EASA/CASIA Annual Meeting 2017

Challenges during the investigation of an accident in Oajevágge, Norrbotten County, Sweden on 8 January 2016 involving the aeroplane SE-DUX of the model CL-600-2B19, operated by West Atlantic Sweden AB.

Nicolas Seger/Johan Nikolaou

Statens haverikommission
Swedish Accident Investigation Authority

Agenda

- The arctic environment
- Priorities and methods at the accident site
- Wreckage recovery
- Stakeholders, planning and coordination
- Analysis of available data
- Visualisation of the event
- Conclusions

CRJ 200 PF

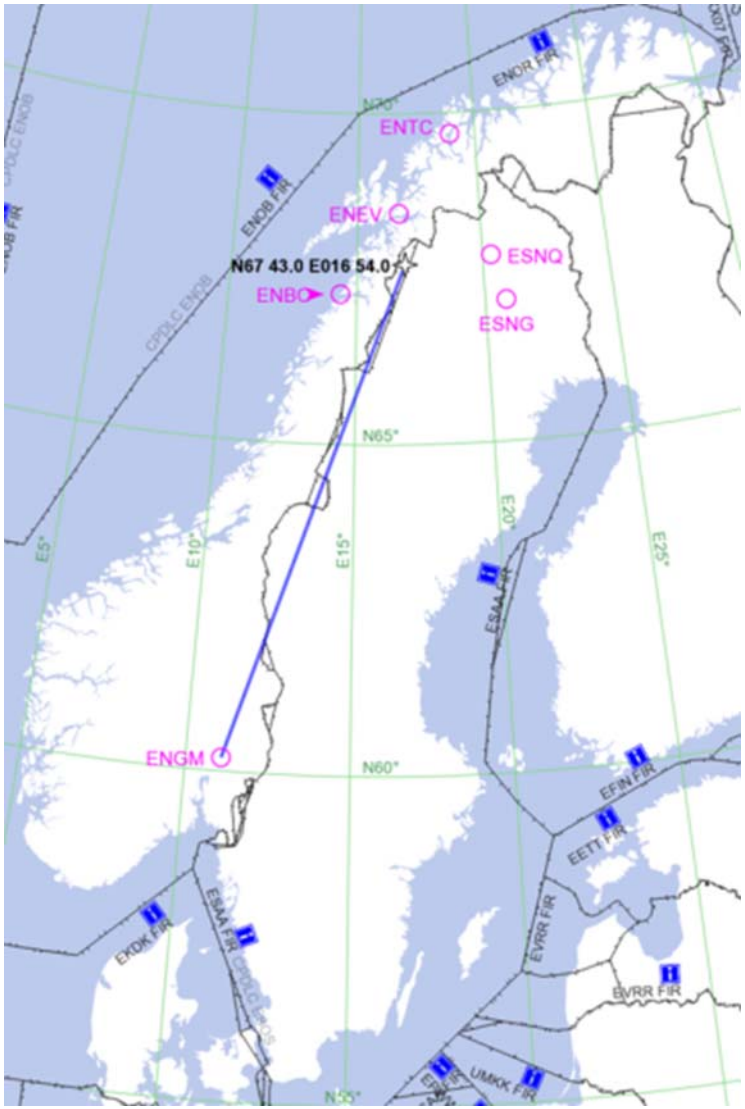
Distress message – lost contact

00.19 hrs

Distress message from aircraft at FL 330

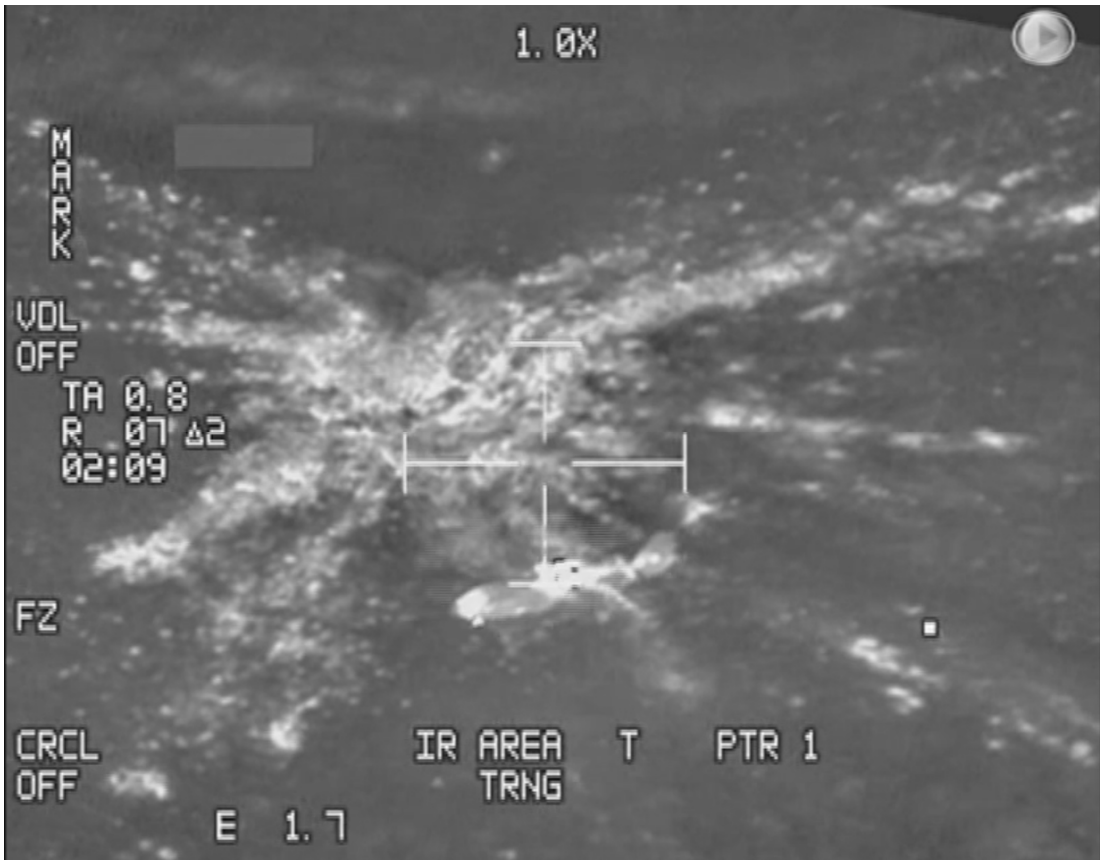
“Mayday
Mayday
Mayday
Air Sweden 294”

ATC lost contact FL 88



Search and rescue

- 03.07 hrs accident site localised by F16, RNAF
- No chance of survival



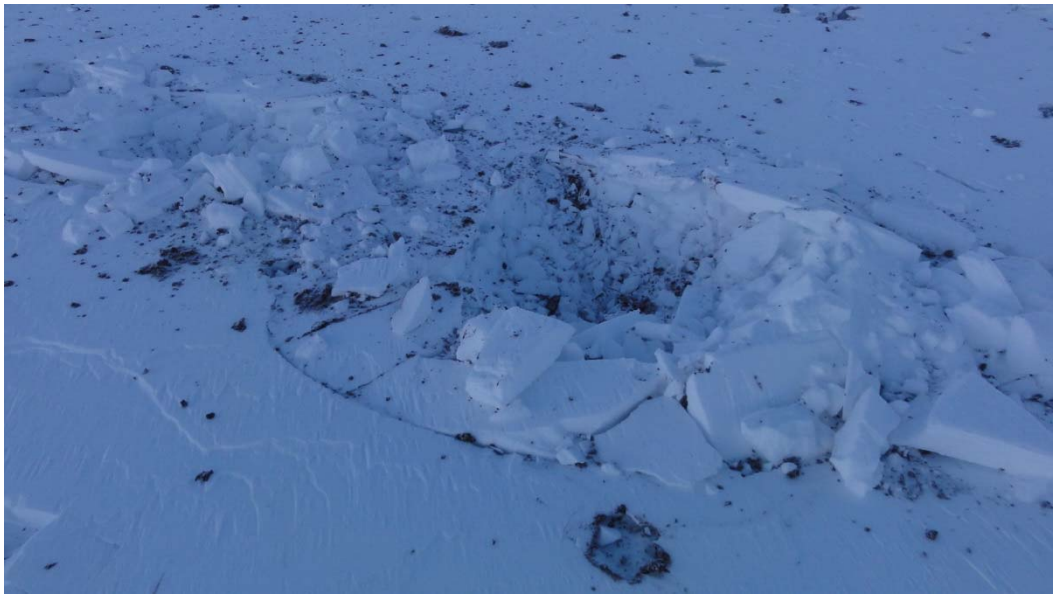
Arctic environment - challenges

Meteorological conditions

- - 25°C to - 40°C (- 13°F to - 40°F)
- Wind and wind chill factor (10 kts: - 25°C ⟹ - 40°C)
- Sun above horizon 10:50 am to 13:05 pm
- Weather time frame of 2 days
  - Site accessible by helicopter only (20 min flight)
  - Snow covering of site

Challenges

- Communication (satellite phone only)
- Cameras
  - Low battery life
  - Lens condensation
- Deep frozen ground



