P6: Development of new cockpit interfaces

Human Machine Interface (HMI)

Cpt. Carsten Schmidt-Moll
German Lufthansa AG

A full scope simulator

A320 Cockpit

A full scope simulator

New Cockpit Interfaces
- better HMI -

New cockpit interfaces

Simulator research: Technical abnormal

1. HMI: What kind of information?
2. HMI: How to get that information?
3. HMI: When to get the info and how long it takes (timing)?

New cockpit interfaces

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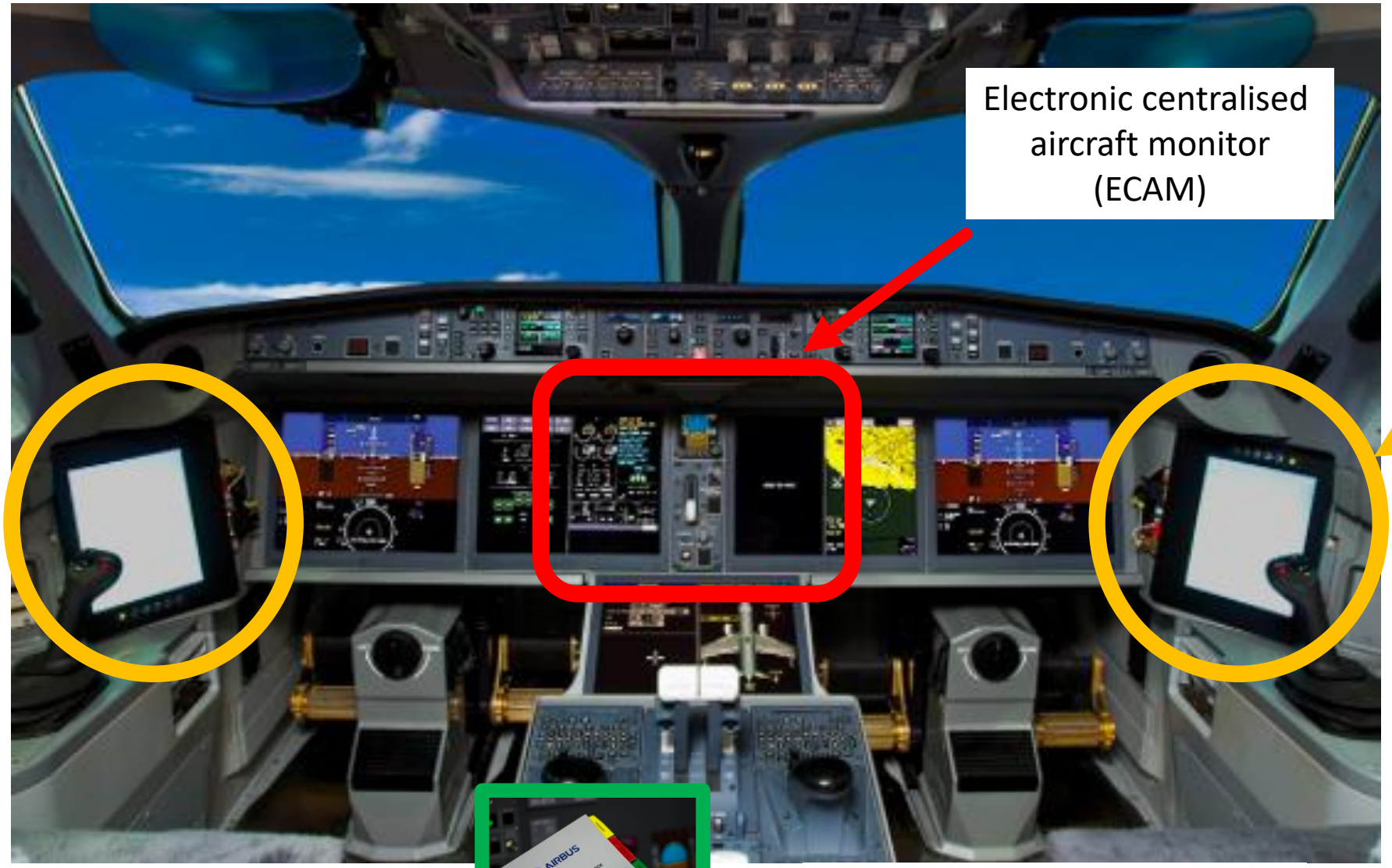
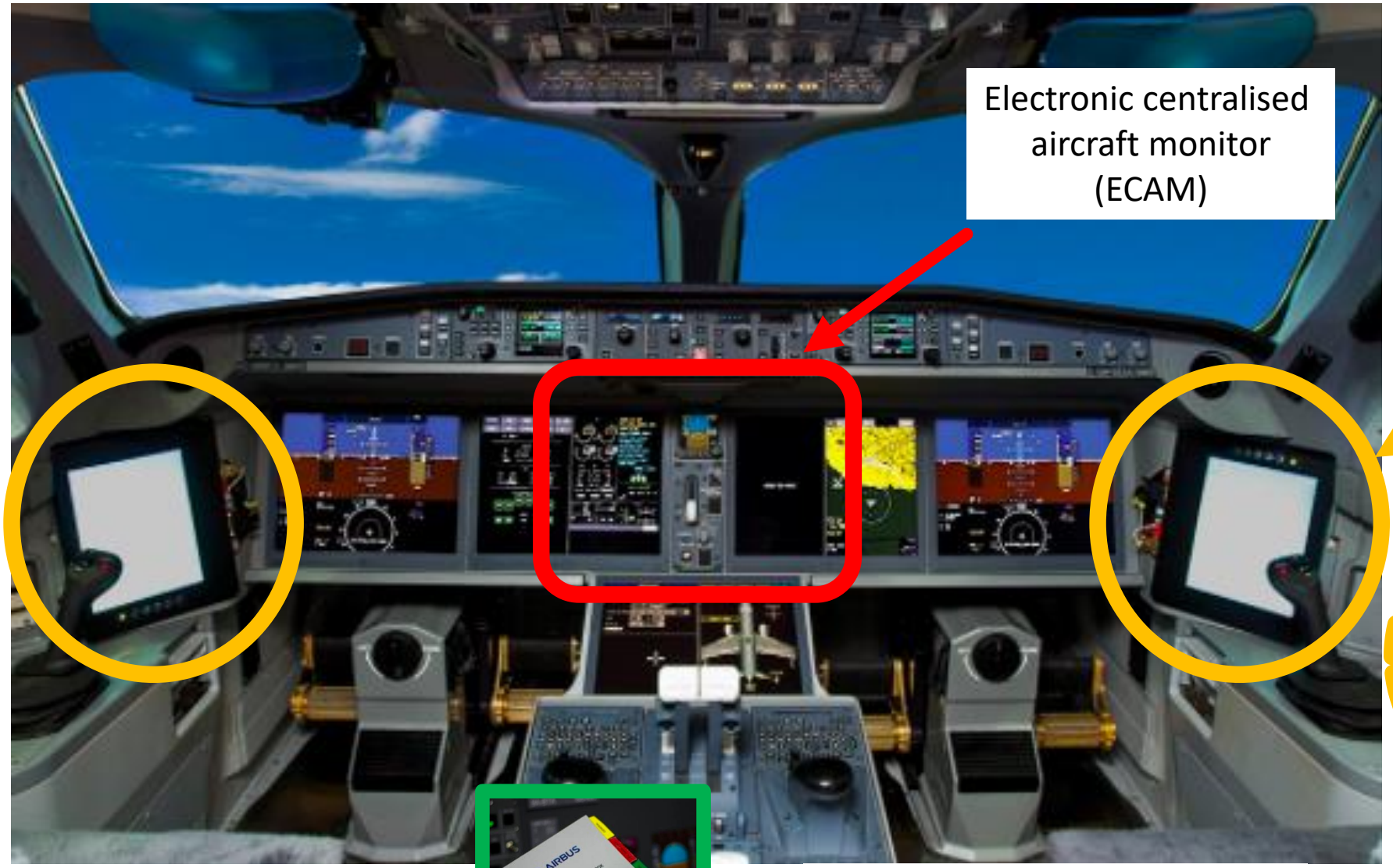
Cockpit Interfaces



Quick Reference Handbook (QRH)

Cockpit Interfaces



Electronic centralised aircraft monitor (ECAM)

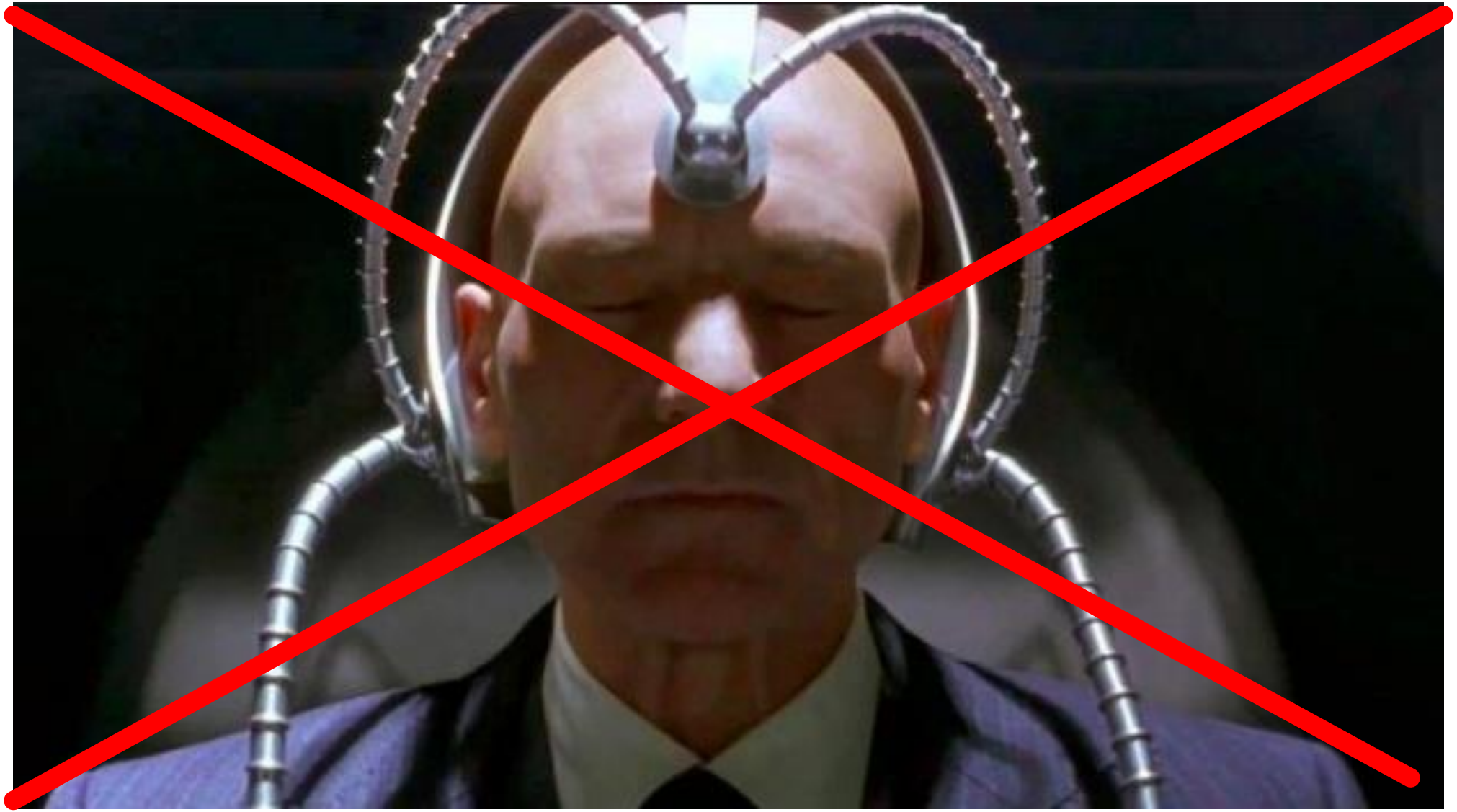
Electronic Flight Bag (EFB)

