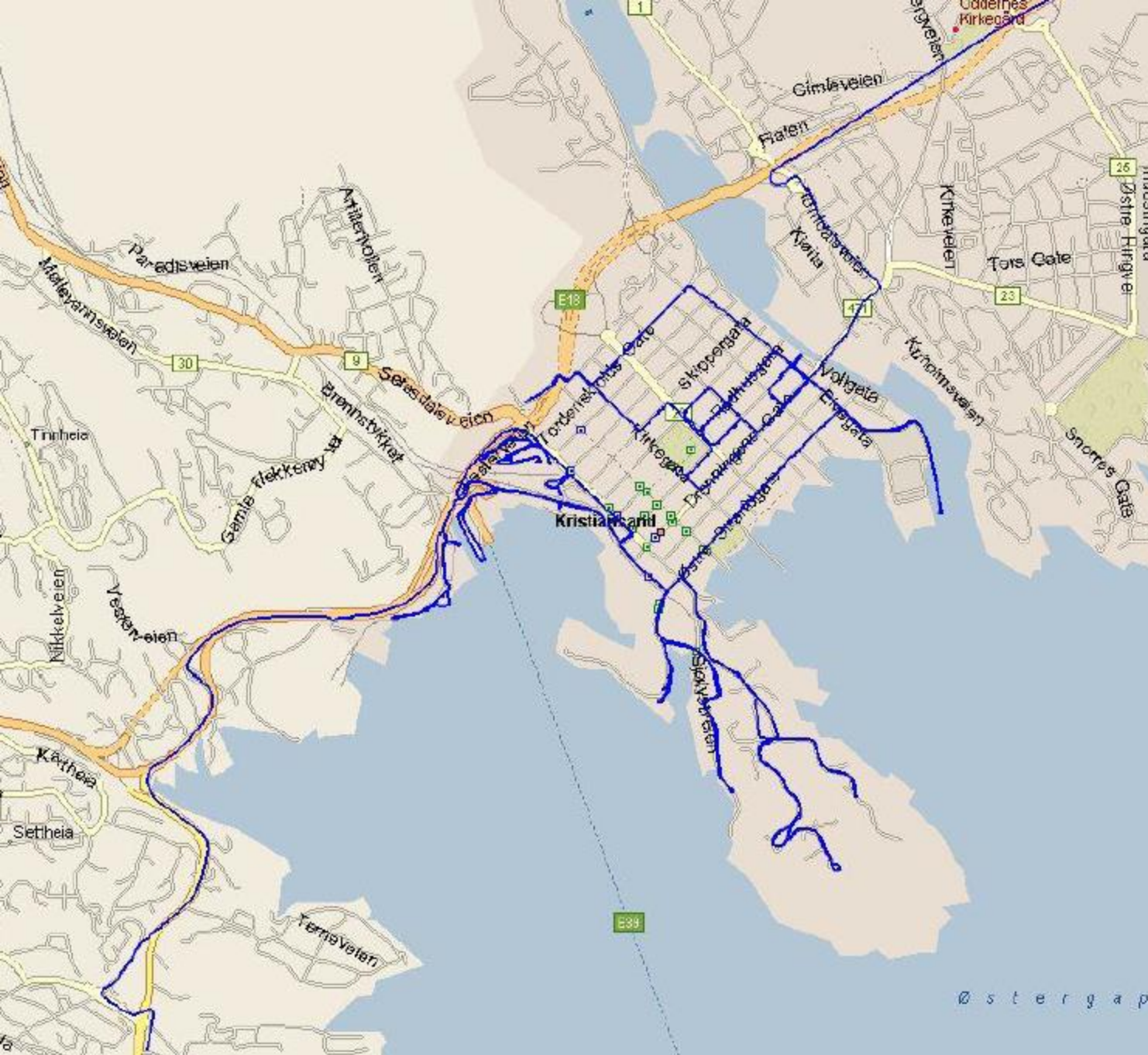


WHAT WAS DONE?

CONFUSION OVER RESPONSIBILITIES..

- AVINOR TECHNICAL CENTRE WAS NOTIFIED A WHILE AFTER THE EVENT. AND SUBSEQUENTLY NKOM WAS NOTIFIED. (NKOM, NORWEGIAN COMMUNICATION AUTHORITY)
- AVINOR HAD NO PROCEDURE FOR HANDLING SUCH REPORTS. (IT IS NOW DESCRIBED, HANDBOOK FOR ATM. [FS-H-L001-45](#))
- WHO'S RESPONSIBILITY IS IT..? MINE?





Nkom control 24.2.2015
GPS-freq: L1 (1575,42 MHz)
og L2 (1227,60 MHz)
One 'hit' mid centre of town.

Spectrum strategy for the Norwegian Communications Authority 2015-2016

Illegal use of frequencies

Nkom's frequency monitoring service supervises frequency use in Norway and documents illegal and/or improper use.

Through targeted campaigns Nkom aims to identify non-compliant or illegal use of products that creates problems for frequency users. Products of this nature include mobile amplifiers, d-GPS transmitters and DECT phones.

Nkom provides information to prevent illegal use of frequencies, but also campaigns against illegal use of frequencies, and follows up any detected issues with sanctions in accordance with the law and regulations. The sanctions imposed shall reflect the severity of the case in hand.

CHALLENGES FOR THE INDUSTRY.

- GNSS/PBN PROCEDURES AS A 'STAND ALONE' SYSTEM ?
 - - NO GROUND BASED EQUIPMENT
 - - NO AUTOMATED WARNING SYSTEMS
 - - NO RESPONSIBLE FUNCTION WITHIN AVINOR ?
LEGALLY...FORMAL... INFORMAL...PUBLIC PERCEIVED

RNAV APPROACHES AND NEW AIRPORTS. (PART THREE)



COCKPIT WORKLOAD.. AN ISSUE?

- THE PHYSICAL INSTALLATION IN CPT IS DIFFICULT TO ALTER..
- THE NAV COMPUTER.. DEFAULT : COMPARE VOR, MULTI DME, IRS AND GPS SIGNALS.
- PREPARING A GNSS APPROACH IS MORE COMPLICATED THAN PREPARING FOR AN ILS
- HARDWARE MUST BE RE-PROGRAMMED FROM ITS ORIGINAL OBJECTIVE.



HIGHSPEED WALKTHROUGH OF FMC SETUP FOR
AN LNAV/VNAV GNSS APPROACH..

THIS IS AN EXTRACT FROM CREW TRAINING 2010

TYPES OF RNAV APPROACHES



- RNAV GNSS (GPS)

- NPA (NON PRECISION APPROACH)

LNAV MINIMA

- APV (APPROACH WITH VERTICAL GUIDANCE)

LNAV/VNAV MINIMA

- RNAV (RNP) AR

- APV APPROACH WITH VERTICAL GUIDANCE

LNAV/VNAV MINIMA

RNAV GNSS (GPS) **NPA**

- **NPA** (NON PRECISION APPROACH)