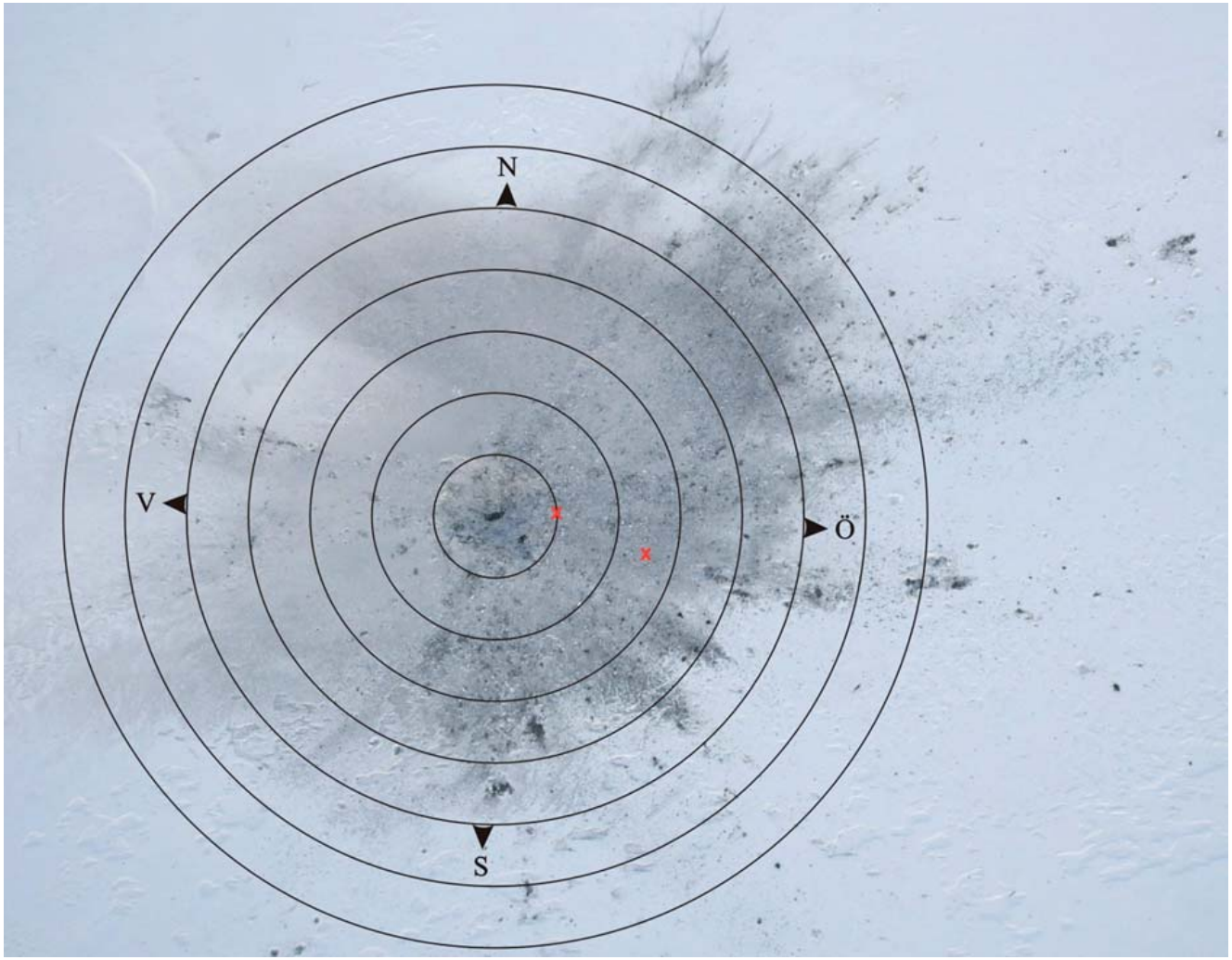
Top priorities

- Recorders
  - FDR and CVR
- Four corners
  - Eliminate inflight breakup scenario