1. OM-B
2. Landing Performance (LAPA)
3. Charts

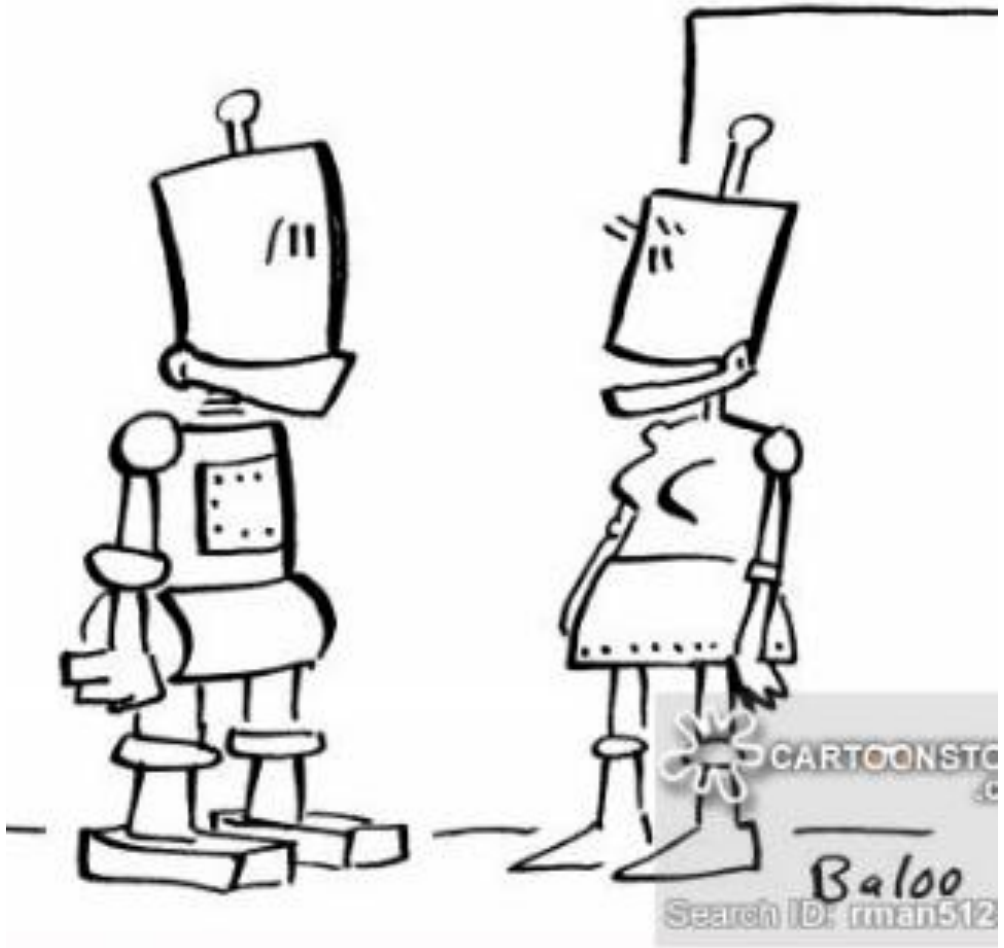
Quick Reference Handbook (QRH)

No artificial intelligence

No artificial intelligence



No interface at all



No interface at all

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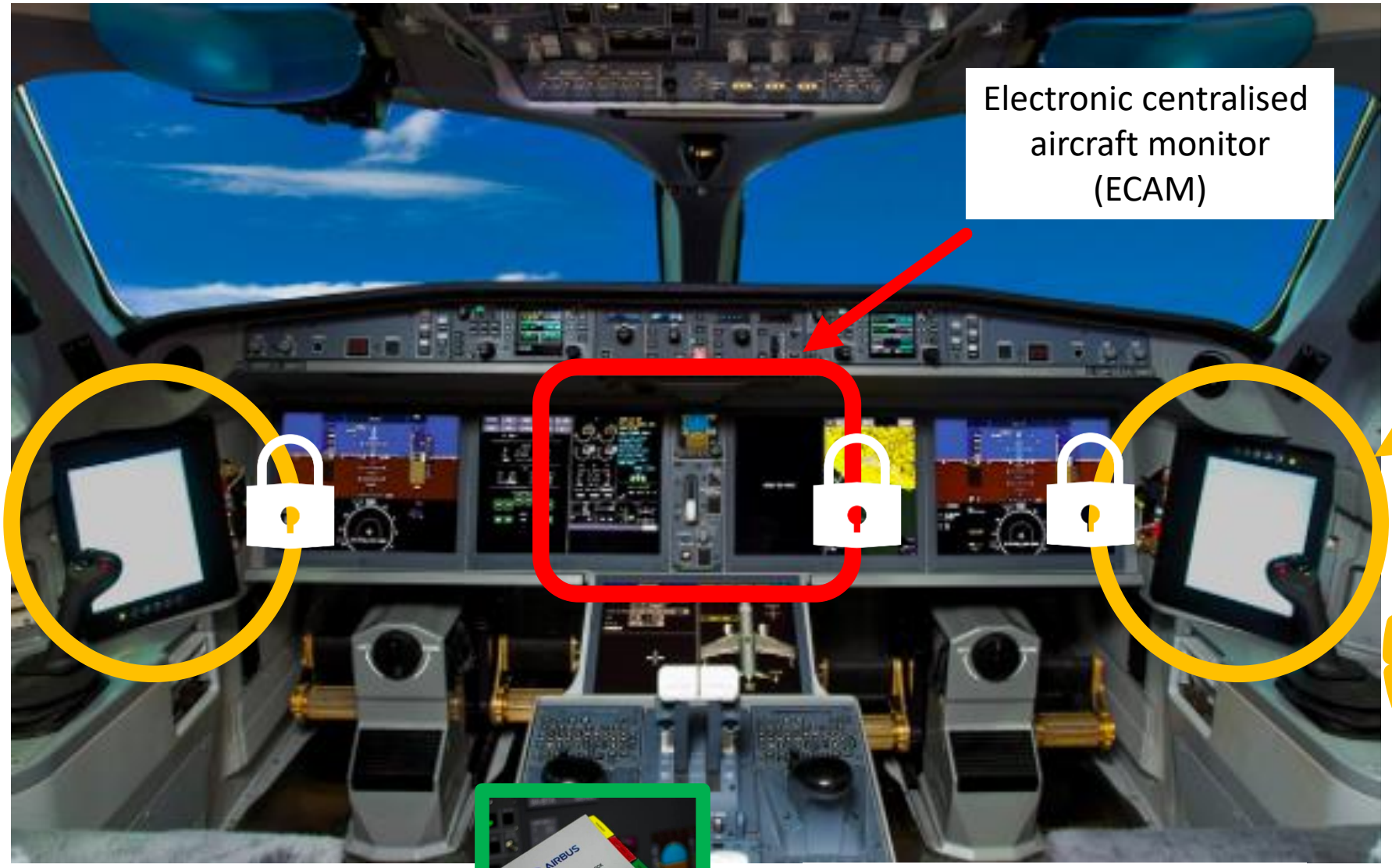

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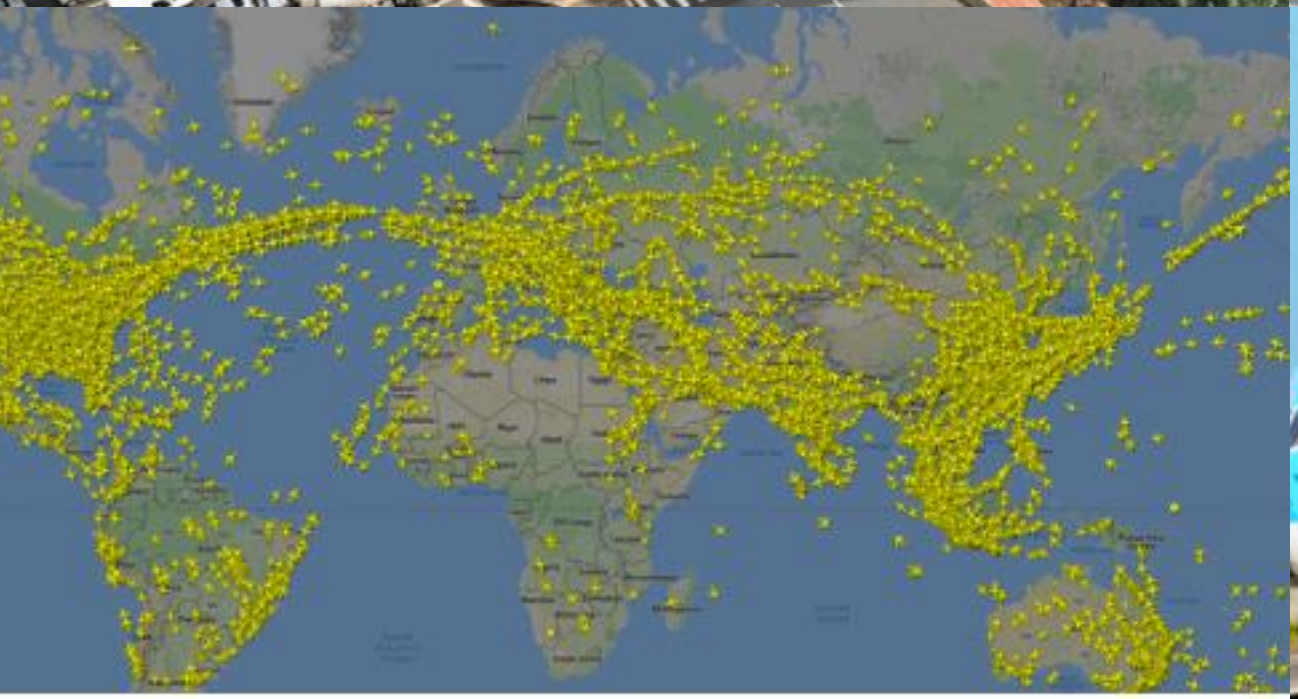
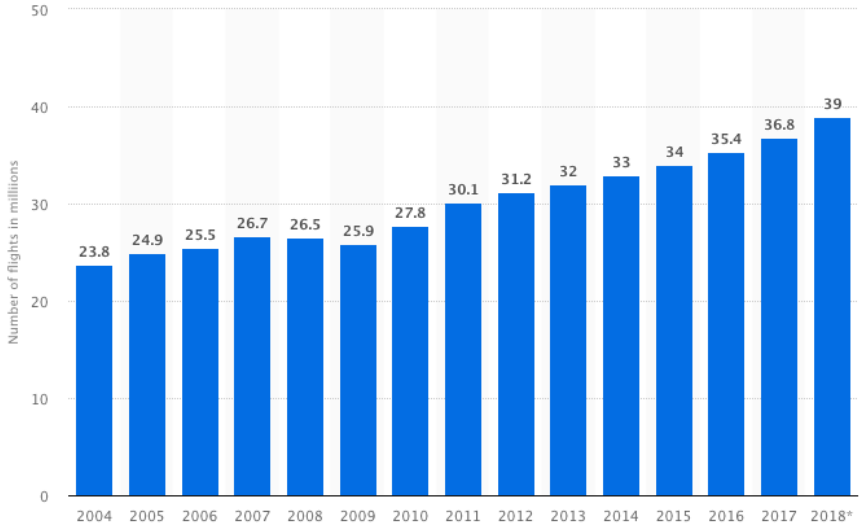


Number of flights performed by the global airline industry from 2004 to 2018 (in millions)



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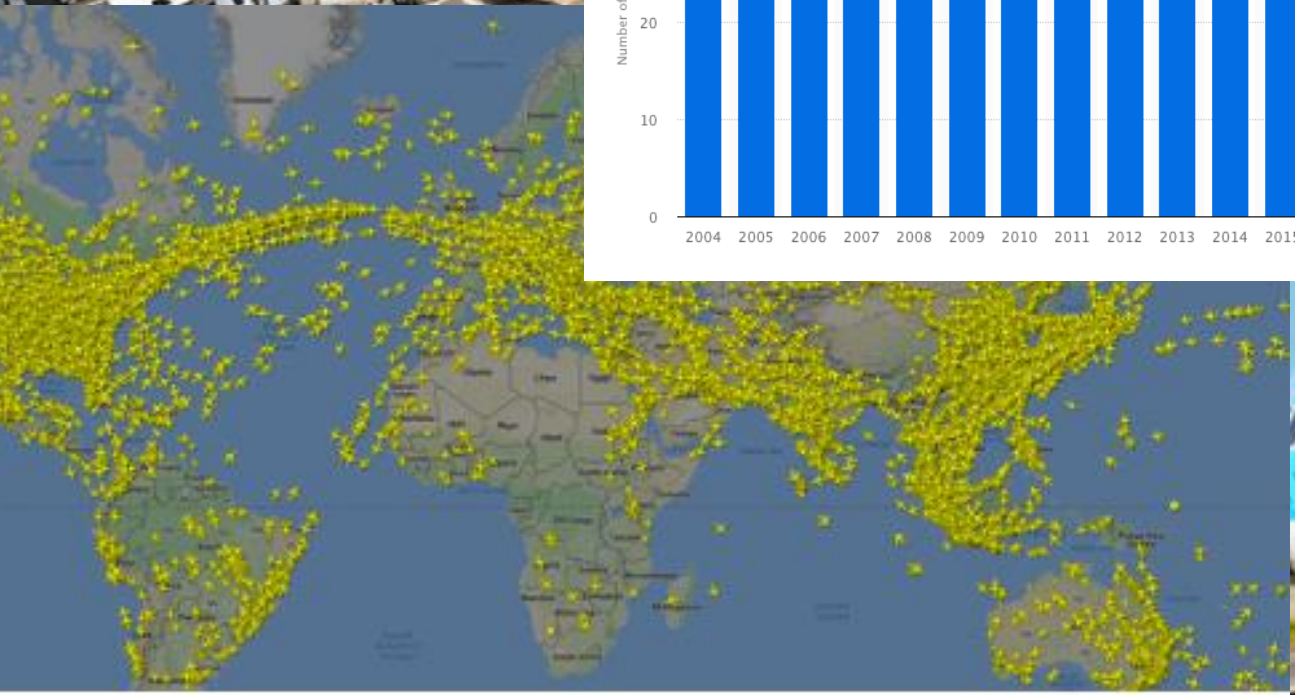
PNG + PDF + XLS + PPT +

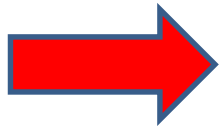
DESCRIPTION SOURCE MORE INFORMATION

The statistic gives the number of flights performed globally by the airline industry from 2004 through 2018. Passenger air traffic and the number of flights performed are on the rise; in 2017, 36.8 million flights were operated worldwide.