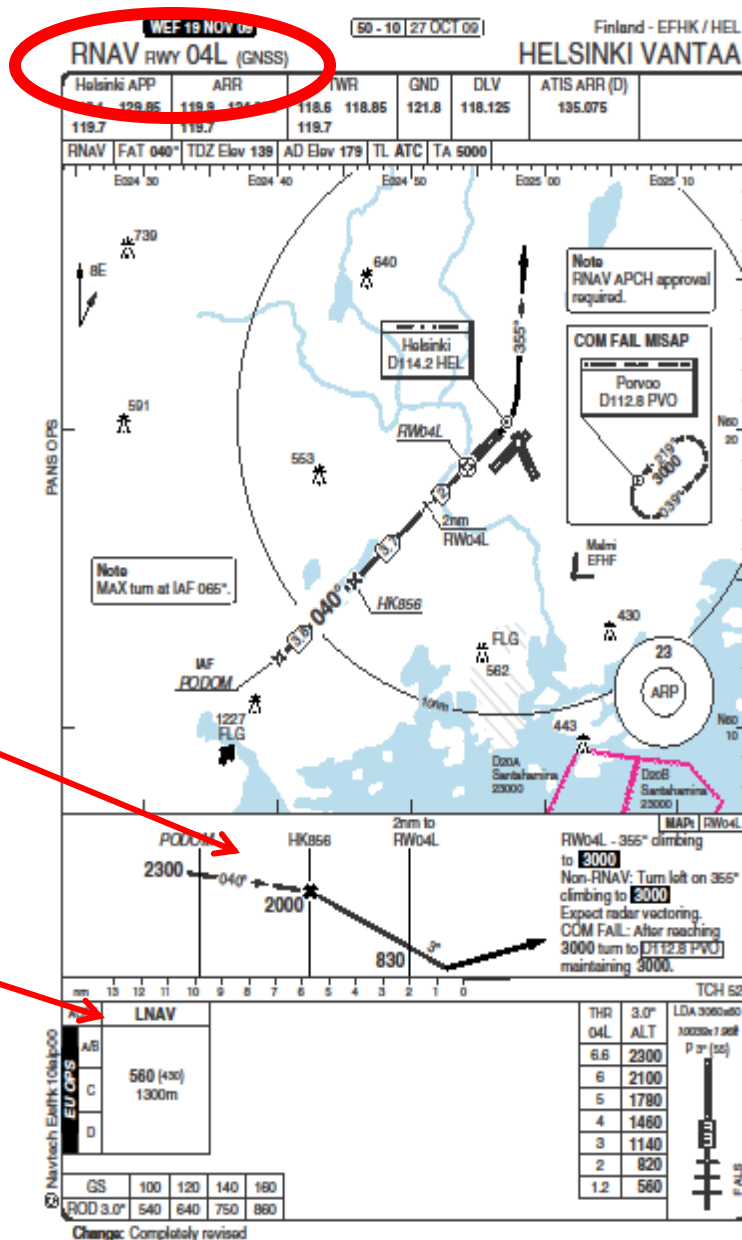
- - LNAV MINIMA ONLY

- TEMPERATURE CORRECTION REQUIRED FOR ALL ALTITUDES BELOW MSA TO ENSURE OBSTACLE CLEARANCE.

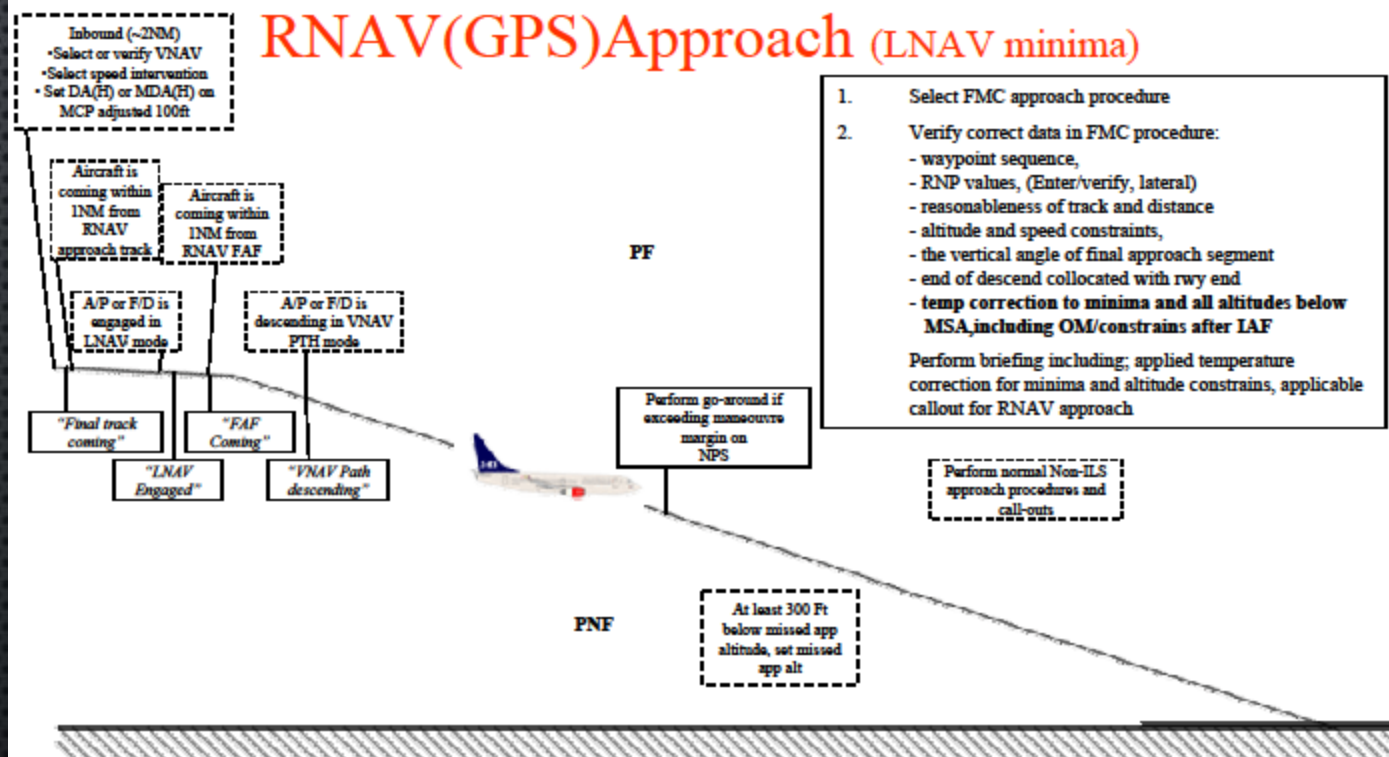
NPA (Non Precision Approach)

Temperature correction required for all altitudes below MSA.

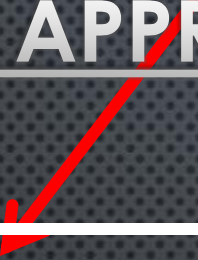
LNAV minima only



RNAV(GPS) Approach (LNAV minima)



TYPES OF RNAV APPROACHES



- RNAV GNSS (GPS)

➤ APV (APPROACH WITH VERTICAL GUIDANCE)