Accident site

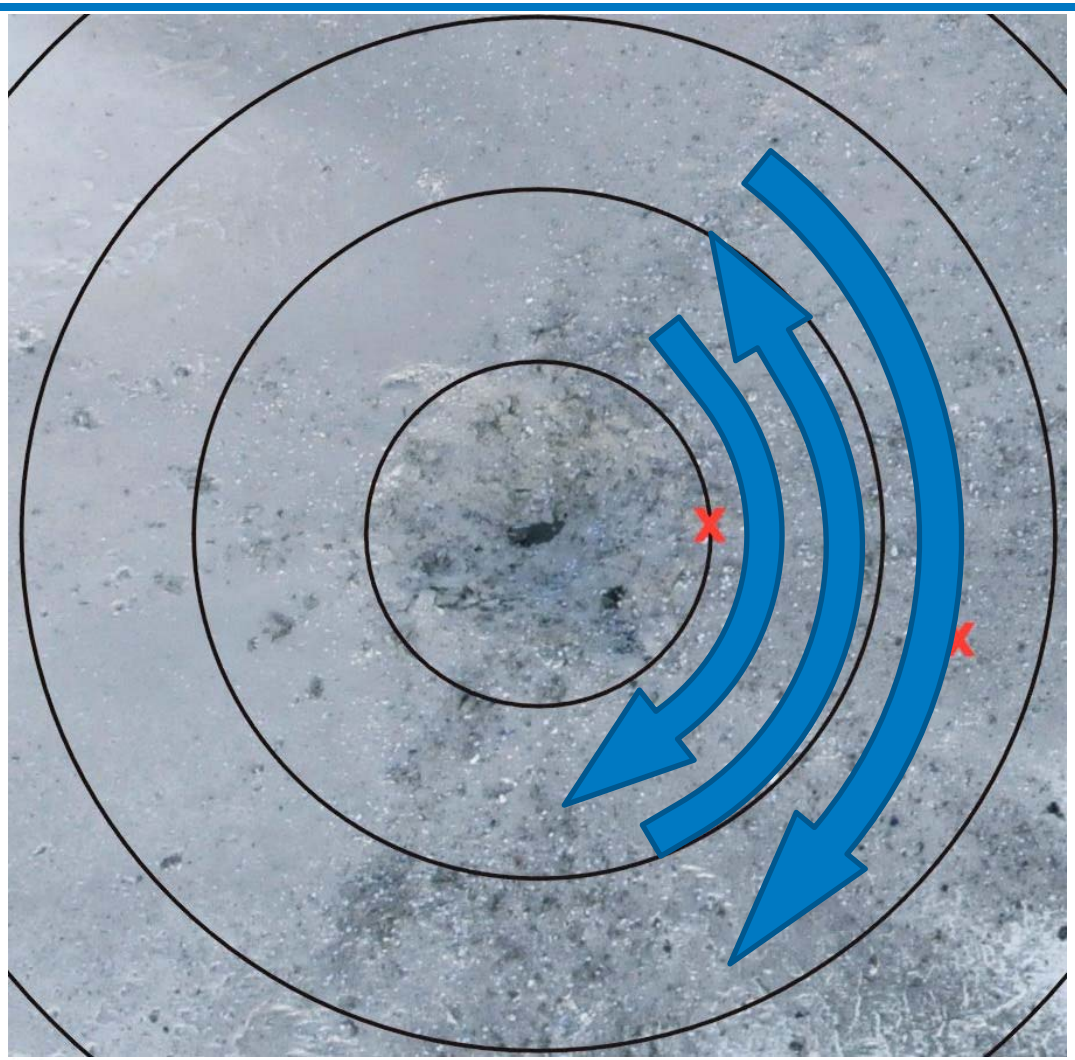
Accident site

The polar method



FDR and chassis of CVR

Search pattern



Searching CVR CSMU

Search continues

Wreckage recovery

Accredited Representatives

- Canada
- France
- Norway
- Spain
- USA

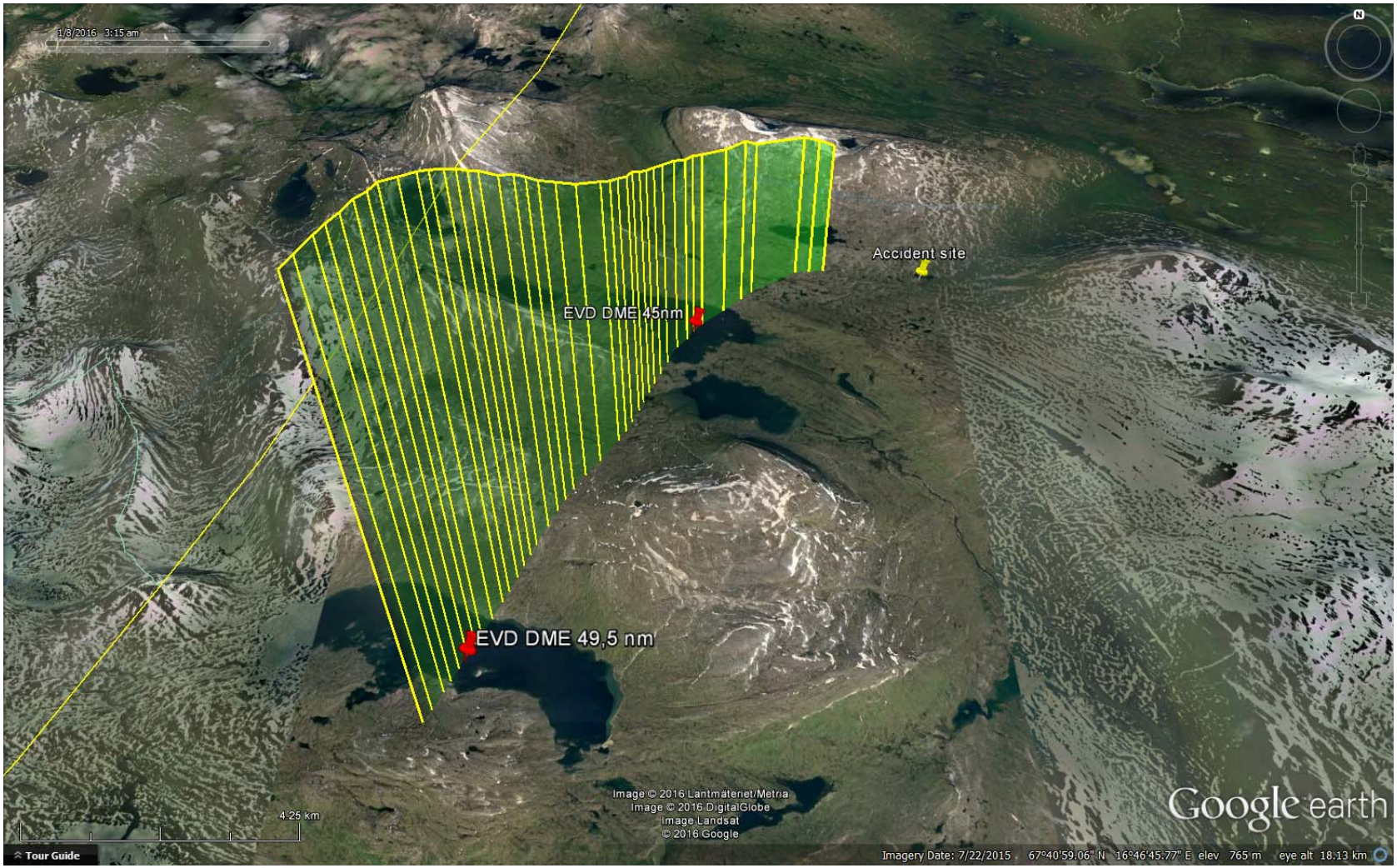
Advisors

- Swedish Transport Agency
- ICAO
- EASA
- Transport Canada
- Bombardier
- FAA
- GE
- Honeywell
- Northrop Grumman
- Rockwell Collins
- BEA

Experts

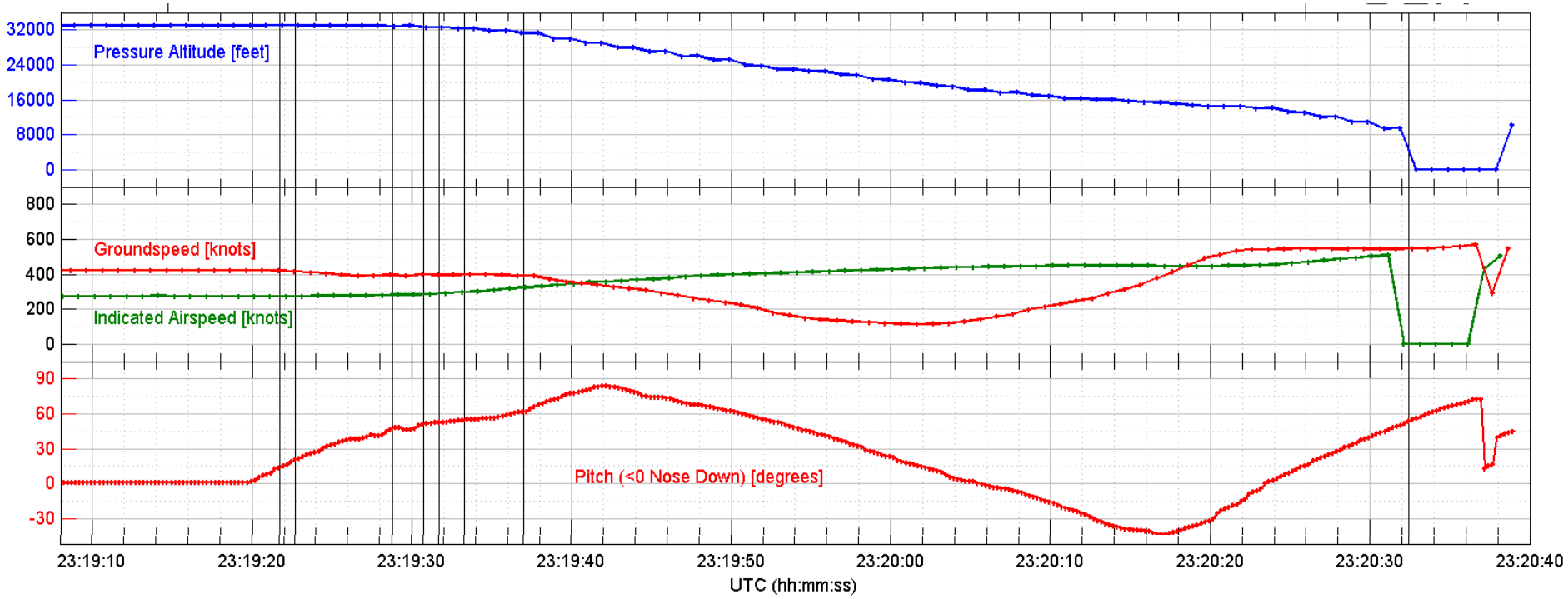
- Rescue services
- Aviation mechanics
- Aviation medicine
- Environmental physiology