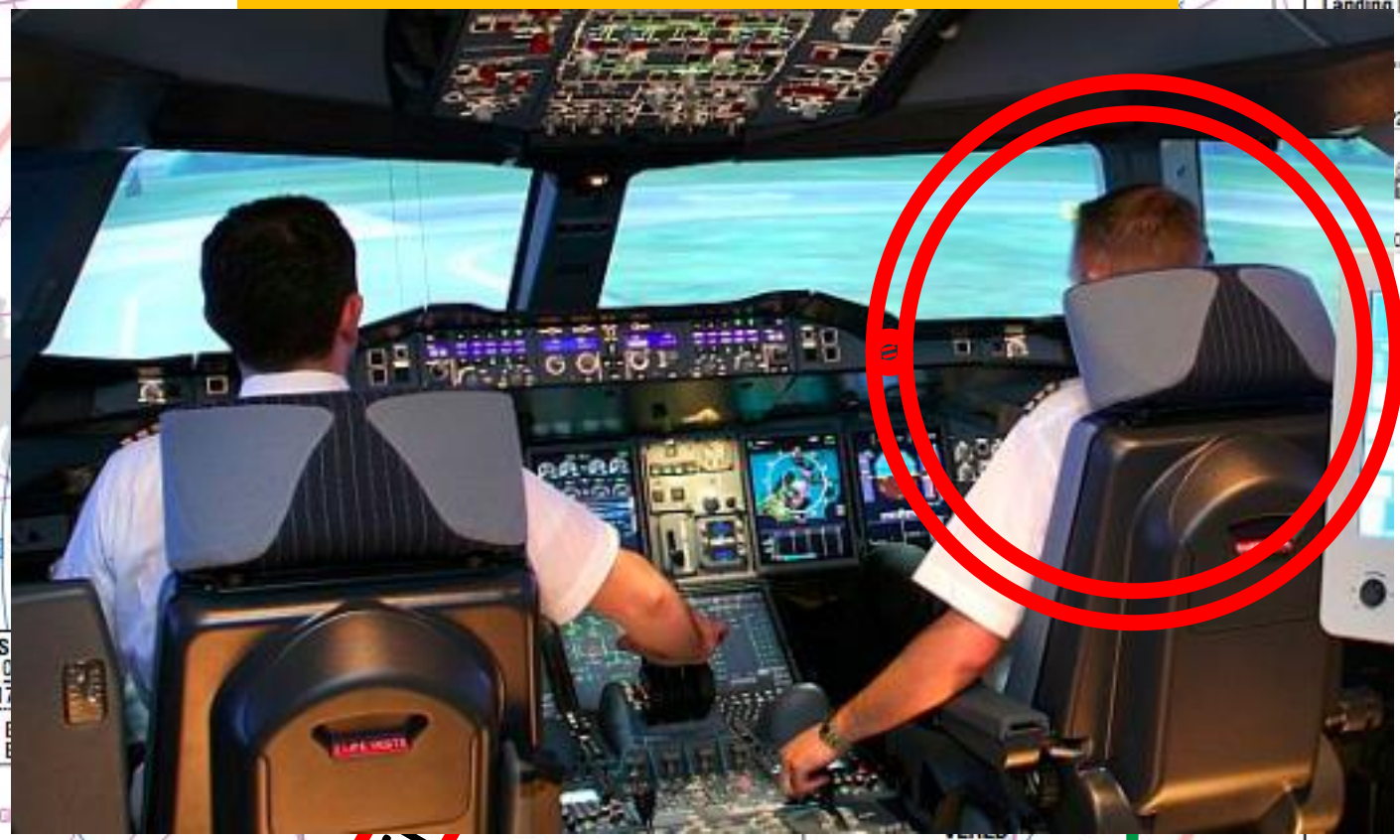
The changing environment

1. Big data becomes available on board the aircraft (internet allow actual news airports, weather, etc.)
2. More people fly: larger aircraft go to smaller airports
3. New airports arise having less infrastructure
4. Competition increases and reliability puts pressure on crews
5. Airlines operating with less extra fuel (time pressure)
6. Airlines wish to reduce number of crews and pilots (fatigue)



Increasing need for actual information

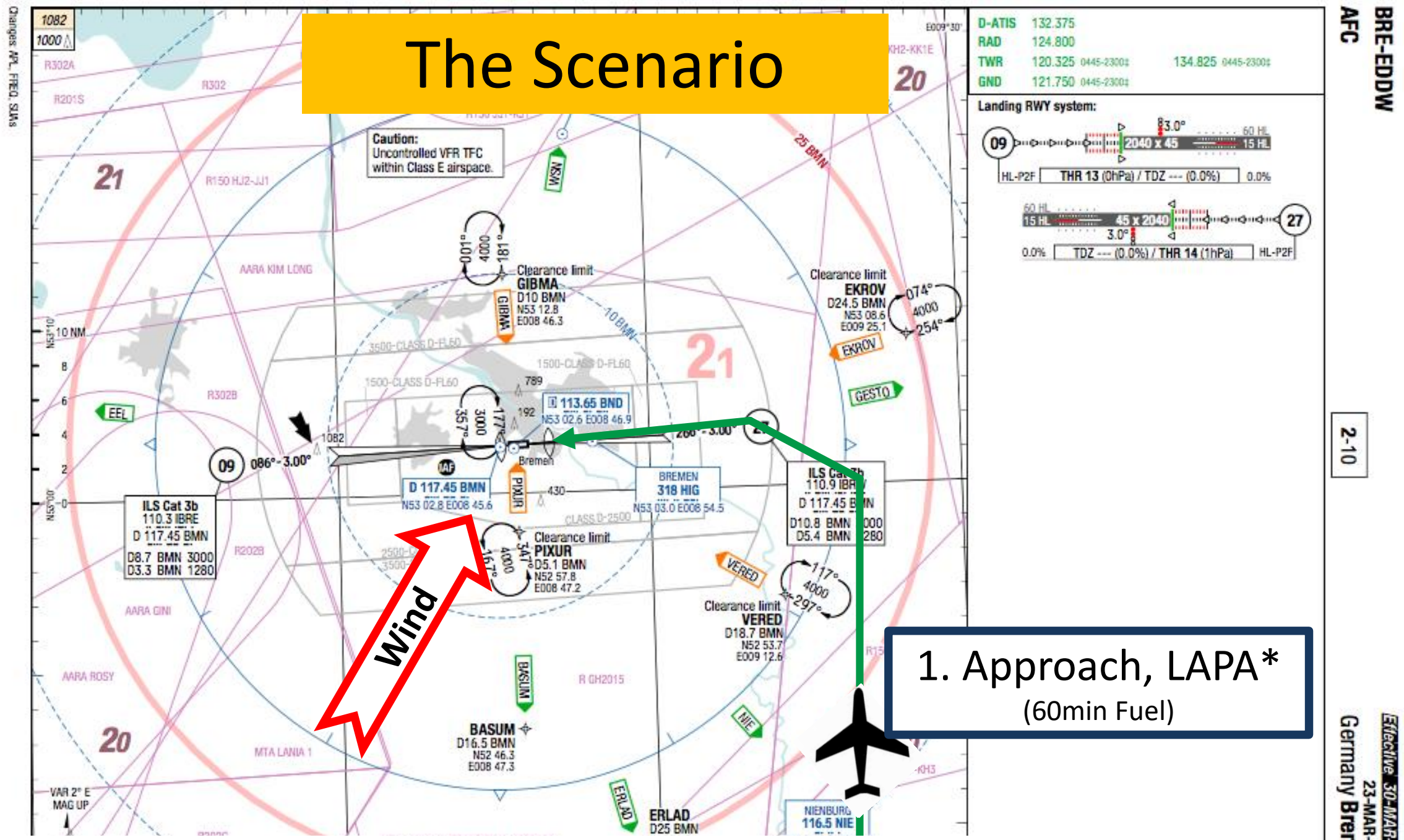
The Scenario



1. Approach, LAPA*
(60min Fuel)

* ATIS J: EDDW 21018KT 2000 BKN004 OVC020 1/0 1013 TEMPO RWY wet RVR600 -SN

The Scenario



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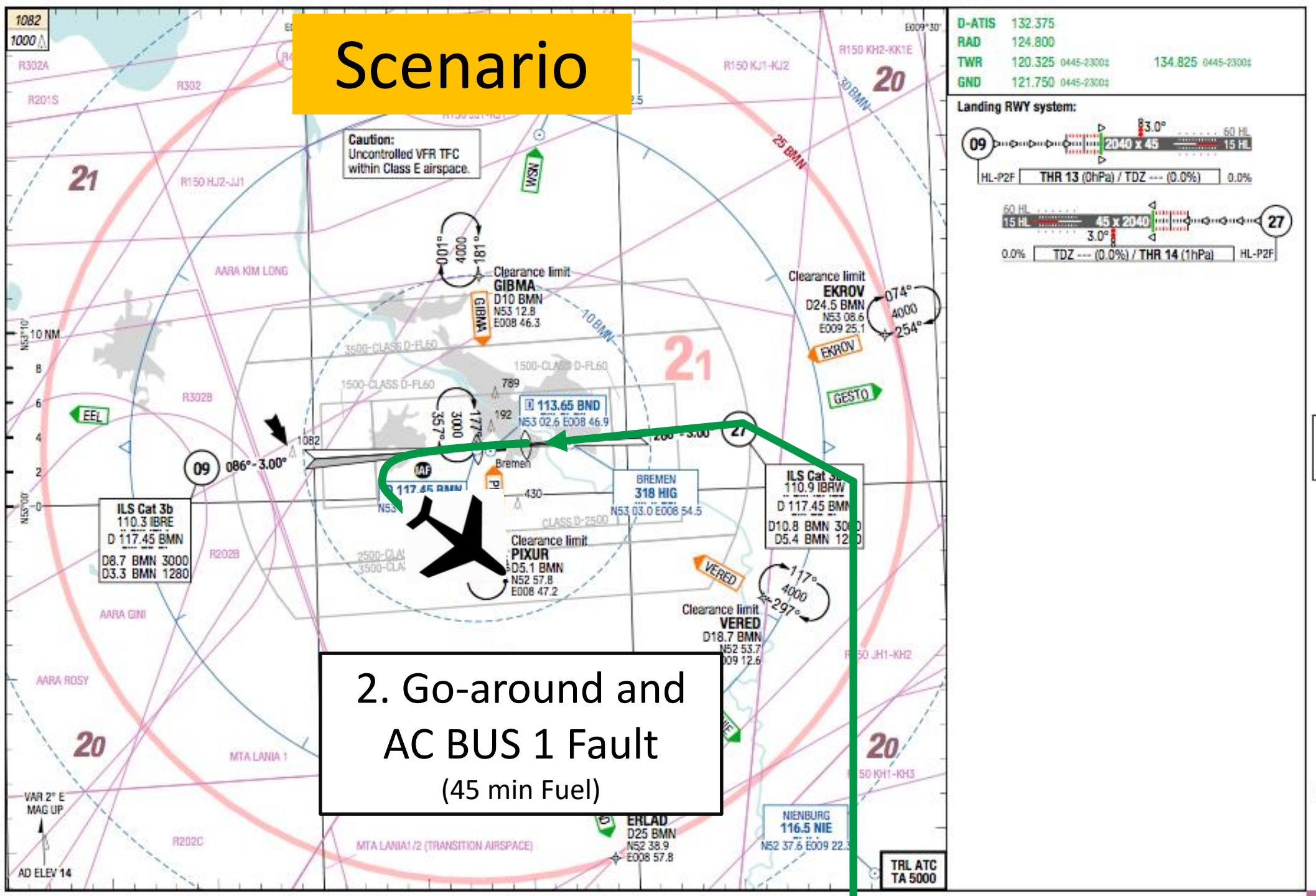
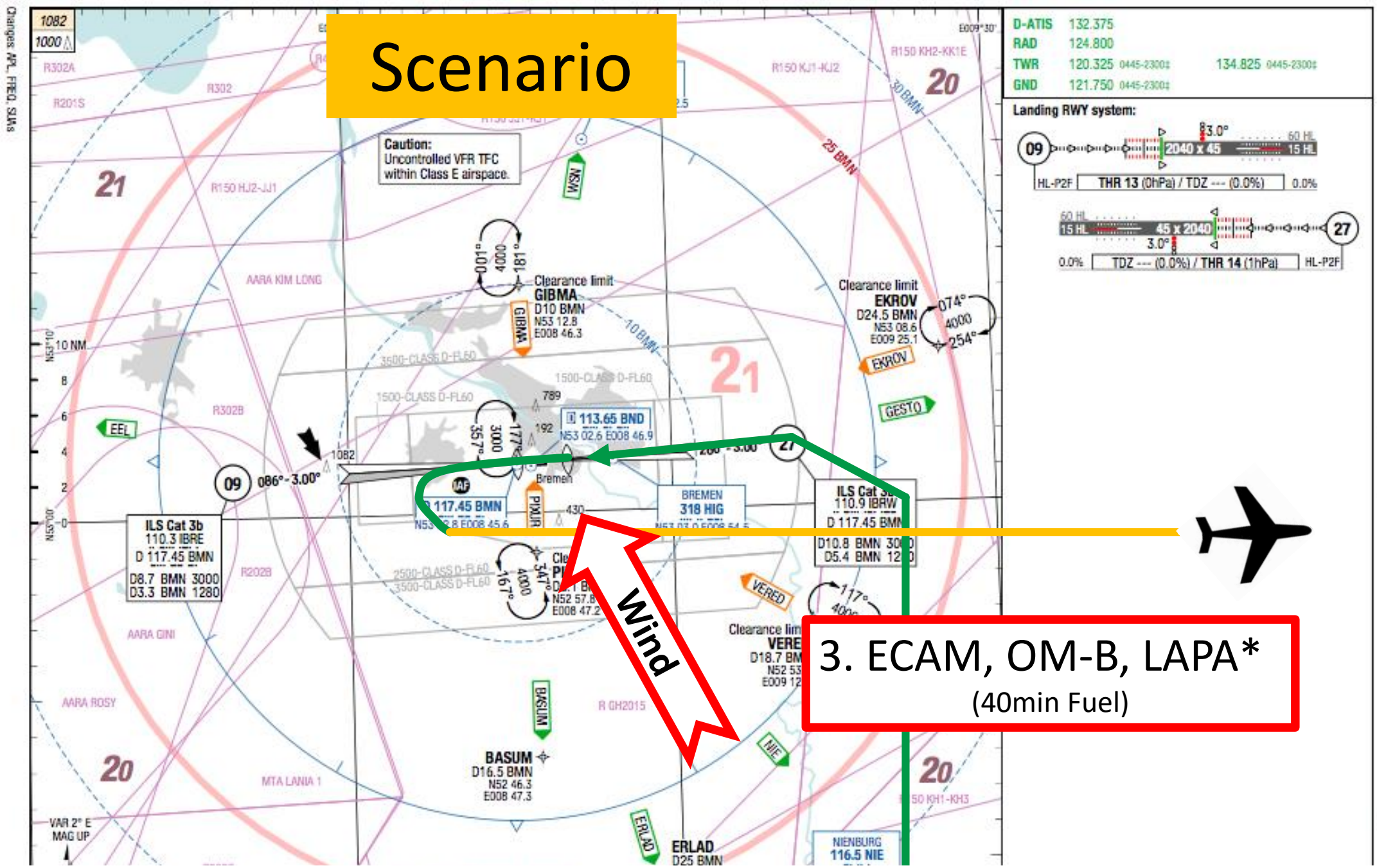