LNAV/VNAV MINIMA

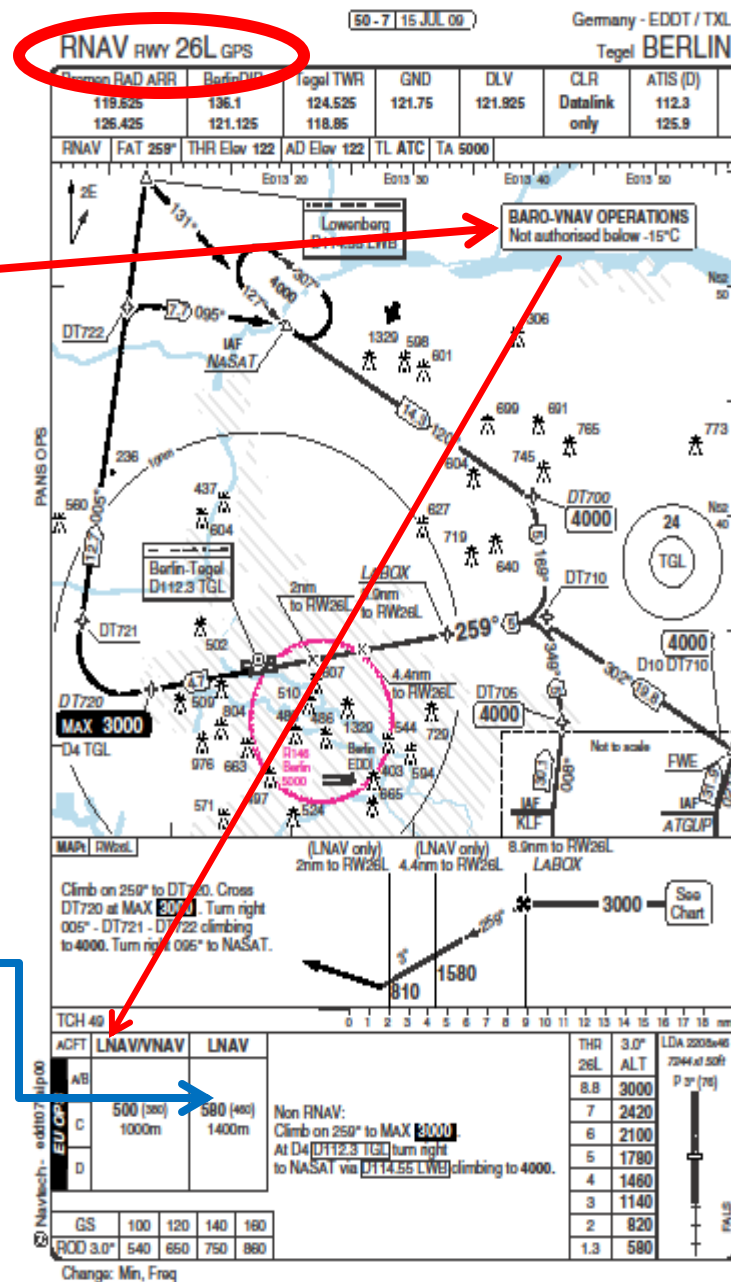
RNAV GNSS (GPS) **APV**

- APV (APPROACH PROCEDURE WITH VERTICAL GUIDANCE)
 - USE LNAV/VNAV MINIMA (WITHIN TEMP LIMIT).
 - TEMPERATURE CORRECTION FOR MINIMA ONLY.
-
- ❖ IF OUTSIDE TEMP LIMIT USE NPA PROCEDURE (LNAV MINIMA).

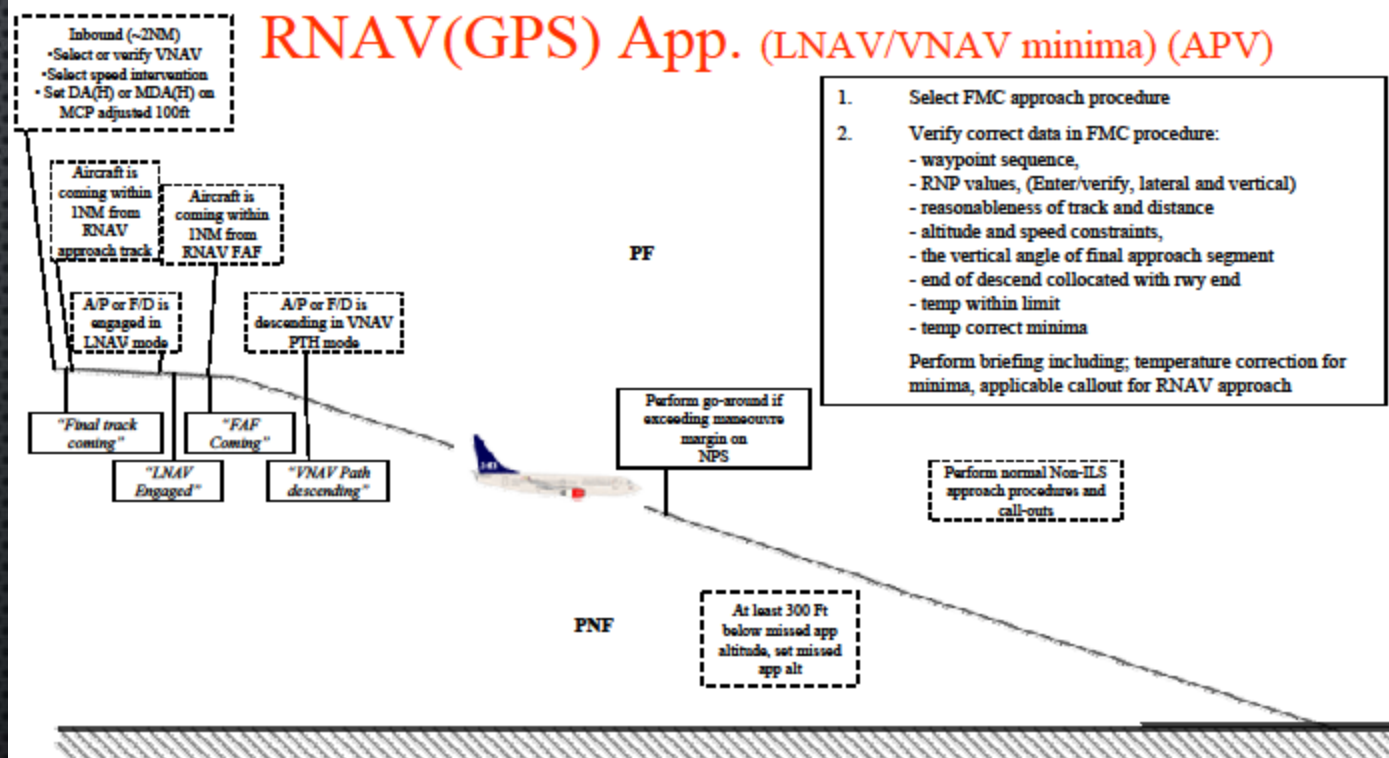
Must be within temperature limits
In order to use LNAV/VNAV minima

No temperature corrections except for minima (LNAV/VNAV)

Note: If outside temperature limits use LNAV minima and procedure for NPA (non precision approach)



RNAV(GPS) App. (LNAV/VNAV minima) (APV)



GENERAL RNAV FLIGHT DECK PREPARATION

FOLLOWING APPLIES FOR ALL RNAV APPROACHES

- SELECT THE RNAV APPROACH PROCEDURE FROM DEP/ARR PAGE
- NEVER BUILD YOUR OWN PROCEDURE OR CHANGE ANY VALUES FOR THE FAF WAYPOINT OR BEYOND.
- TEMP ADJUST MINIMA

RW32

GENERAL RNAV FLIGHT DECK PREPARATION

- LEGS Page



CHECK FOLLOWING DATA ON
LEGS PAGE AGAINST CHART.

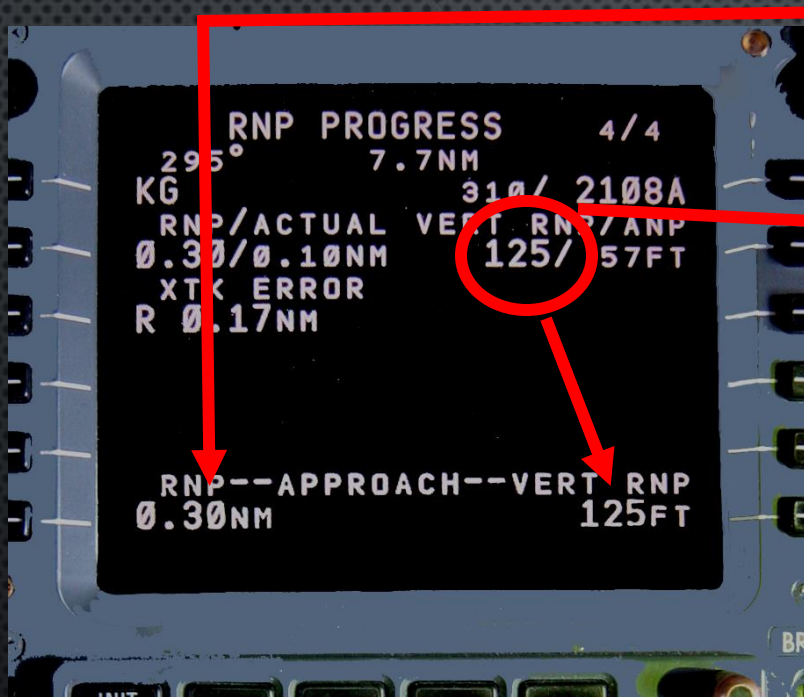
- G/P ANGLE DISPLAYED.
- ALTITUDES.
- CHECK TRACK AND DISTANCE FROM FAF TO RW TO BE REASONABLE.
- DO NOT USE THE PROCEDURE IF ERRORS ARE FOUND.