Wide Area Multilateration

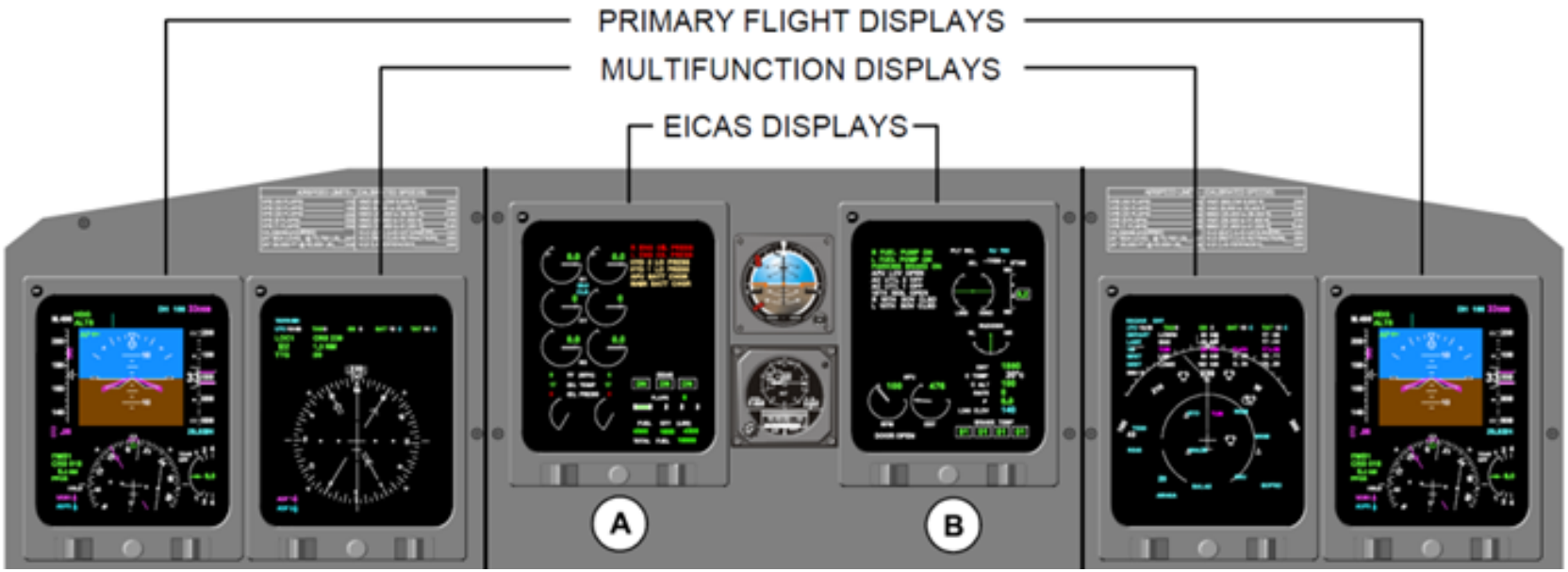


Understanding FDR-data

- pitch angle, roll angle, magnetic heading and ground speed

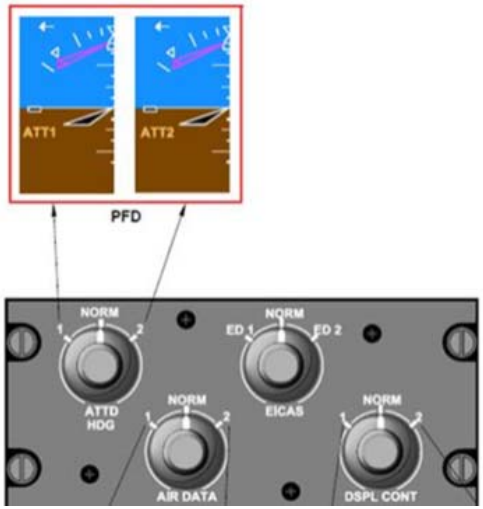


Attitude indicators



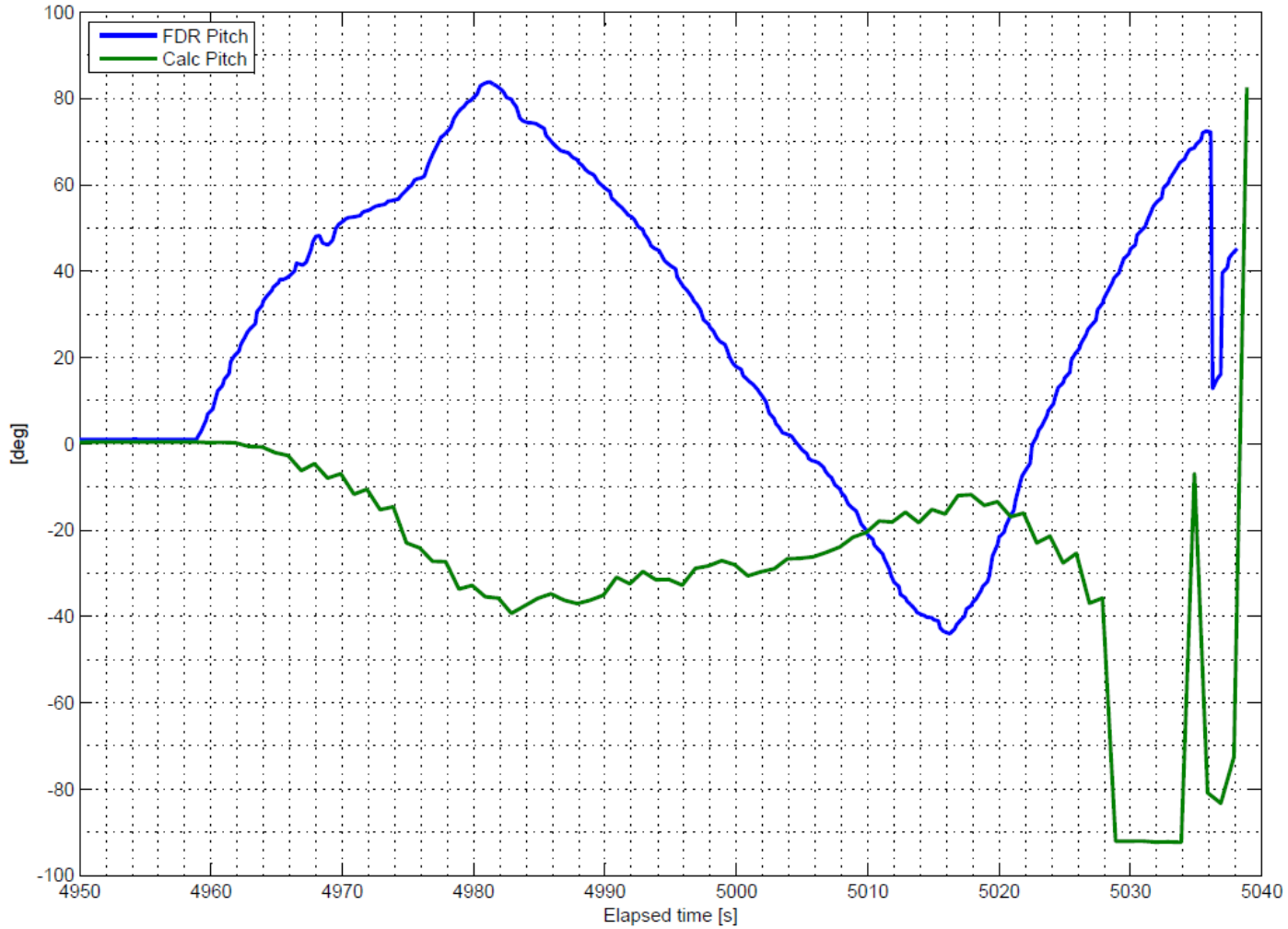
IRU 1

FDR

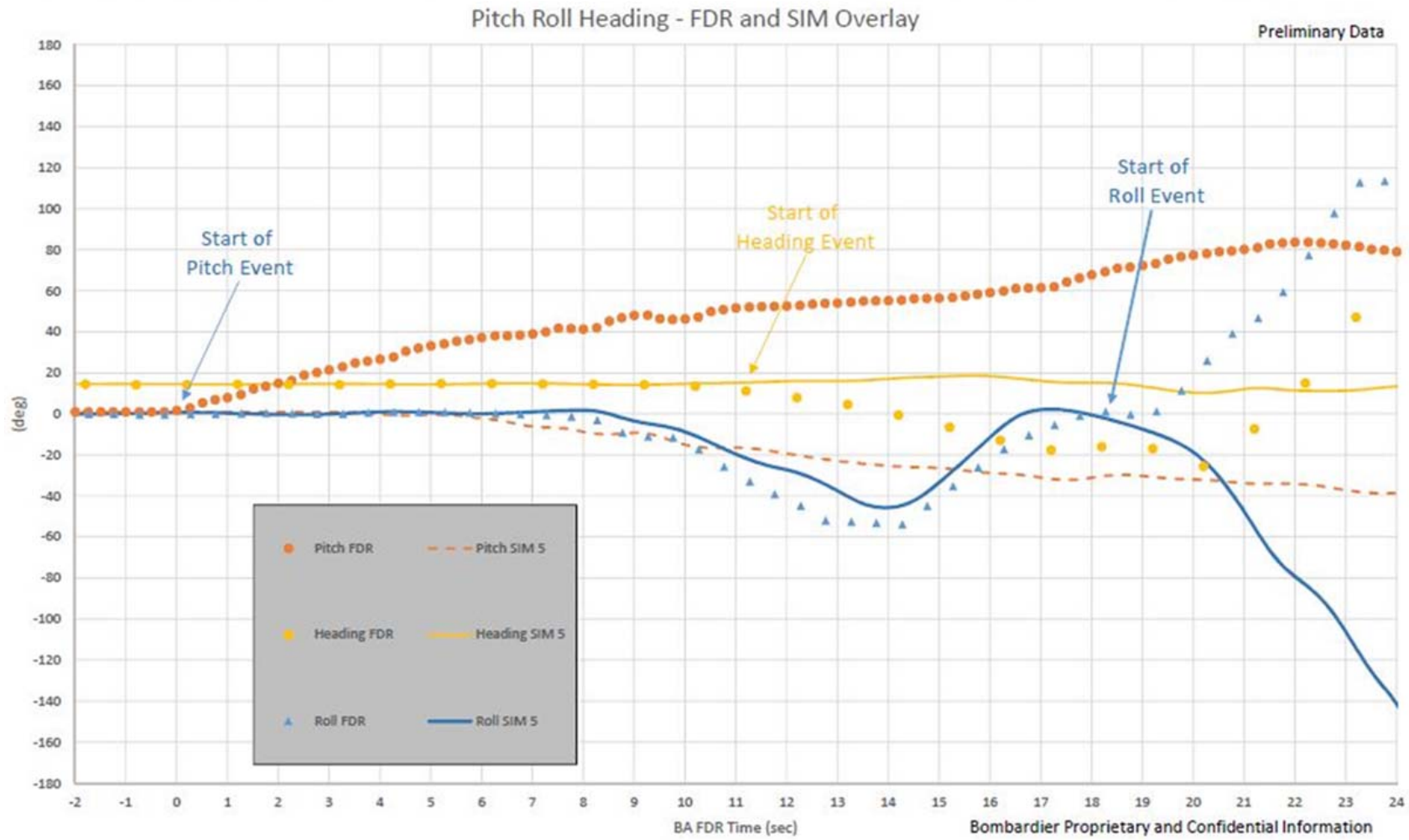


IRU 2

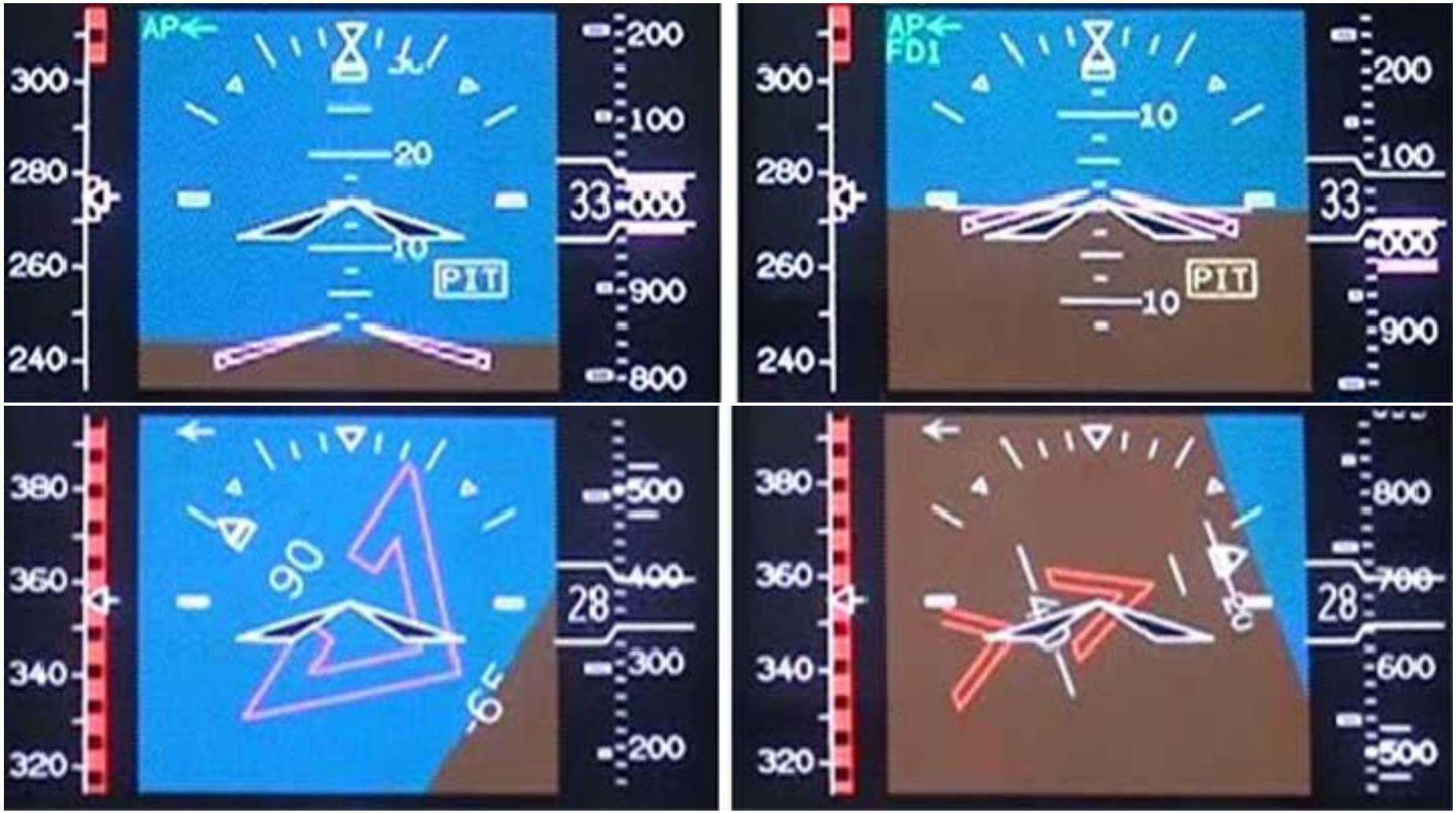
Calculation to validate pitch



FDR and simulation overlay



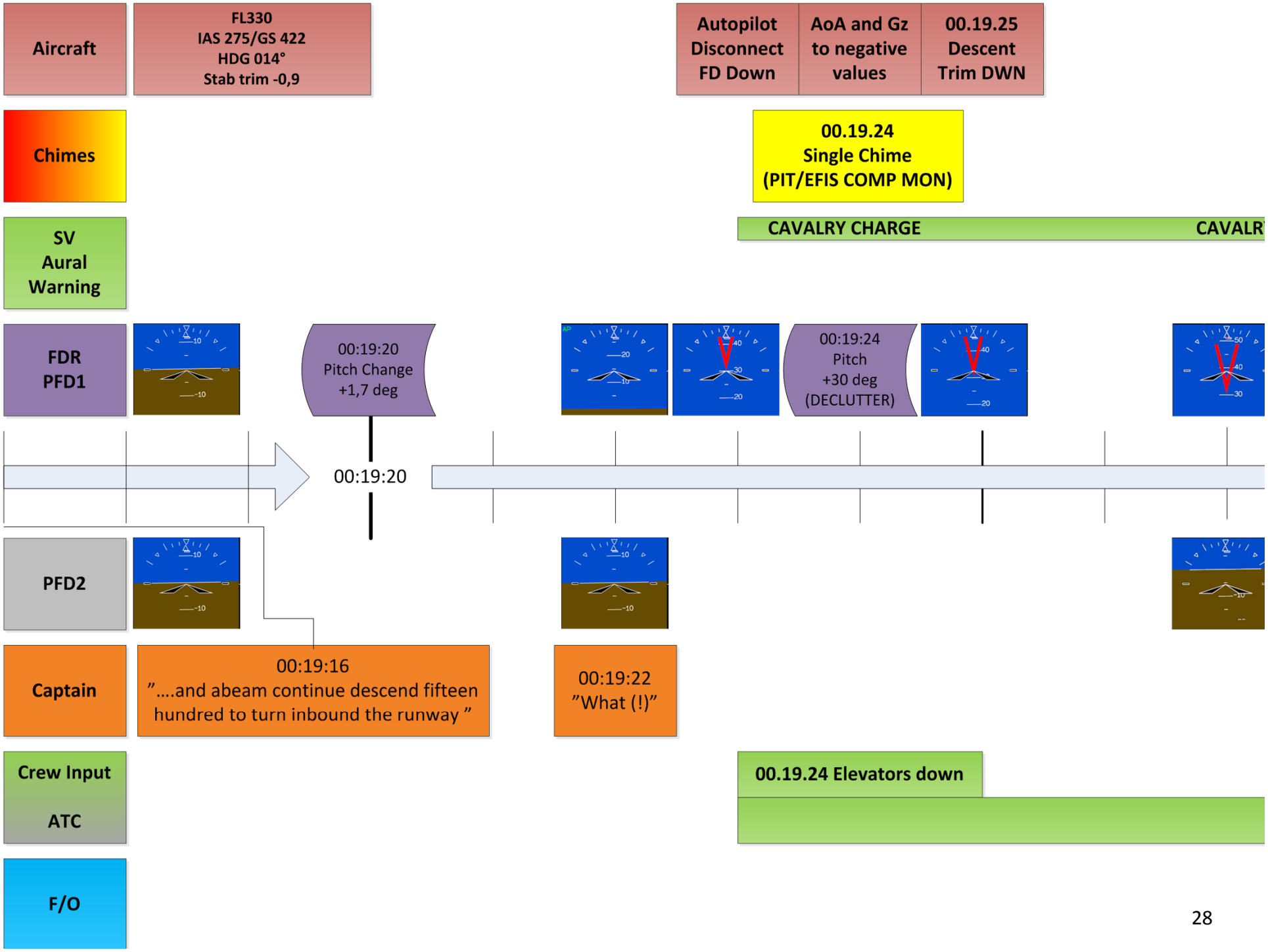
FDR and simulation at t2 and t22



Statens haverikommission
Swedish Accident Investigation Authority

Meetings

- Family meetings, Gällivare, Sweden
- Press conference, Luleå, Sweden
- Operator meeting, Stockholm, Sweden
- Investigation meeting, Bombardier, Montreal
- Factual information meeting with families, Stockholm, Sweden
- Factual information meeting with other stakeholders, Stockholm, Sweden (60 participants)


Aircraft
FL330
IAS 275/GS 422
HDG 014°
Stab trim -0,9
Autopilot Disconnect FD Down