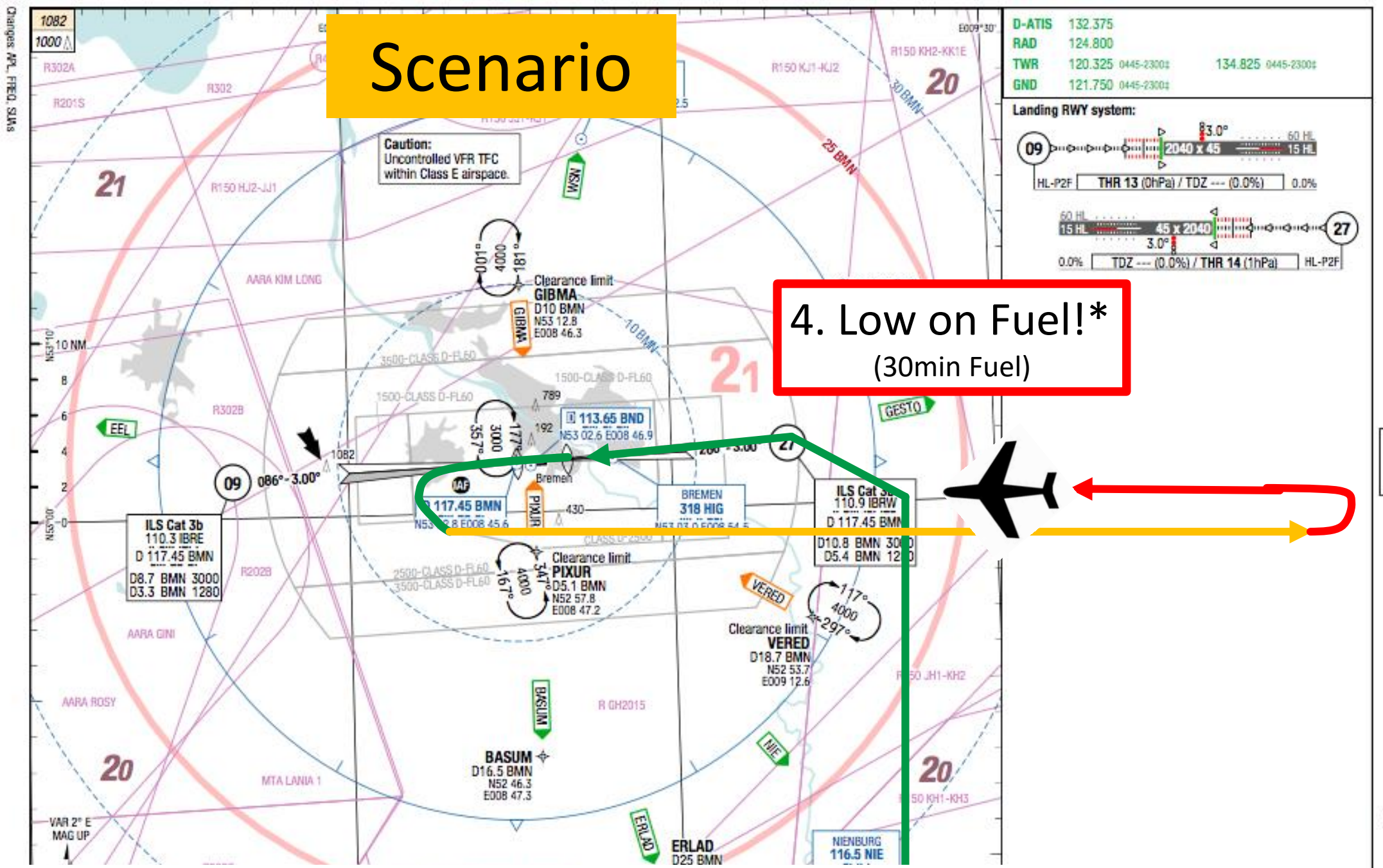
2. Go-around and
AC BUS 1 Fault
(45 min Fuel)

Scenario



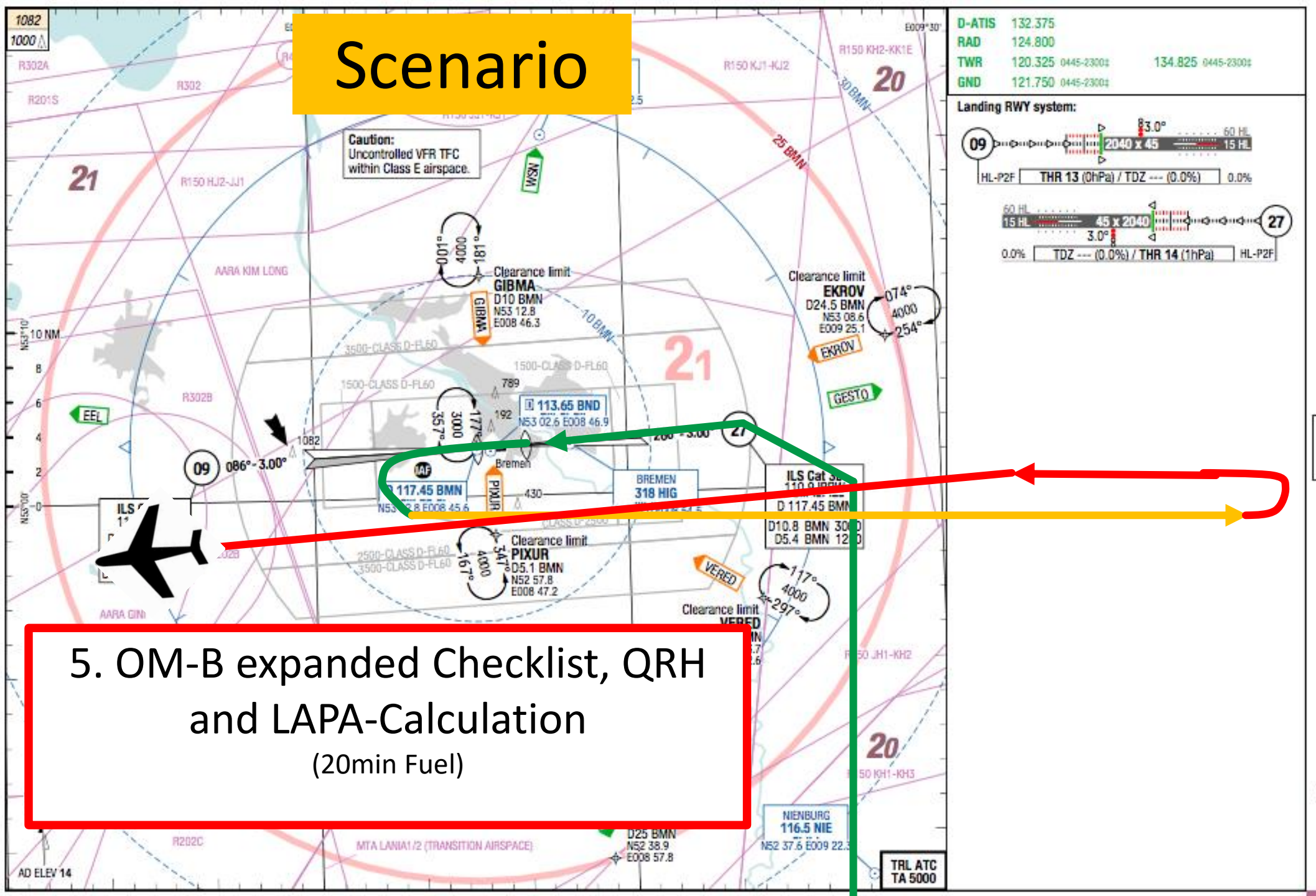
* **New Weather** AITS K: EDDW 16018KT RVR 0500 BKN002 OVC004, Temp 1/0 1013 RWY 4mm slush -SN

Scenario



* BRE RWY 09 in use due to wind; shorter distance than to divert to Hamburg or Hannover!