- VERIFY THAT THE RWY WAYPOINT & E/D IS COLLOCATED
- DO NOT USE THE PROCEDURE IF ERRORS ARE FOUND.

GENERAL RNAV FLIGHT DECK PREPARATION

PROGRESS Page 4/4



- VERIFY LATERAL RNP = 0. __ NM
- ENTER VERTICAL RNP = 125 FT
(NOT APPLICABLE YA311-552)

GENERAL RNAV FLIGHT DECK PREPARATION

- **ADDITIONAL PREPARATION IF USING LNAV MINIMA**
- TEMPERATURE CORRECTION REQUIRED FOR ALL ALTITUDES BELOW MSA TO ENSURE OBSTACLE CLEARANCE. (ENTER CORRECTIONS ON LEGS PAGE)

RNAV APPROACH FLIGHT DECK PROCEDURE

SAME PROCEDURE APPLIES FOR ALL RNAV APPROACHES

- CHECK ENGAGED OR ENGAGE LNAV AND VNAV (SPEED INTERVENTION)
- VERIFY THAT LNAV/VNAV PTH ANNUNCIATES ON FMA

APPROXIMATELY 2 NM BEFORE FAF

- RESET MCP ALTITUDE TO MINIMA, ADJUSTED TO NEAREST +100FT ABOVE MINIMA IF NECESSARY.
- WHEN PASSING 300 FT BELOW MISSED APPROACH ALTITUDE, SET MISSED APPROACH ALTITUDE. (CHECK FMA FOR VNAV PTH TO REMAIN ACTIVE PITCH MODE).

RNAV APPROACH FLIGHT DECK PROCEDURE

**THERE ARE TWO ALTERNATIVES TO MONITOR YOUR LATERAL AND VERTICAL
DEVIATION:**

1. PF AND PNF MONITOR NAVIGATION PERFORMANCE SCALES (NPS) ON THE PFD.
2. PNF MONITOR MCDU PROGRESS PAGE 4. (YA311-552)

RNAV APPROACH FLIGHT DECK PROCEDURE

- METHOD 1:

PF AND PNF MONITOR VERTICAL AND LATERAL DEVIATION ON PFD AND ND (NPS). IF OUTSIDE MANOUVERRINGAREA (RNP MINUS ANP) AFTER PASSING FAF PERFORM A MISSED APP.

(IF OUTSIDE MORE THAN 10 SECONDS, THE BARS TURN AMBER AND THE POINTER STARTS FLASHING.)



- METHOD 2: (YA311-552)

PNF MONITORS VERTICAL AND LATERAL DEVIATION ON PROGRESS PAGE 4/4. IF VALUES EXCEEDS:

“XTR ERROR” > RNP

“VERT DEV” > -75 FT

AFTER PASSING FAF PERFORM A MISSED APP.



RNAV (RNP) AR

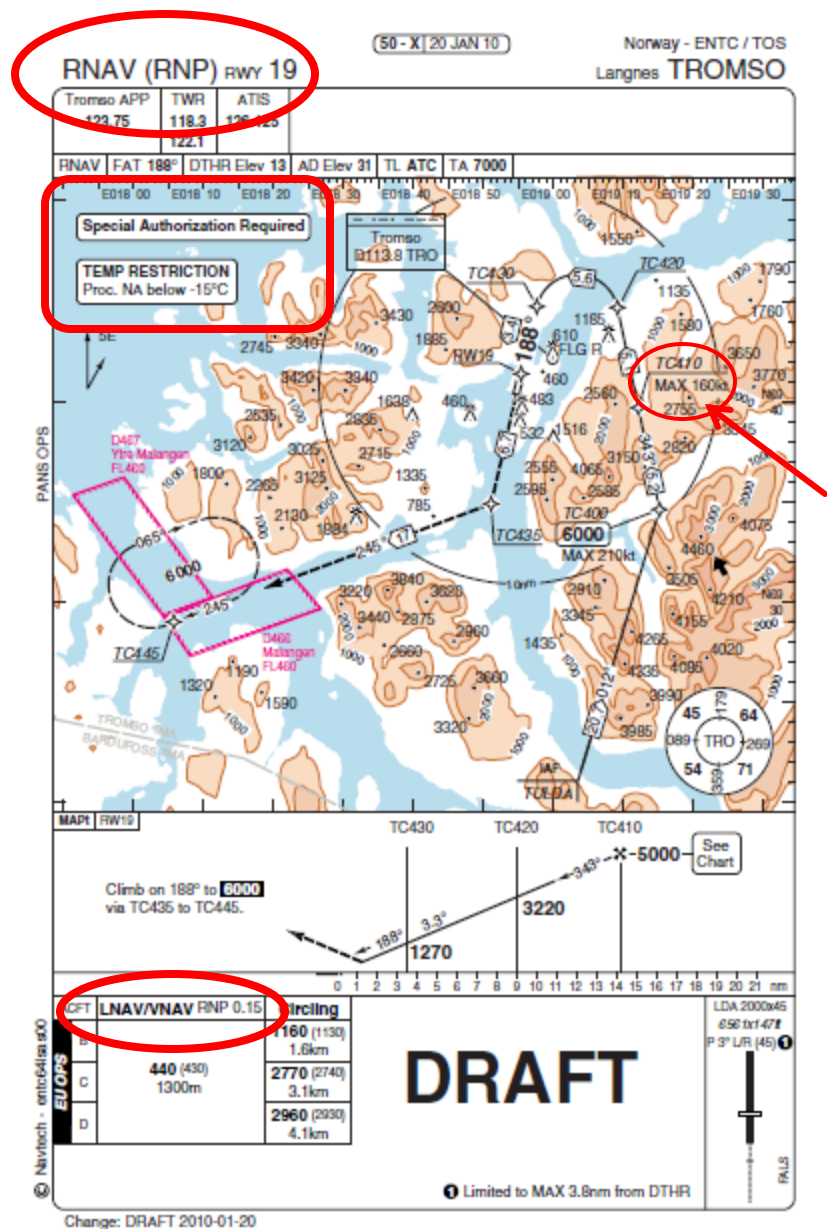


Approach Procedure with Vertical Guidance

RNAV (RNP) AR APPROACH PREPARATION

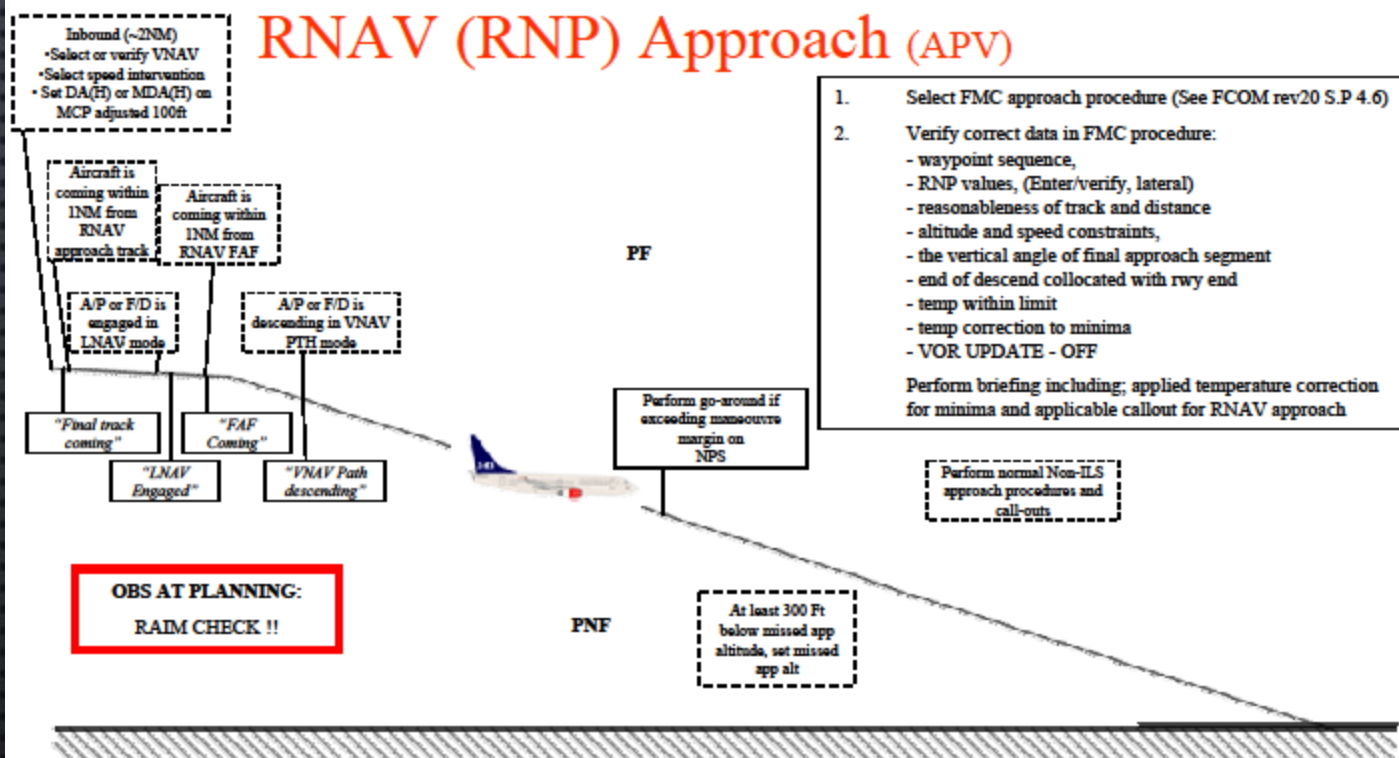
REVIEW SP.4.6.