AoA and Gz to negative values
00.19.25 Descent Trim DWN
Chimes
00.19.24 Single Chime (PIT/EFIS COMP MON)
SV Aural Warning
CAVALRY CHARGE
CAVALR
FDR PFD1
00:19:20 Pitch Change +1,7 deg
00:19:24 Pitch +30 deg (DECLUTTER)
00:19:20
PFD2
Captain
00:19:16 "....and abeam continue descend fifteen hundred to turn inbound the runway "
00:19:22 "What (!)"
Crew Input
ATC
00.19.24 Elevators down
F/O

Aircraft

Sounds of loose objects hitting ceiling

Gz -1

00.19.33
Stab Trim
+ 1,7

VMO
315 KT

Chimes

00.19.29
Triple Chime

00.19.32
Triple Chime
(cut out)

SV
Aural
Warning

Y CHARGE

CAVALRY CHARGE

CAVALRY CHARGE

Engine Oil

Bank Angle

Bank Angle

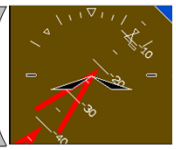
Stabilizer Trim Clacker

FDR
PFD1

00:19:30

PFD2

00:19:32
PFD 2
(DECLUTTER)



Captain

00:19:30
”What (!)”

00:19:35
”Come on, help, me
help me, help me”

Crew Input

ATC

00.19.24 -00.19.43 Pilot Trim Command Active (00.19.29 – 00.19.32 Copilot Trim Command Active)