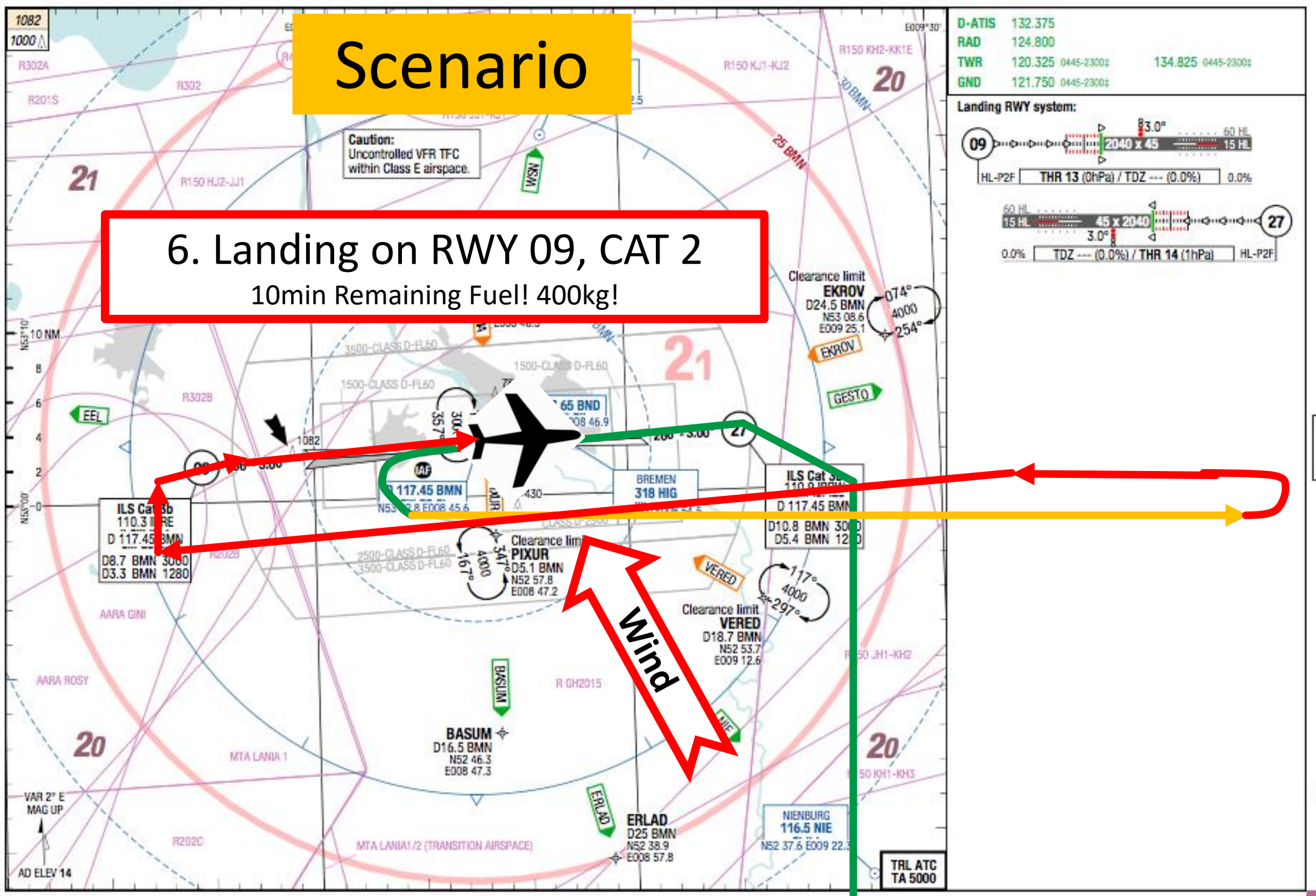
Scenario



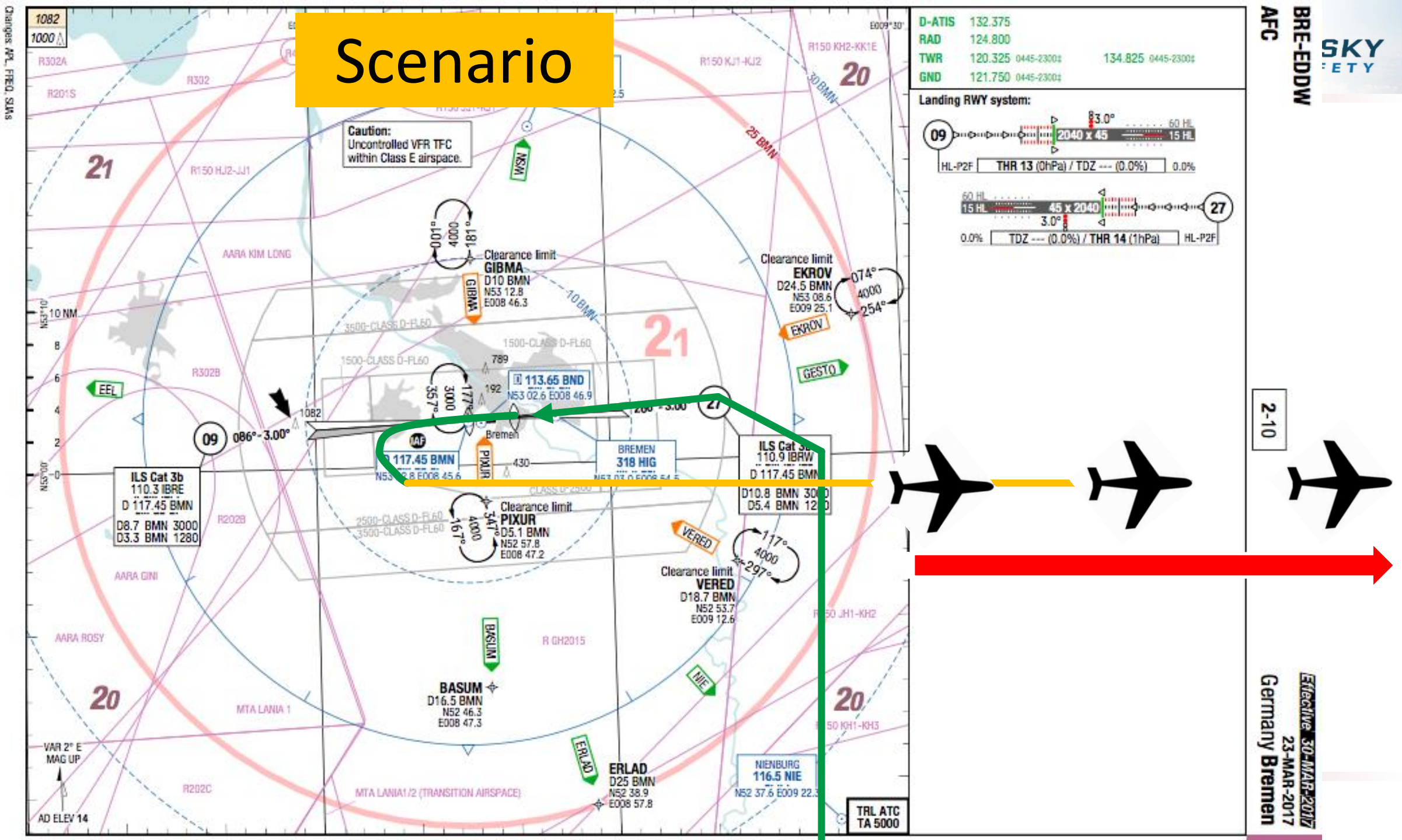
5. OM-B expanded Checklist, QRH and LAPA-Calculation

(20min Fuel)

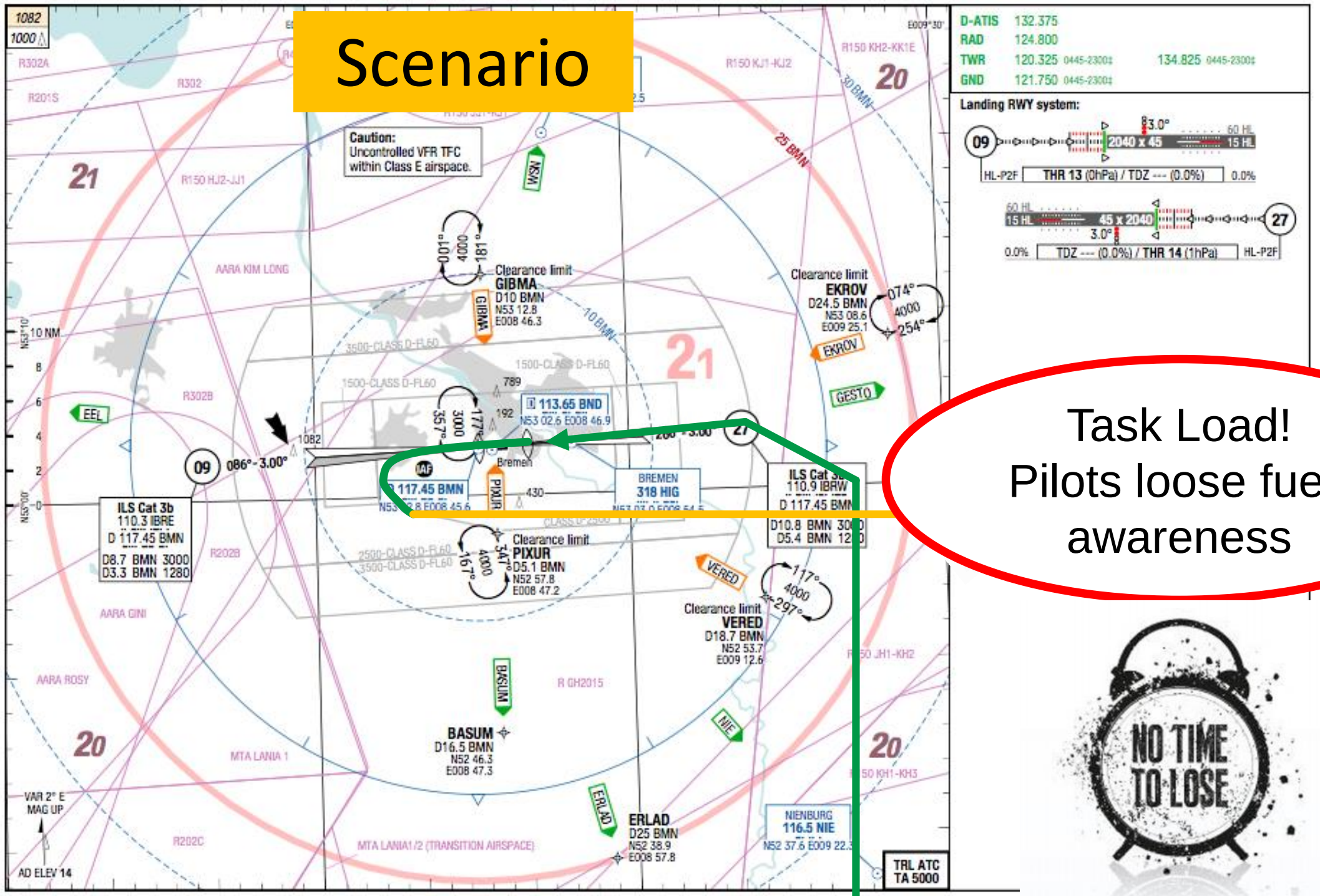
Scenario


6. Landing on RWY 09, CAT 2
10min Remaining Fuel! 400kg!
Wind
D-ATIS 132.375
RAD 124.800
TWR 120.325 134.825
GND 121.750
Landing RWY system:
09
27
2040 x 45
45 x 2040
THR 13 (0hPa) / TDZ --- (0.0%)
TDZ --- (0.0%) / THR 14 (1hPa)
Caution:
Uncontrolled VFR TFC
within Class E airspace.
Clearance limit
EKROV
D24.5 BMN
N53 08.6
E009 25.1
Clearance limit
PIXUR
D5.1 BMN
N52 57.8
E008 47.2
Clearance limit
VERED
D18.7 BMN
N52 53.7
E009 12.6
BASUM
D16.5 BMN
N52 46.3
E008 47.3
ERLAD
D25 BMN
N52 38.9
E008 57.8
ILS Cat IIIb
110.3
D 117.45 BMN
D8.7 BMN 3000
D3.3 BMN 1280
BREMEN
318 HIG
NIENBURG
116.5 NIE
TRL ATC
TA 5000
BRE-EDDW
AFC
2-10
Effective 30-MAR-2017
23-MAR-2017
Germany Bremen

Scenario


BRE-EDDW
AFC
D-ATIS 132.375
RAD 124.800
TWR 120.325 0445-2300‡ 134.825 0445-2300‡
GND 121.750 0445-2300‡
Landing RWY system:
09
2040 x 45
3.0°
60 HL
15 HL
HL-P2F
THR 13 (0hPa) / TDZ --- (0.0%)
0.0%
27
45 x 2040
TDZ --- (0.0%) / THR 14 (1hPa)
Caution:
Uncontrolled VFR TFC
within Class E airspace.
Clearance limit
GIBMA
D10 BMN
N53 12.8
E008 46.3
Clearance limit
EKROV
D24.5 BMN
N53 08.6
E009 25.1
113.65 BND
N53 02.6 E008 46.9
ILS Cat 3b
110.3 IBRE
D 117.45 BMN
D8.7 BMN 3000
D3.3 BMN 1280
117.45 BMN
BREMEN
318 HIG
Clearance limit
PIXUR
D5.1 BMN
N52 57.8
E008 47.2
Clearance limit
VERED
D18.7 BMN
N52 53.7
E009 12.6
BASUM
D16.5 BMN
N52 46.3
E008 47.3
ERLAD
D25 BMN
N52 38.9
E008 57.8
NIENBURG
116.5 NIE
TRL ATC
TA 5000
VAR 2° E
MAG UP
AD ELEV 14
2-10
Effective 30-MAR-2017
23-MAR-2017
Germany Bremen

Scenario



Task Load!
Pilots loose fuel-awareness

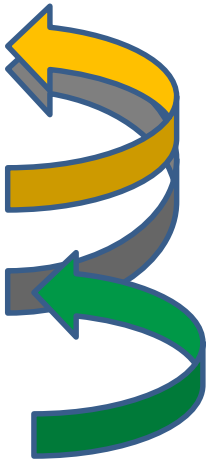
Approach- and Abnormal Procedure

➢ Normal Approach

- approach briefing
- landing performance calculation (on EFB*)