1. CHECK MIN TEMP WITHIN LIMITS
2. DEP/ARR PAGE: RNAV RWY...
3. LEGS PAGE: CHECK COURSE, DIST, ALT AND SPEEDS TO BE REASONABLE.
4. ND: CHECK RWY WAYPOINT & E/D COLLOCATED (PLN MODE)
5. NAV STATUS 2/2: VOR UPDATE OFF. (MCDU: PROG- NAV STATUS - PAGE2)
6. PROG PAGE 4/4: CHECK/SET RNP 0,.. SET VERT RNP 125 (NOT APPLICABLE YA311-552)



NOTE MAX
SPEED 160

RNAV (RNP) Approach (APV)



1. Select FMC approach procedure (See FCOM rev20 S.P 4.6)
 2. Verify correct data in FMC procedure:
 - waypoint sequence,
 - RNP values, (Enter/verify, lateral)
 - reasonableness of track and distance
 - altitude and speed constraints,
 - the vertical angle of final approach segment
 - end of descend collocated with rwy end
 - temp within limit
 - temp correction to minima
 - VOR UPDATE - OFF
- Perform briefing including: applied temperature correction for minima and applicable callout for RNAV approach

THE SHORT VERSION!!



NON ILS using FMC

1. Track/Distance/Alt
2. GP°
3. RW.. on legs page
4. Temp corr
5. RAW data

Exampel: any
NDB- LLZ- VOR-appr.

RNAV GNSS

LNAV/VNA V Minima

1. Track/Distance/
Alt
2. GP°
3. E/D at RWY THR
4. Temp within
limits
5. RNP 0.3/125

Exampel:
AGH

LNAV Minima

1. Track/Distance/
Alt
2. GP°
3. E/D at RWY THR
4. Temp corr
5. RNP 0.3

Exampel:
FRA HAN TXL HEL

RNAV (RNP) AR

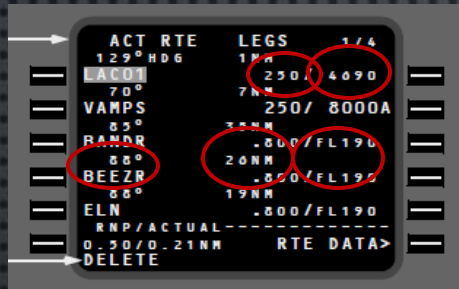
RAIM Prediction

1. Track/Distance/Alt/S
pd
2. GP°
3. E/D at RWY THR
4. Temp within limits
5. VOR - OFF
6. RNP 0.xx /125 if pos.

Exampel:
INN ARN01R TOS

Procedure for checking the FMC setup before starting a RNAV approach (LNAV minima or LNAV/VNAV minima)

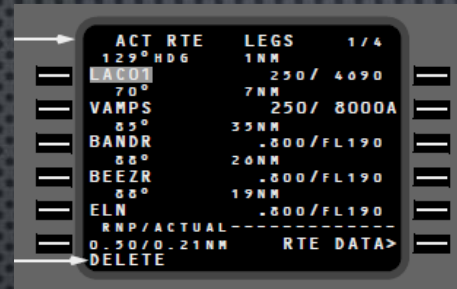
Step 1.
Legs page



Check
track/distans/alt/spd
Check GP angle

(Temp corrections to
altitudes if using LNAV
minima.