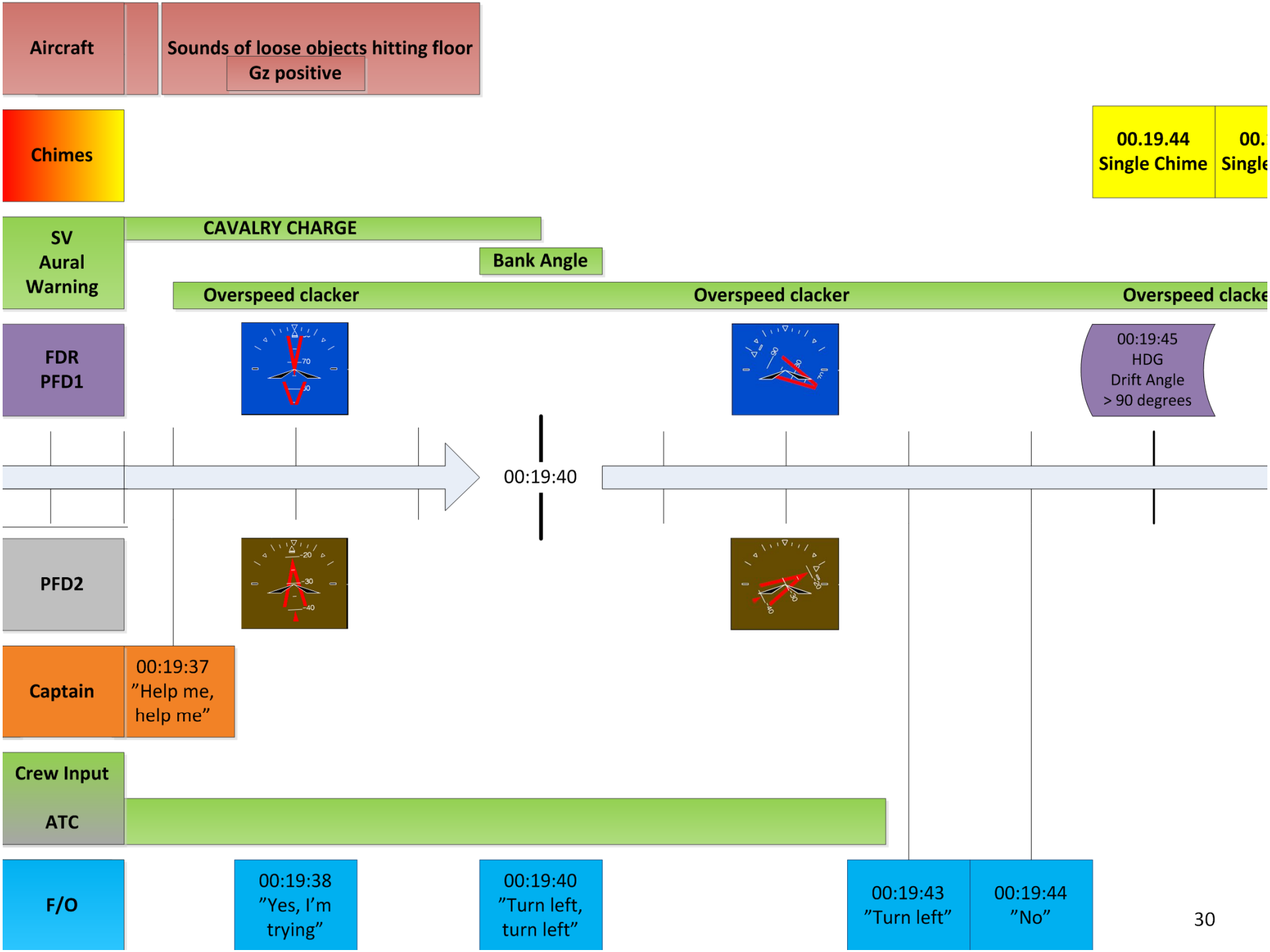
F/O

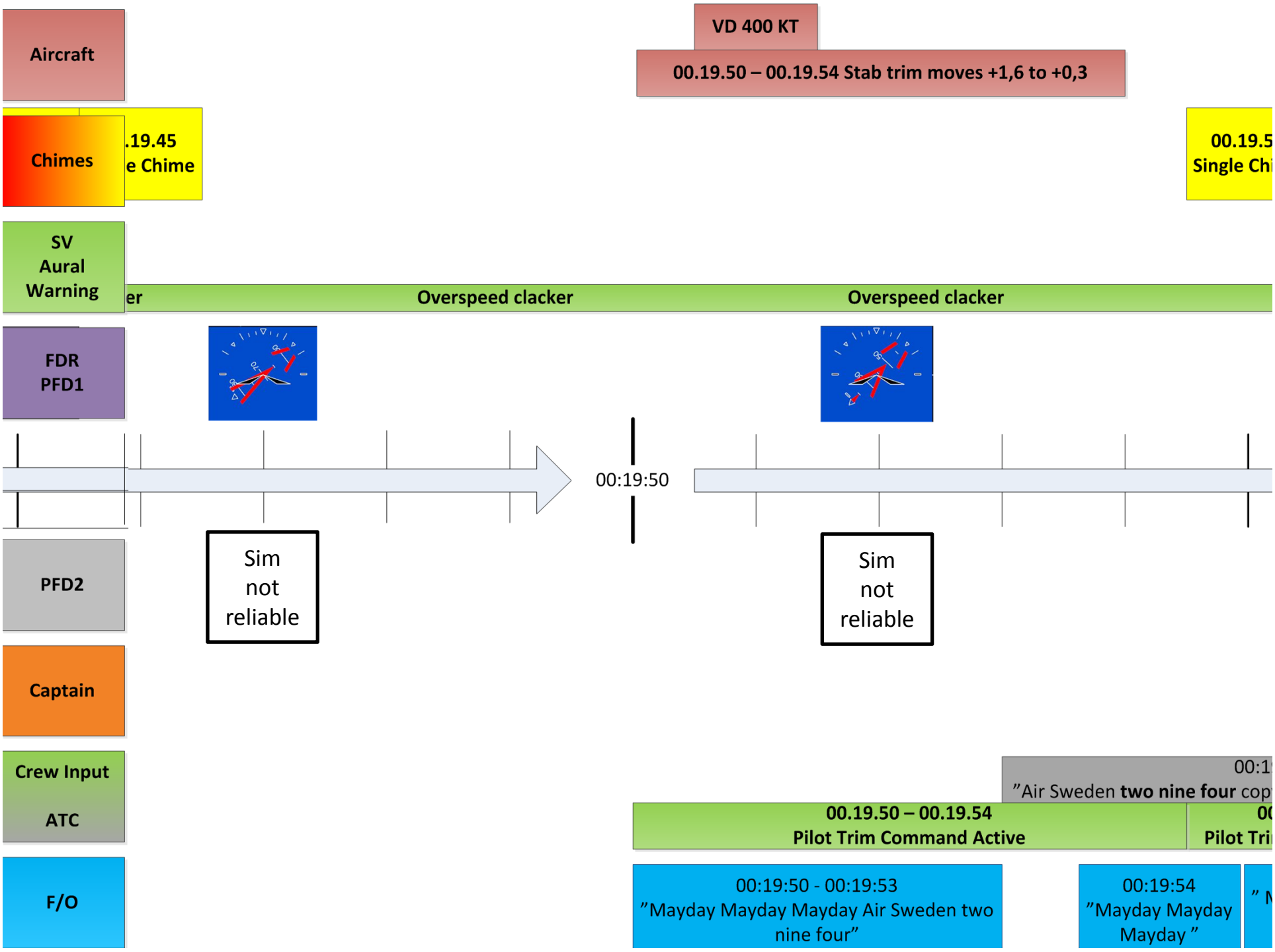
00:19:29
”What (!)”

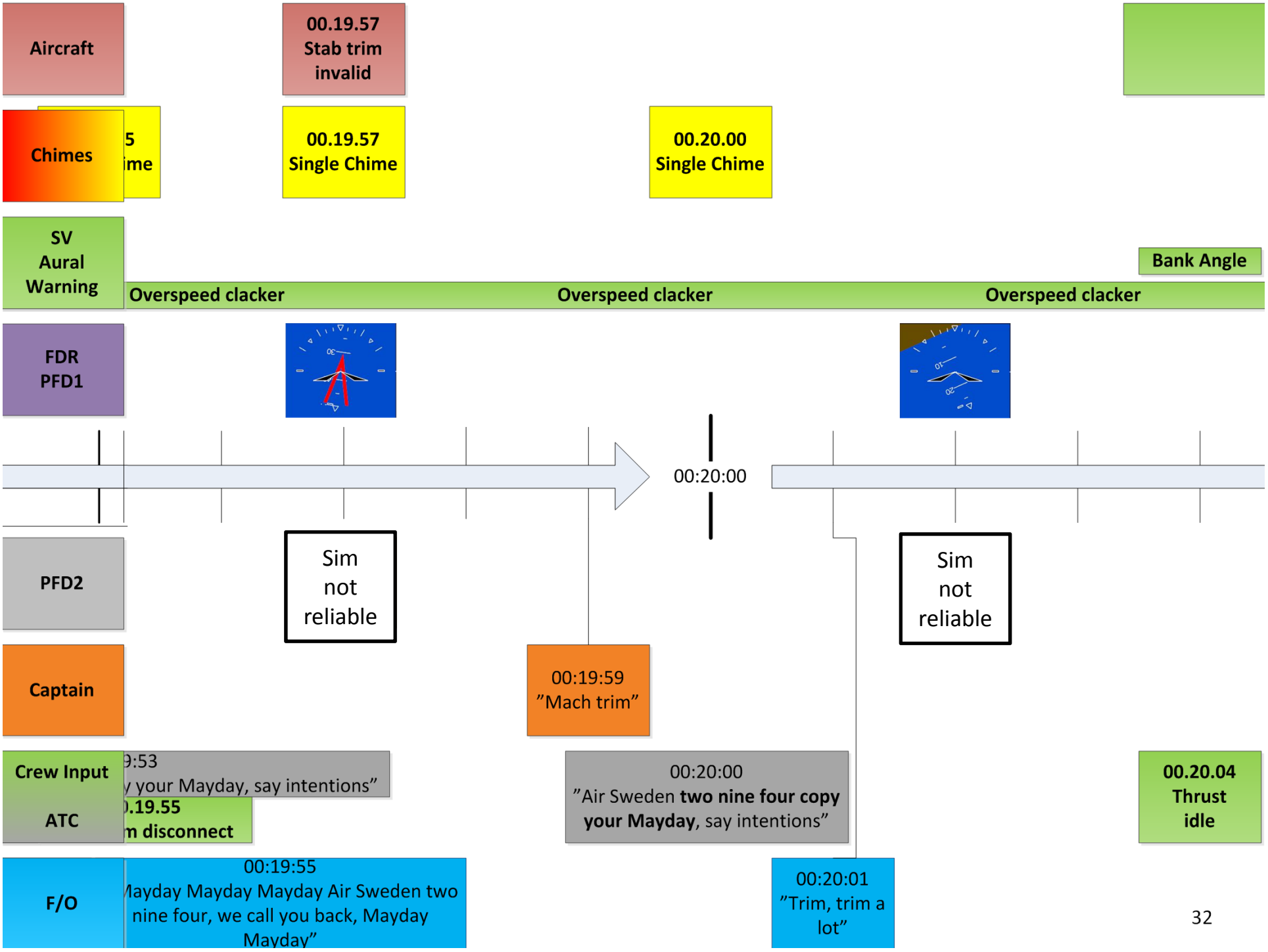
00:19:33
”Come up”