➢ Abnormal Procedure

- Abnormal procedure (ECAM of aircraft)
- OM-B (additional documentation on EFB*)
- NEW landing perf. calculation (on EFB*)
- NEW approach briefing



- Check of quick reference handbook (QRH)

* EFB = Electronic Flight Bag, Tablet or Notebook used by the pilot

Approach- and Abnormal Procedure

➢ Normal Approach

- approach briefing
- landing performance calculation (on EFB*)

Pilot Flying (+ATC)

➢ Abnormal Procedure

- Abnormal procedure (ECAM of aircraft)
- OM-B (additional documentation on EFB*)
- NEW landing performance calculation (on EFB*)
- NEW approach briefing
- Check of quick reference handbook (QRH)

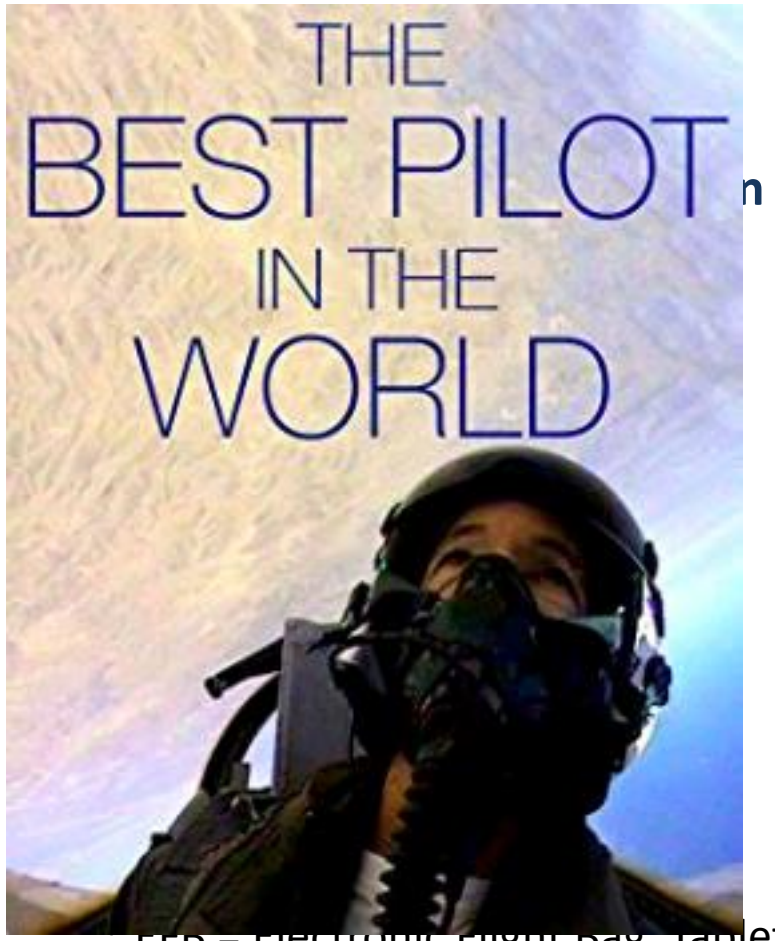
Pilot Monitoring

* EFB = Electronic Flight Bag, Tablet or Notebook used by the pilot

Approach- and Abnormal Procedure

➢ Normal Approach

-
- n (on EFB*)



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- Abnormal procedure (ECAM of aircraft)
- OM-B (additional documentation on EFB*)
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- Check of quick reference handbook

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Approach- and Abnormal Procedure

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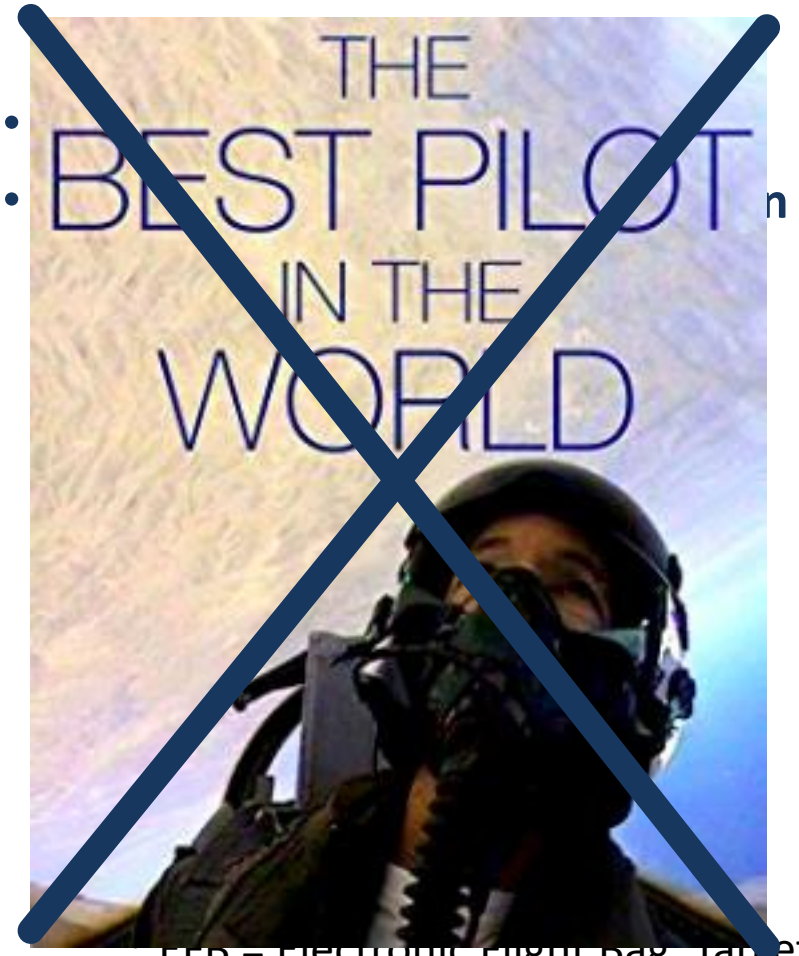


-
- n (on EFE

EFB = Electronic Flight Bag, Tablet or Notebook used by the pilot

➢ Abnormal Procedure

Scenario

Caution:
Uncontrolled VFR TFC
within Class E airspace.