Step 2.
Legs page

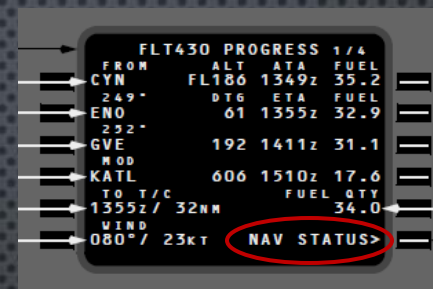


Still on LEGS page select
plan mode on nav display

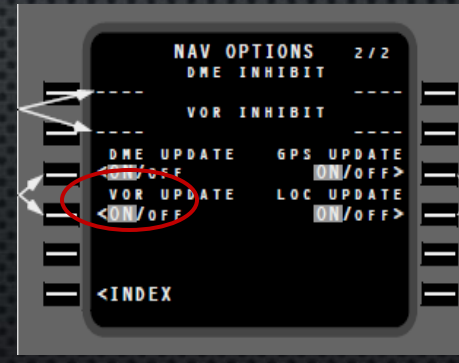


Check runway symbol
to
be collocated with E/D

Step 3.
Progress page 1

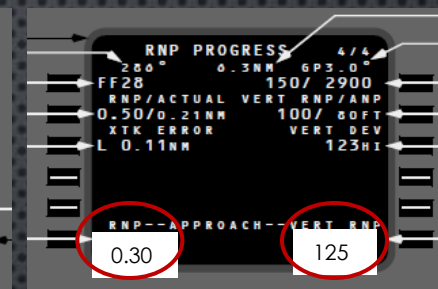


NAV STATUS – next page



Select VOR UPDATE -
OFF

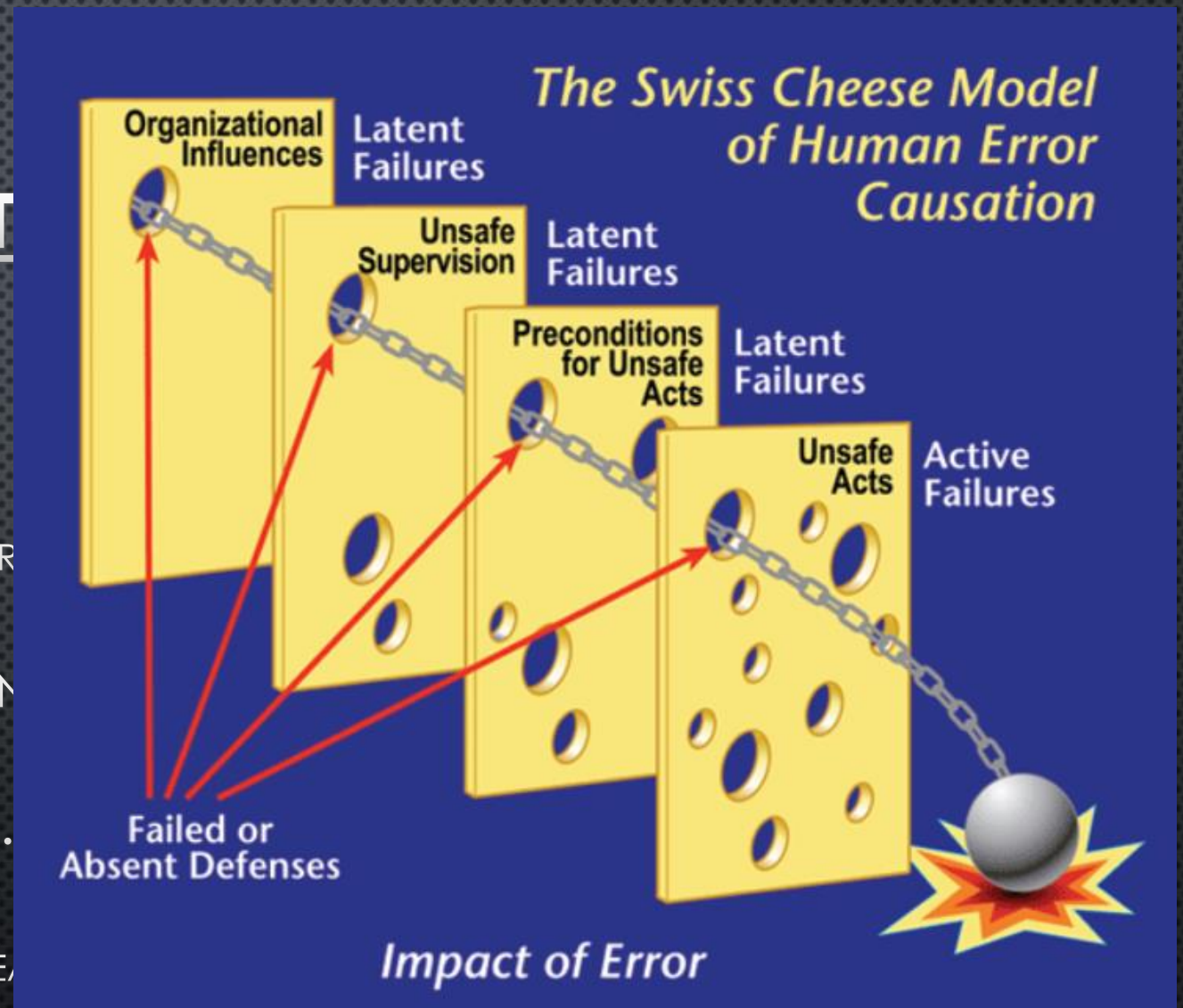
Step 4.
Progress page 4



Check approach RNP 0....
Enter VERT RNP 125 ft
(Not applicable YA311-552)

ADDITIONAL CALL OUT

- “LNAV ENGAGED”WHEN APPROACH FIX
- “FINAL TRACK COMING”...WITHIN 1 NM
- “FINAL APPROACH FIX COMING”....
- “VNAV PATH DESCENDING”WHEN LEAVING



FUTURE.. NEW AND EXISTING AIRPORTS..

- AIRPORT OWNERS ARE PLANNING/CONTEMPLATING TO REMOVE CONVENTIONAL NAV AIDS. (ILS/GP)
- NEW AIRPORT IS PLANNED TO HAVE NO NAV AIDS IN COMBINATION WITH NO SURVAILANCE.
 - GULLKNAPP NORTH EAST OF KRISTIANSAND



GULLKNAPP

NO BACKUP, NO
VERIFICATION OF
GPS..



100W Super GPS Jammer

Price: [Get Latest Price](#)

Min. order: 1 Piece

Trade Terms: FOB, CIF, EXW

Payment Terms: L/C, T/T, Paypal, Money Gram, Western Union

Trademark: APEC



[Enlarge Image](#)



Researchers successfully hack US drone by spoofing GPS

Article by: Darren Griffin

Date: 1 Jul 2012



Researchers in the US have hacked into a drone and succeeded in taking control of it.

The researchers, from the University of Texas were able to demonstrate how they spoofed the GPS signals being used to direct the drone. US Department of Homeland Security officials were present to witness the hack attempt.

Iran claimed to have taken control of a US RQ-170 drone in 2011 and put the drone on display.

Although in this case the drone was utilising the unencrypted civilian GPS data signal, it demonstrates the security issues surrounding the increased use of drones for military surveillance and attack purposes. Whilst, technically, much more difficult to spoof the encrypted military GPS signal, it's not impossible and the risk of terrorists being able to take control of a heavily armed drone cannot be ignore.

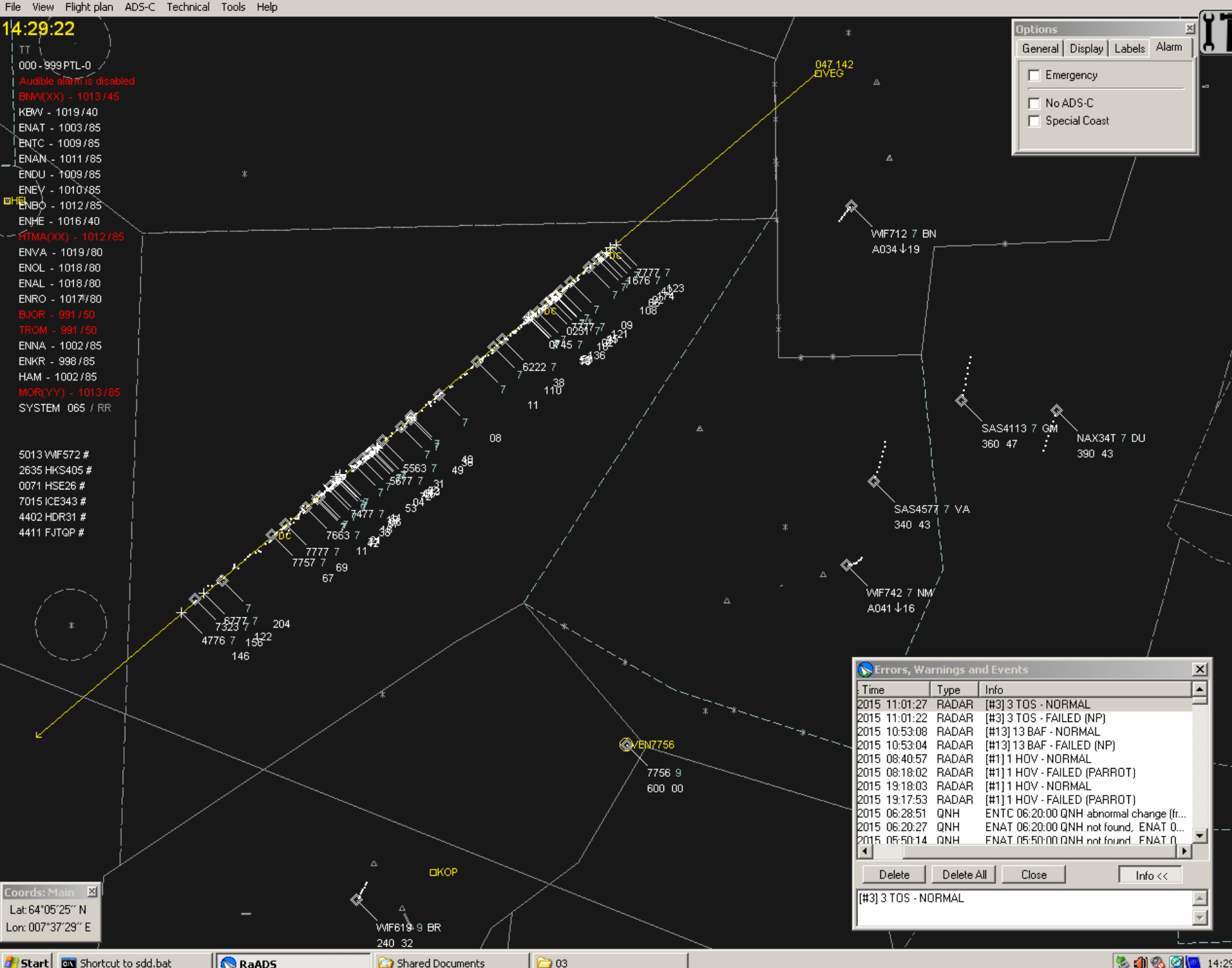
Source: [FOX News](#)