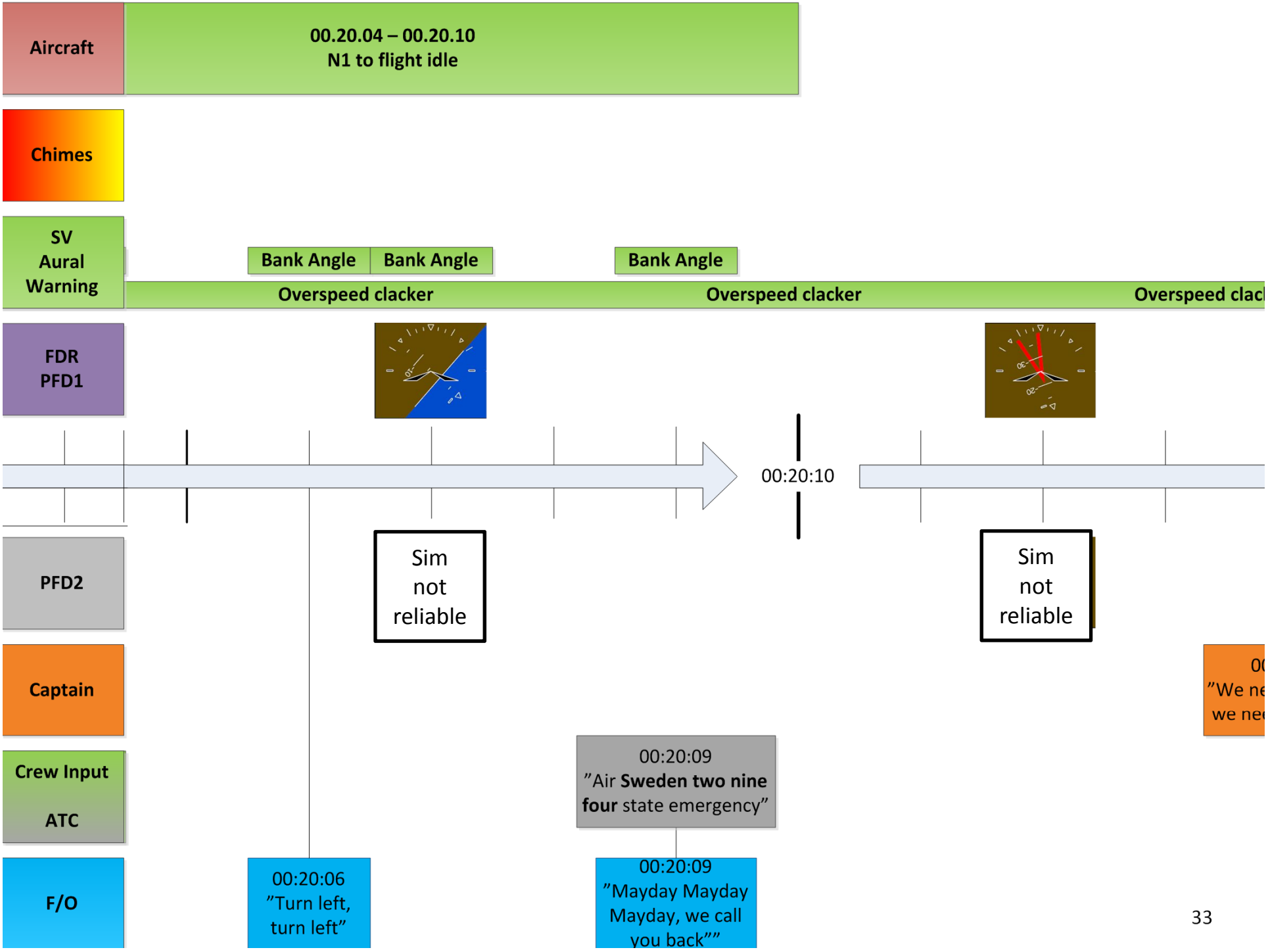
00:19:35
”Turn right”

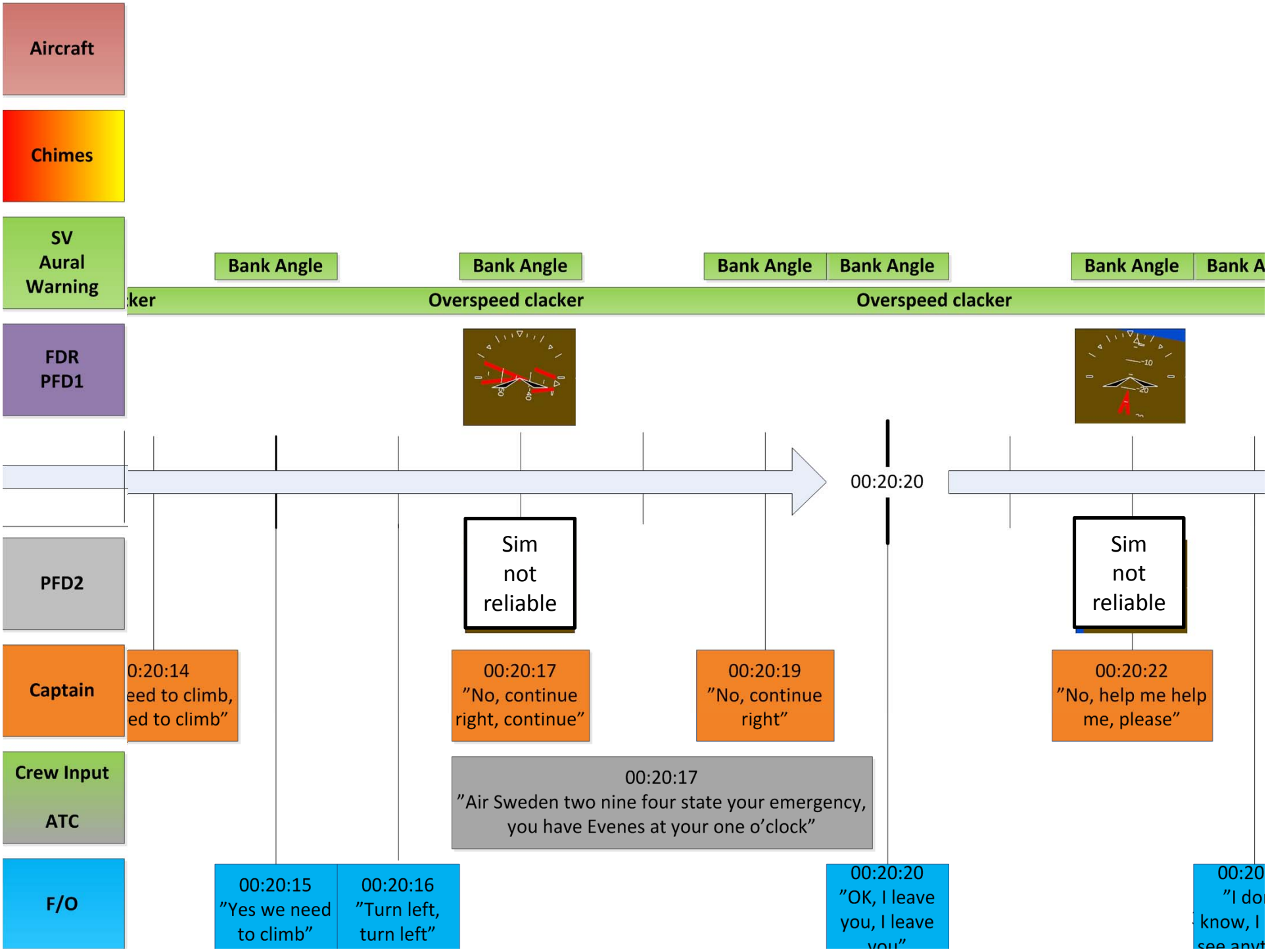
00:19:36
”What (!)”