Clearance limit
GIBMA
D10 BMN
N53 12.8
E008 46.3

Clearance limit
PIXUR
D5.1 BMN
N52 57.8
E008 47.2

Clearance limit
VERED
D18.7 BMN
N52 53.7
E009 12.6

BASUM
D16.5 BMN
N52 46.3
E008 47.3

ERLAD
D25 BMN
N52 38.9
E008 57.8

ILS Cat 3b
110.3 IBRE
D 117.45 BMN
D8.7 BMN 3000
D3.3 BMN 1280

113.65 BND
N53 02.6 E008 46.9

117.45 BMN

BREMEN
318 HIG

ILS Cat
110.9 IBRW
D 117.45 BMN
D10.8 BMN
D5.4 BMN

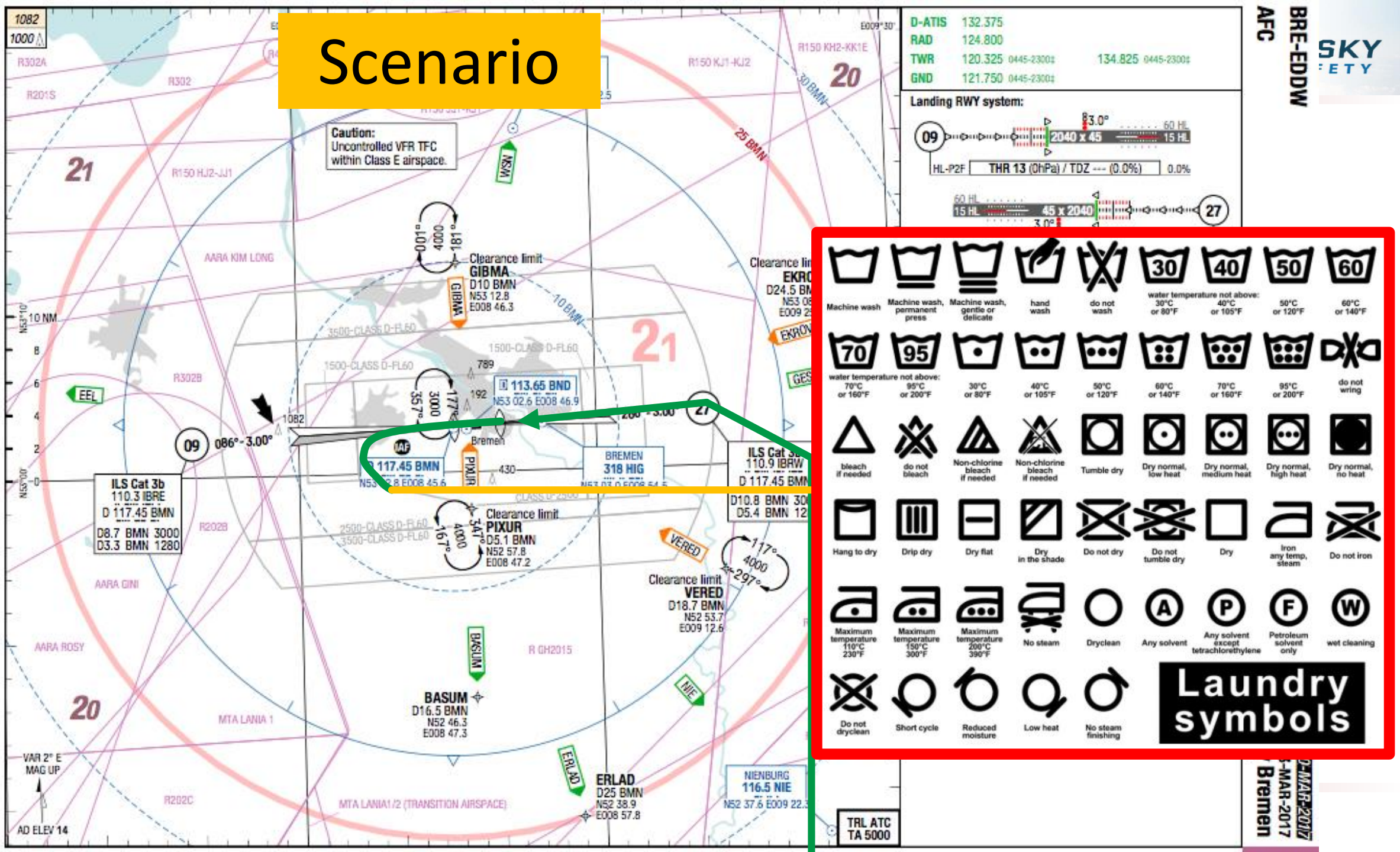
NIENBURG
116.5 NIE

TRL ATC
TA 5000

AD ELEV 14

Effective 30-MAR-2017
23-MAR-2017
Germany Bremen

Scenario


Caution:
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Clearance limit
GIBMA
D10 BMN
N53 12.8
E008 46.3
Clearance limit
PIXUR
D5.1 BMN
N52 57.8
E008 47.2
Clearance limit
VERED
D18.7 BMN
N52 53.7
E009 12.6
BASUM
D16.5 BMN
N52 46.3
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D25 BMN
N52 38.9
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ILS Cat 3b
110.3 IBRE
D 117.45 BMN
D8.7 BMN 3000
D3.3 BMN 1280
09 086°-3.00°
113.65 BND
N53 02.6 E008 46.9
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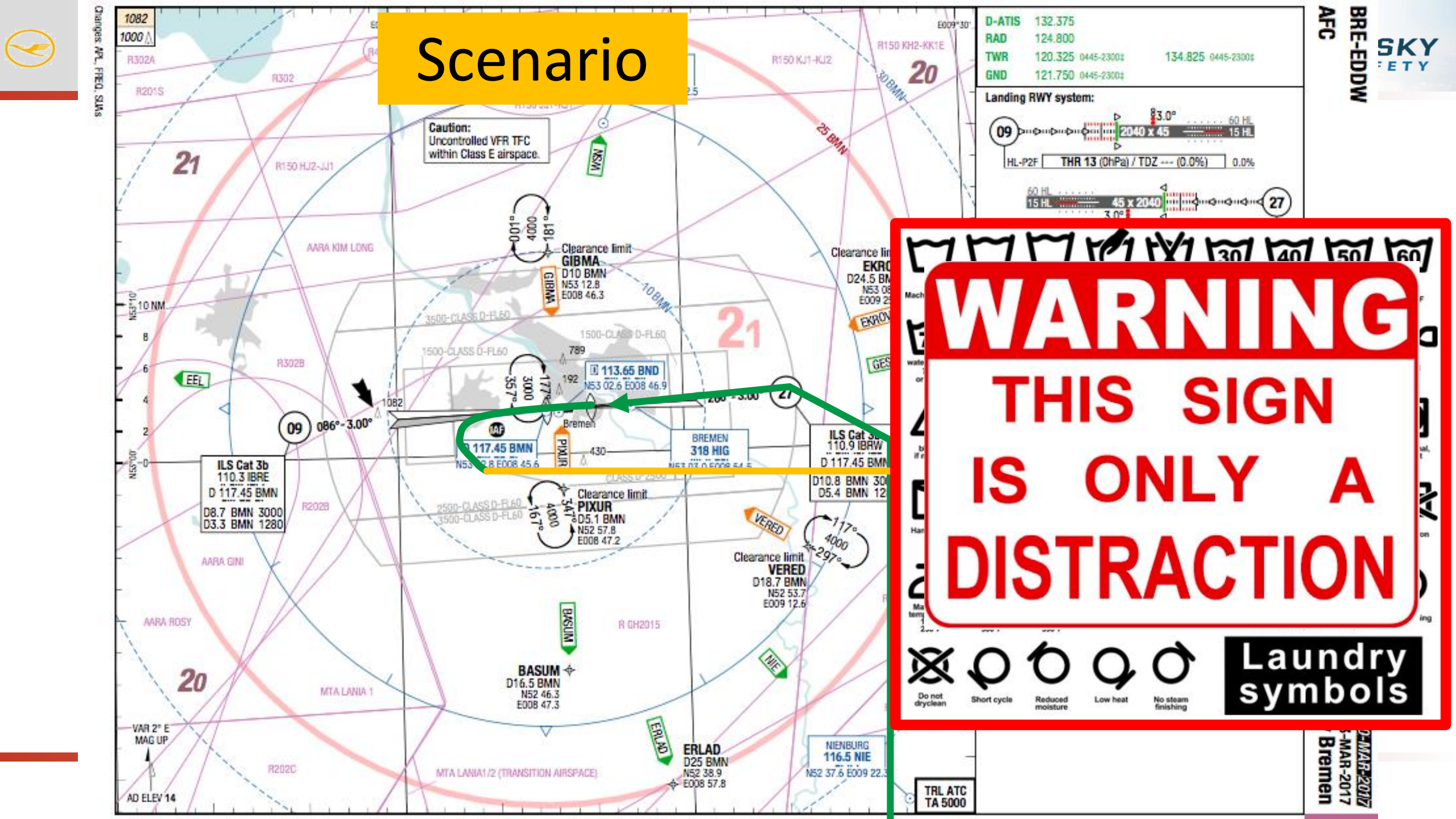
ILS Cat
110.9 IBRW
D 117.45 BMN
D10.8 BMN
D5.4 BMN
NIENBURG
116.5 NIE
N52 37.6 E009 22.3
TRL ATC
TA 5000
D-ATIS 132.375
RAD 124.800
TWR 120.325 0445-2300‡ 134.825 0445-2300‡
GND 121.750 0445-2300‡
Landing RWY system:
09 2040 x 45 27
THR 13 (0hPa) / TDZ --- (0.0%)
45 x 2040
VAR 2° E
MAG UP
AD ELEV 14
BRE-EDDW
AFC
Bremen

Machine wash
Machine wash, permanent press
Machine wash, gentle or delicate
hand wash
do not wash
water temperature not above: 30°C or 80°F
40°C or 105°F
50°C or 120°F
60°C or 140°F
water temperature not above: 70°C or 160°F
95°C or 200°F
30°C or 80°F
40°C or 105°F
50°C or 120°F
60°C or 140°F
70°C or 160°F
95°C or 200°F
do not wring
bleach if needed
do not bleach
Non-chlorine bleach if needed
Non-chlorine bleach if needed
Tumble dry
Dry normal, low heat
Dry normal, medium heat
Dry normal, high heat
Dry normal, no heat
Hang to dry
Drip dry
Dry flat
Dry in the shade
Do not dry
Do not tumble dry
Dry
Iron any temp, steam
Do not iron
Maximum temperature 110°C 230°F
Maximum temperature 150°C 300°F
Maximum temperature 200°C 390°F
No steam
Dryclean
Any solvent
Any solvent except tetrachlorethylene
Petroleum solvent only
wet cleaning
Do not dryclean
Short cycle
Reduced moisture
Low heat
No steam finishing
Laundry symbols

Scenario


WARNING
THIS SIGN
IS ONLY A
DISTRACTION
Laundry symbols
Do not dryclean
Short cycle
Reduced moisture
Low heat
No steam finishing
Caution:
Uncontrolled VFR TFC
within Class E airspace.
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RAD 124.800
TWR 120.325 0445-2300‡ 134.825 0445-2300‡
GND 121.750 0445-2300‡
Landing RWY system:
09
27
2040 x 45
45 x 2040
THR 13 (0hPa) / TDZ --- (0.0%)
Clearance limit
GIBMA
D10 BMN
N53 12.8
E008 46.3
Clearance limit
PIXUR
D5.1 BMN
N52 57.8
E008 47.2
Clearance limit
VERED
D18.7 BMN
N52 53.7
E009 12.6
BASUM
D16.5 BMN
N52 46.3
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ERLAD
D25 BMN
N52 38.9
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BREMEN
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ILS Cat
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D 117.45 BMN
D10.8 BMN
D5.4 BMN
NIENBURG
116.5 NIE
N52 37.6 E009 22.3
TRL ATC
TA 5000
VAR 2° E
MAG UP
AD ELEV 14
BRE-EDDW
AFC
SKY
ETY

Challenge of staying focussed

Challenge of staying focussed

New Cockpit Interfaces

Simulator research: Technical abnormal

1. HMI: What kind of information?
2. HMI: How to get that information?
3. HMI: When to get the info and how long it takes (timing)?

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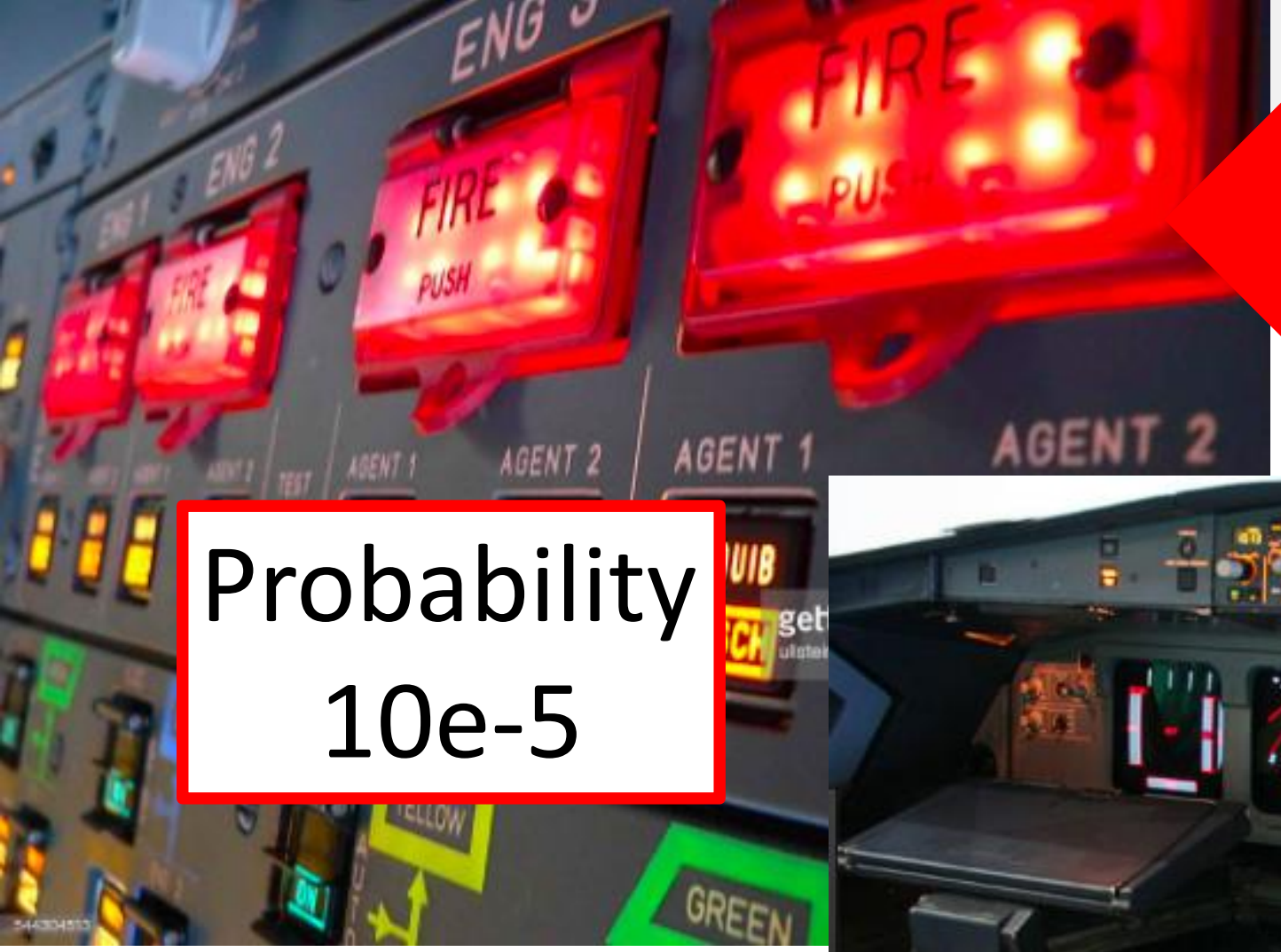
Priorities !

FUTURE SKY SAFETY

Fire versus Fuel shortage

FUTURE SKY SAFETY

Fire versus Fuel shortage



Probability 10e-5

Probability 10e-3

Cockpit interfaces


N327NW HJ-CG
LDG GEAR
BRK FAN
AUTO BRK
TERR ON ND
DOOR / OXY
LIFE VEST
LIFE VEST

- Fuel Awareness does **NOT** correlate with:

  age, amount of flight hours, amount of aircraft types or with the number of airline companies worked for

- There is no multitasking: The more interruptions, the more mistakes and the lower the fuel awareness

Simulator research: Technical abnormal

1. HMI: What kind of information?
2. HMI: How to get that information?
3. HMI: When to get the info and how long it takes (timing)?

Format !

Right place - right format

1. Fuel must be in Primary Flight Display (PFD)
2. Remaining fuel given in kg
(must recalculated from **kg** in **minutes**)

Time needed for a hike

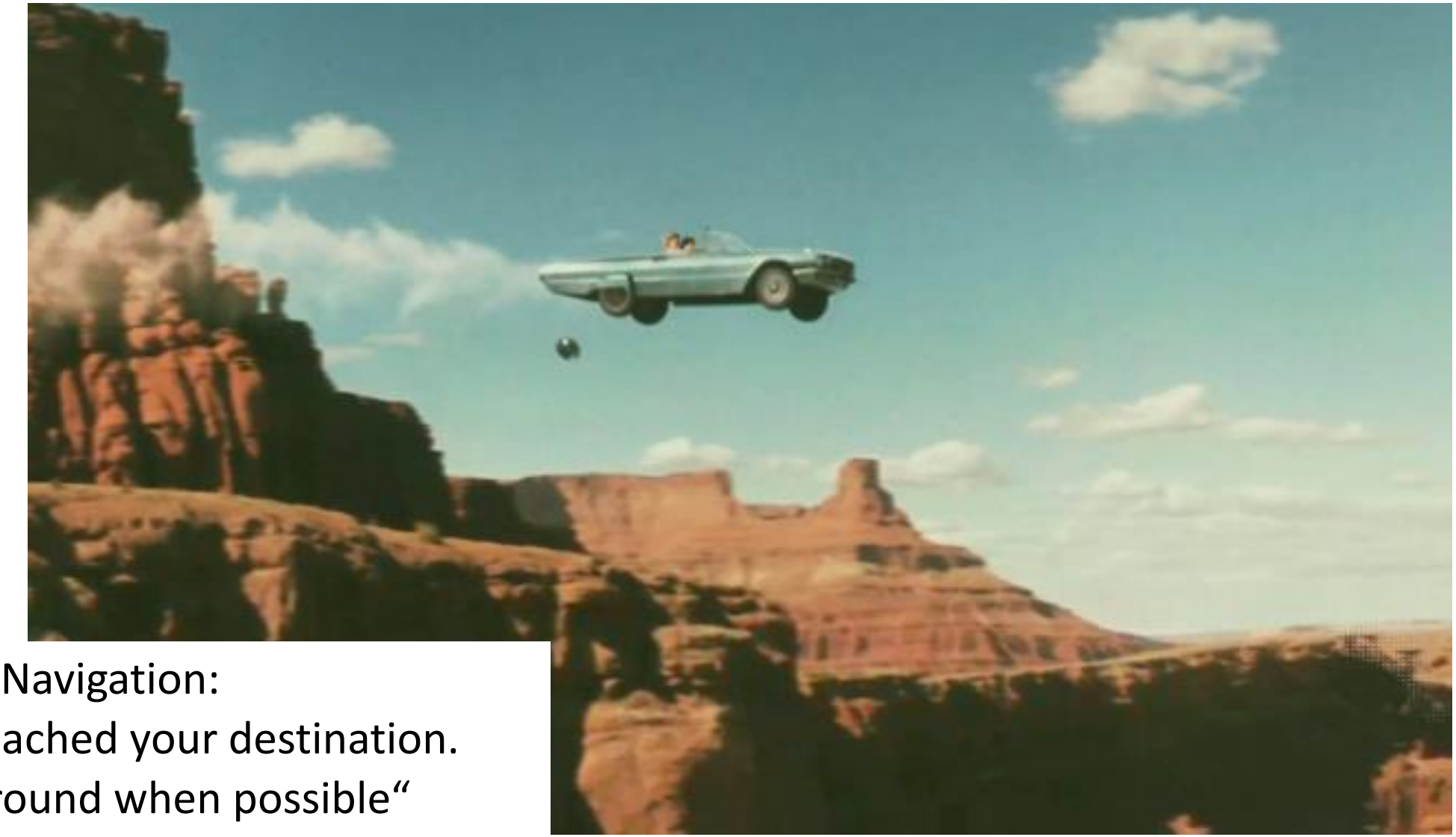
Time vs. calories

Simulator research: Technical abnormal

1. HMI: What kind of information?
2. HMI: How to get that information?
3. HMI: When to get the info and how long it takes (timing)?