14:29:22

TT
000-999 PTL-0
Audible alarm is disabled
BNW(XX) - 1013/45
KEW - 1019/40
ENAT - 1003/85
ENTC - 1009/85
ENAN - 1011/85
ENDU - 1009/85
ENEY - 1010/85
ENBO - 1012/85
ENHE - 1016/40
HTMA(XX) - 1012/85
ENVA - 1019/80
ENOL - 1018/80
ENAL - 1018/80
ENRO - 1017/80
BJOR - 991/50
TROM - 991/50
ENNA - 1002/85
ENKR - 998/85
HAM - 1002/85
MOR(VY) - 1013/85
SYSTEM 065 / RR

5013 WMF572 #
2635 HKS405 #
0071 HSE26 #
7015 ICE343 #
4402 HDR31 #
4411 FJTQP #

Coords: Main
Lat: 64°05'25" N
Lon: 007°37'29" E



SUN BURST AND RADAR WOES

November 2015
All traffic in Sweden
suspended.
Norway control
managed ok..
(ARTAS, ATM
surveillance Tracker
And Server)

Time	Type	Info
2015 11:01:27	RADAR	[#3] 3 TOS - NORMAL
2015 11:01:22	RADAR	[#3] 3 TOS - FAILED (NP)
2015 10:53:08	RADAR	[#13] 13 BAF - NORMAL
2015 10:53:04	RADAR	[#13] 13 BAF - FAILED (NP)
2015 08:40:57	RADAR	[#1] 1 HOV - NORMAL
2015 08:18:02	RADAR	[#1] 1 HOV - FAILED (PARROT)
2015 19:18:03	RADAR	[#1] 1 HOV - NORMAL
2015 19:17:53	RADAR	[#1] 1 HOV - FAILED (PARROT)
2015 06:28:51	QNH	ENTC 06:20:00 QNH abnormal change (fr...
2015 06:20:27	QNH	ENAT 06:20:00 QNH not found, ENAT 0...
2015 05:50:14	QNH	FNAT 05:50:00 QNH not found, FNAT 0...

Delete Delete All Close Info <<

[#3] 3 TOS - NORMAL

TUESDAY, 26TH JANUARY, AALTO UNIVERSITY'S LOCATED IN KIRKKONUMMI,
FINLAND

DETECTED A RARE ANOMALY IN TIME REPORTED BY THE GPS SYSTEM

SWEDISH SEA-AUTHORITY HAD LOTS OF THEIR SHIPS "DISSAPEARING" FROM THE AIS SYSTEM ON
WEN (WEB ENABLED NAVY)

- REPORTS FROM EUROPE INDICATE THAT SYSTEMS AT AT LEAST NINE MAJOR CORPORATIONS WERE IMPACTED. SOME OF THOSE COMPANIES PROVIDE CRITICAL NATIONAL INFRASTRUCTURE.

TORP airport....

SO... I HAVE A UNEASY FEELING..

EUROCONTROL: VISION FOR 2020+:

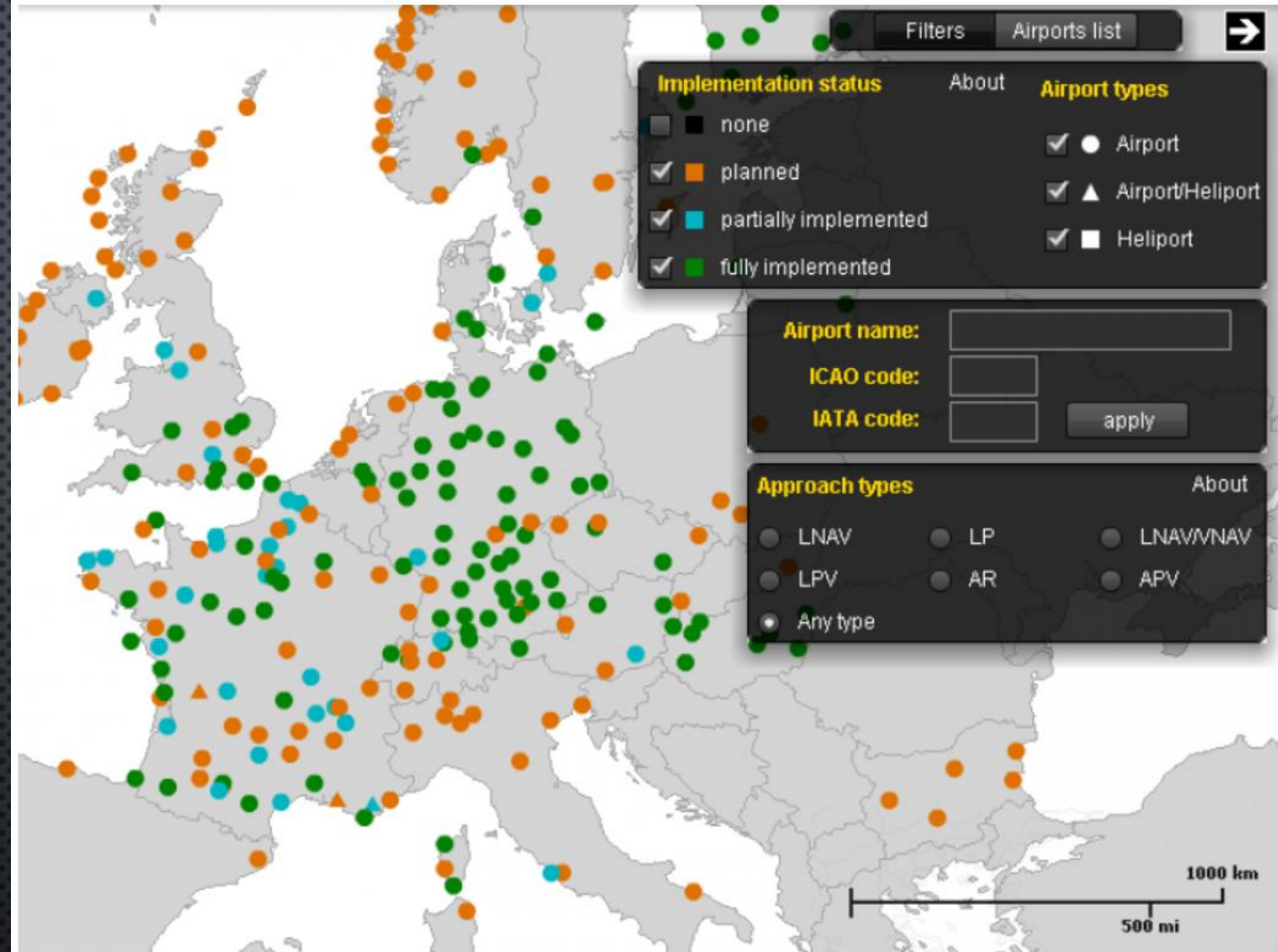
THIS EUROCONTROL POLICY ON GNSS IS BASED ON A GRADUAL RELIANCE ON SATELLITE NAVIGATION

THAT HAS AS FINAL GOAL ITS USE AS SOLE SERVICE, TO THE EXTENT THAT THIS CAN BE SHOWN TO BE THE MOST COST BENEFICIAL SOLUTION AND IF IS SUPPORTED BY A SUCCESSFUL SAFETY AND SECURITY ANALYSES.

THE VISION FOR IMPLEMENTING THIS POLICY IS BASED ON THE COMBINED USE OF SIGNALS COMING FROM AT LEAST TWO CONSTELLATIONS IN DIVERSE FREQUENCY BANDS. USER RECEIVERS WILL PROCESS SIGNALS FROM DIFFERENT GNSS CONSTELLATIONS IN COMBINATION WITH AUGMENTATIONS (E.G. ABAS, GBAS OR SBAS DEPENDING ON INDIVIDUAL BUSINESS CASES AND THE PHASE OF FLIGHT).

The PBN Approach map tool has gone live 05 June 2012

This new tool, developed by EUROCONTROL, illustrates the implementation status and plans for performance based navigation (PBN) final approaches in ECAC area.*.



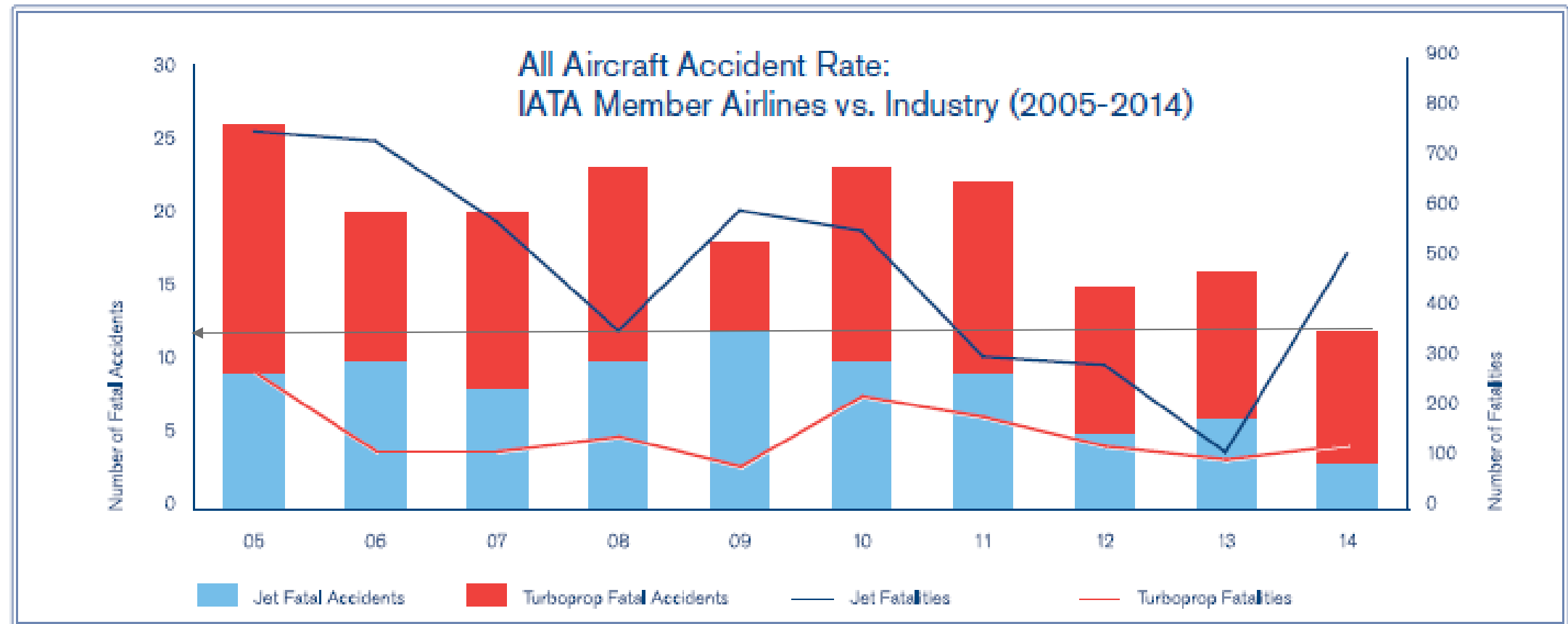
WELL... PROGRESS ? ARE WE MOVING TO FAST?

- GOOD TO LEAVE NON PRECISION APPROACHES BEHIND. AN IMPROVEMENT.
- LEAVE ILS/GP BEHIND FOR GPS BASED PRECISION APPROACHES..? NOT YET.
 - MAN MACHINE INTERFACE..

THANK YOU FOR YOUR ATTENTION

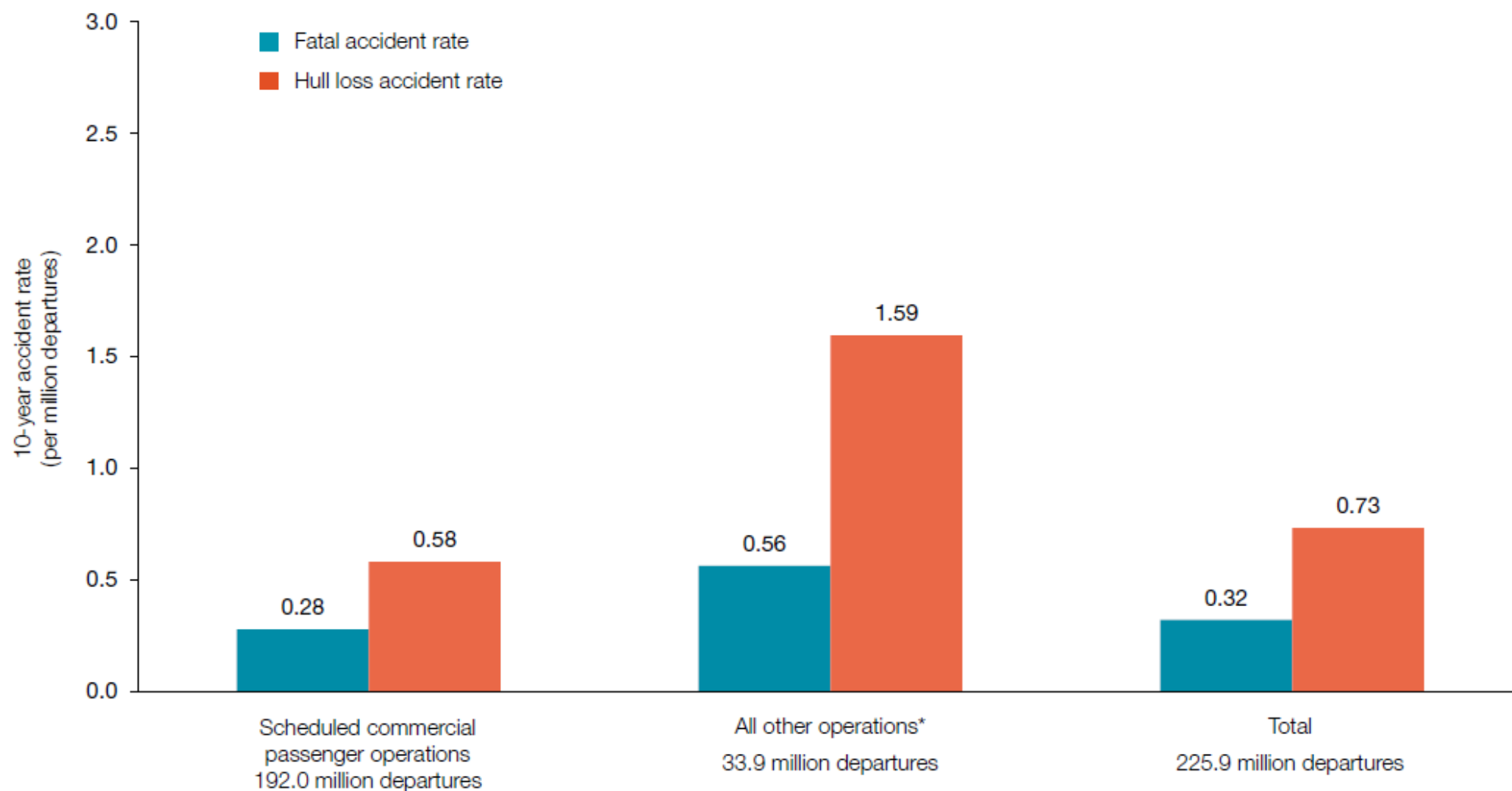


Jet and Turboprop Aircraft: Number of Fatal Accidents and Fatalities (2005-2014)



10-Year Accident Rates by Type of Operation

Fatal and Hull Loss Accidents Worldwide Commercial Jet Fleet | 2005 through 2014



REASON's SWISS CHEESE

The Swiss Cheese Model of Human Error Causation