Timing !

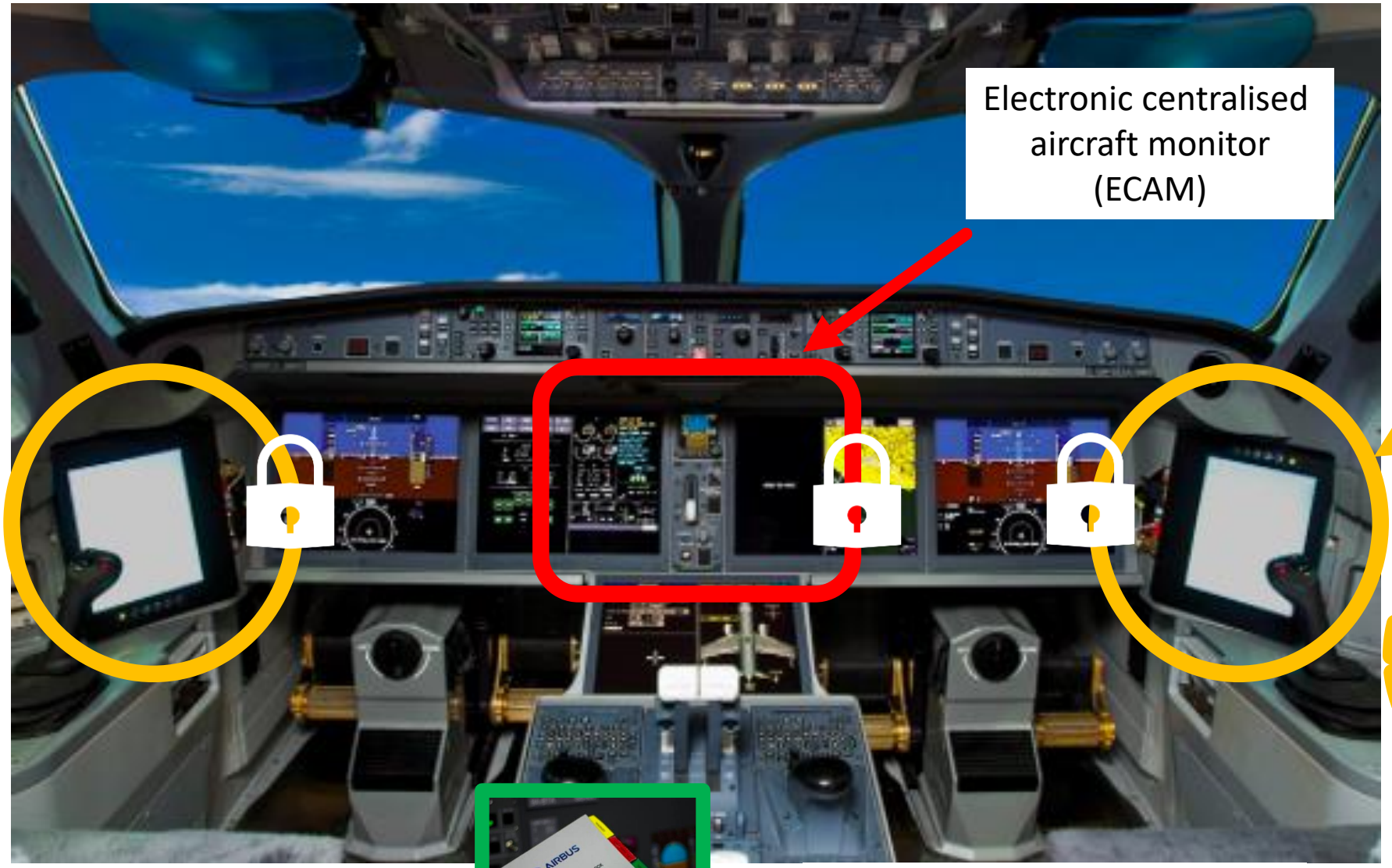
Timing



Car Navigation:

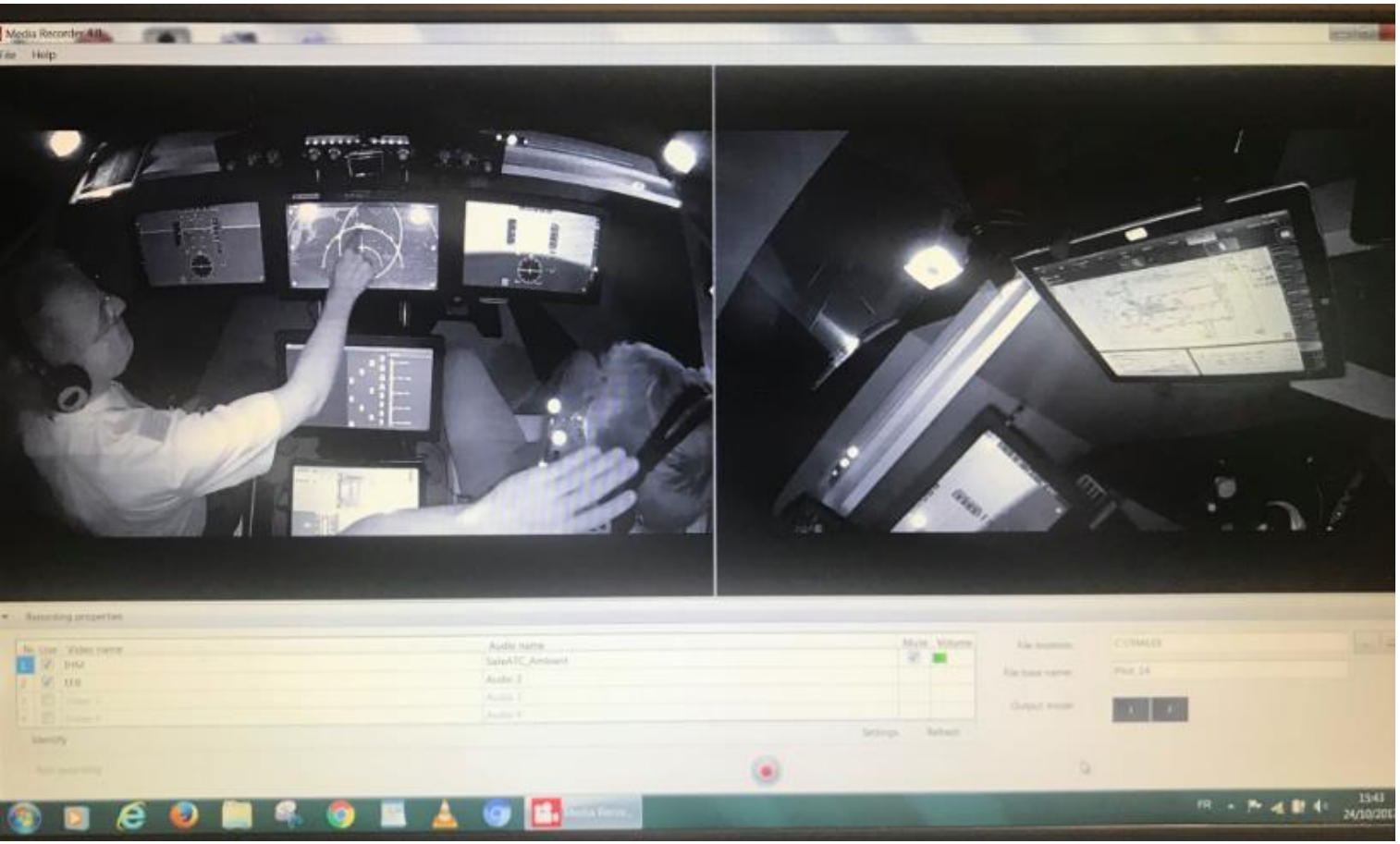
„You have not reached your destination.
Please turn around when possible“

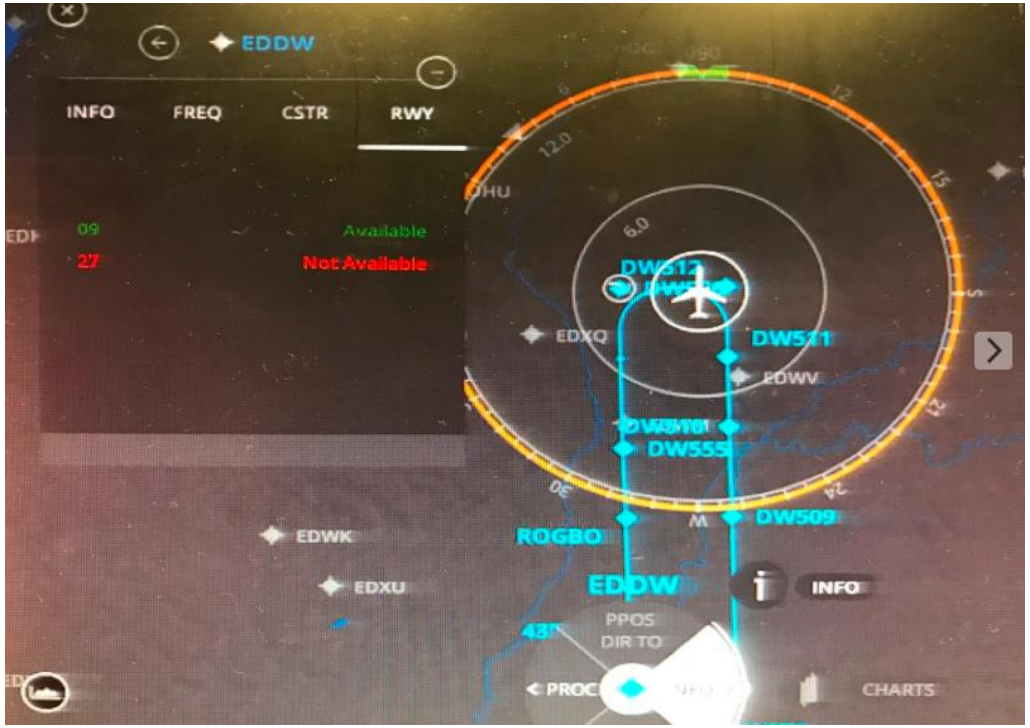
Timing



Quick Reference Handbook (QRH)

New ECAM Interface





EFB – new cockpit interface

Time needed for the calculation

1. The fastest way to calculate landing performance

- Start of computer „Performance Landing“ 0:12 min
- Entry of data with abnormal failure 1:30 min
- Calculation of the program 0:14 min
- (Warning sign with indication „mind crosswind“)

2. The fastest way to look up the OM-B expended checklist

- Start of library „documentation “ 0:10 min
- OM-B search: Limitation -> general limitiation -> wind limits –> max wind condition for CAT II or CAT III -> crosswind -> plus entry of a/c registration 2:30 min

Gesamt 4:26 min

The Electronic Flight Bag (EFB) today

- library: over 30 (!) different operational manuals
- company news, duty roster, safety bulletin
- performance calculation tool
- electronic communication (email, all reports)
- route manual with maps and charts
- complete briefing tool (weather, NOTAMS, etc.)
- over 70 (!) computer based training programs
- different tools (dictionary, converter, etc.)
- flight and fuel efficiency program
- etc. etc. etc.

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- library: over 30(!) different operational manuals
- comp ty bulletin
- perfo
- electr , all reports)
- route arts

tc.)

ms

Resumee: new cockpit interfaces

Simulator research has shown:

1. Correct priorities: **What** is important?
2. Better format: **How** to get that information?
3. Right timing: **When** to get the info and how long does it take

Thank you for your attention