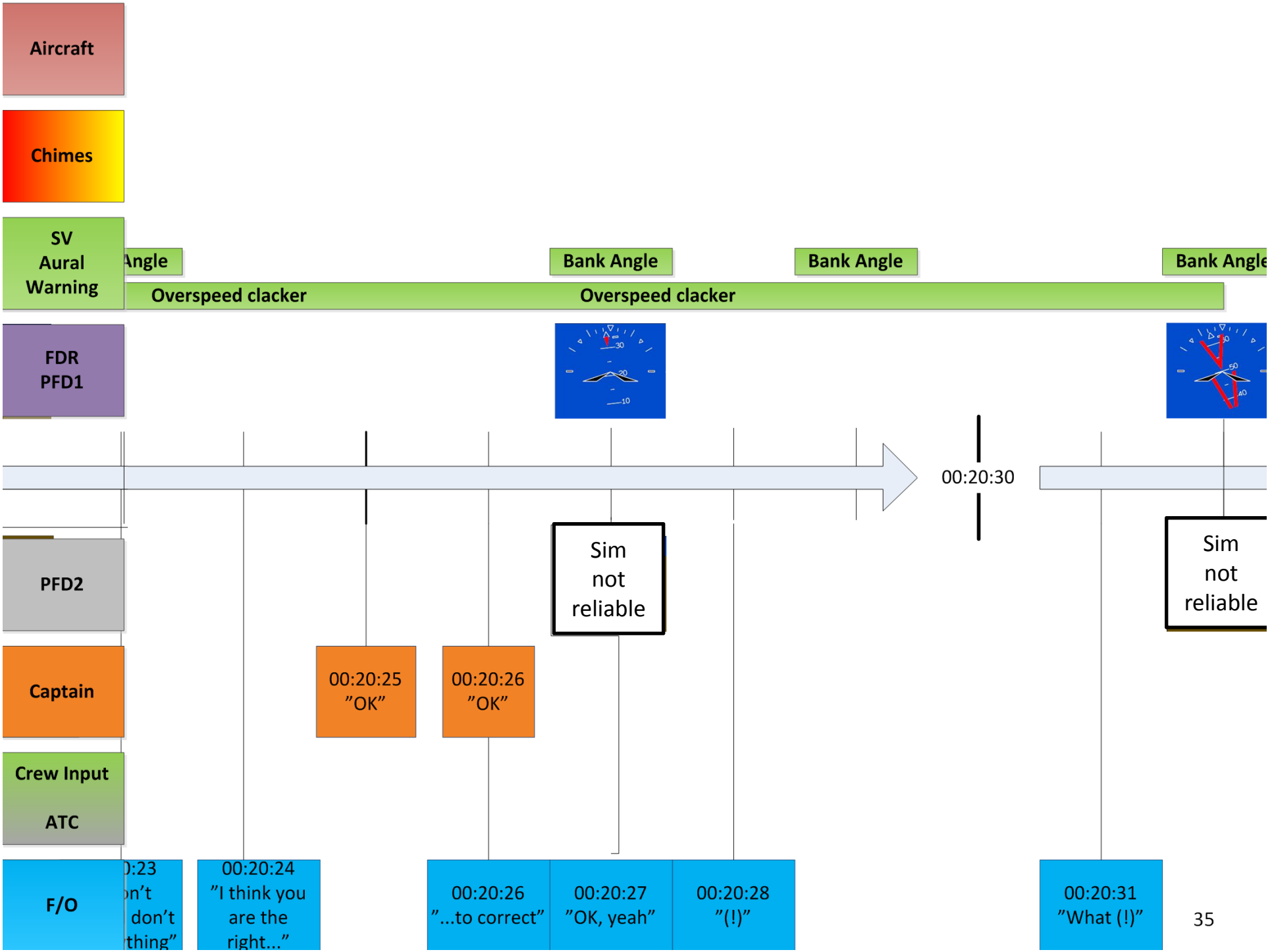

Aircraft
Sounds of loose objects hitting floor
Gz positive
Chimes
00.19.44
Single Chime
00.
Single
SV
Aural
Warning
CAVALRY CHARGE
Bank Angle
Overspeed clacker
Overspeed clacker
Overspeed clacke
FDR
PFD1
00:19:45
HDG
Drift Angle
> 90 degrees
00:19:40
PFD2
Captain
00:19:37
”Help me,
help me”
Crew Input
ATC
F/O
00:19:38
”Yes, I’m
trying”
00:19:40
”Turn left,
turn left”
00:19:43
”Turn left”
00:19:44
”No”

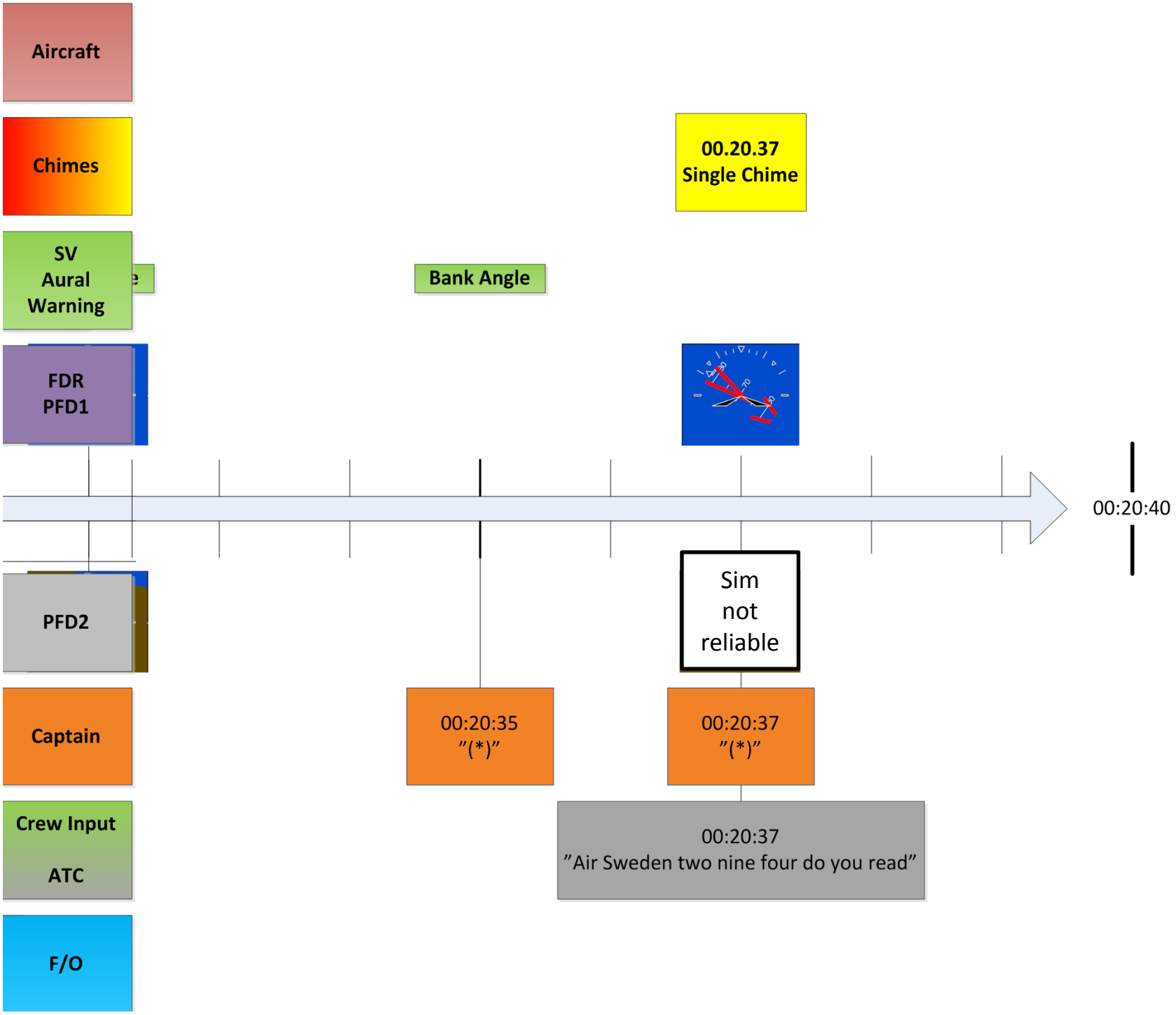

Aircraft
VD 400 KT
00.19.50 – 00.19.54 Stab trim moves +1,6 to +0,3
Chimes
.19.45
e Chime
00.19.5
Single Chi
SV
Aural
Warning
er
Overspeed clacker
Overspeed clacker
FDR
PFD1
00:19:50
PFD2
Sim
not
reliable
Sim
not
reliable
Captain
Crew Input
ATC
00:1
”Air Sweden two nine four cop
00.19.50 – 00.19.54
Pilot Trim Command Active
00
Pilot Tri
F/O
00:19:50 - 00:19:53
”Mayday Mayday Mayday Air Sweden two nine four”
00:19:54
”Mayday Mayday Mayday ”
” M


Aircraft
00.19.57
Stab trim
invalid
Chimes
00.19.57
Single Chime
00.20.00
Single Chime
SV
Aural
Warning
Bank Angle
Overspeed clacker
Overspeed clacker
Overspeed clacker
FDR
PFD1
00:20:00
PFD2
Sim
not
reliable
Sim
not
reliable
Captain
00:19:59
”Mach trim”
Crew Input
ATC
00:20:00
”Air Sweden two nine four copy
your Mayday, say intentions”
00.20.04
Thrust
idle
F/O
00:19:55
nine four, we call you back, Mayday
Mayday”
00:20:01
”Trim, trim a
lot”


Aircraft
00.20.04 – 00.20.10
N1 to flight idle
Chimes
SV
Aural
Warning
Bank Angle
Bank Angle
Bank Angle
Overspeed clacker
Overspeed clacker
Overspeed clacl
FDR
PFD1
00:20:10
PFD2
Sim
not
reliable
Sim
not
reliable
Captain
0(
”We ne
we nee
Crew Input
ATC
00:20:09
”Air Sweden two nine
four state emergency”
F/O
00:20:06
”Turn left,
turn left”
00:20:09
”Mayday Mayday
Mayday, we call
you back””


Aircraft
Chimes
SV Aural Warning
FDR PFD1
PFD2
Captain
Crew Input ATC
F/O
Bank Angle
Bank Angle
Bank Angle
Bank Angle
Bank Angle
Bank A
ker
Overspeed clacker
Overspeed clacker
00:20:20
Sim not reliable
Sim not reliable
0:20:14 eed to climb, ed to climb”
00:20:17 ”No, continue right, continue”
00:20:19 ”No, continue right”
00:20:22 ”No, help me help me, please”
00:20:17 ”Air Sweden two nine four state your emergency, you have Evenes at your one o’clock”
00:20:15 ”Yes we need to climb”
00:20:16 ”Turn left, turn left”
00:20:20 ”OK, I leave you, I leave you”
00:20 ”I do know, I


Aircraft
Chimes
SV Aural Warning
Angle
Bank Angle
Bank Angle
Bank Angle
Overspeed clacker
Overspeed clacker
FDR PFD1
00:20:30
PFD2
Sim not reliable
Sim not reliable
Captain
00:20:25 ”OK”
00:20:26 ”OK”
Crew Input
ATC
F/O
:23 n’t don’t thing”
00:20:24 ”I think you are the right...”
00:20:26 ”...to correct”
00:20:27 ”OK, yeah”
00:20:28 ”(!)”
00:20:31 ”What (!)”


Aircraft
Chimes
00.20.37
Single Chime
SV
Aural
Warning
Bank Angle
FDR
PFD1
00:20:40
PFD2
Sim
not
reliable
Captain
00:20:35
”(*)”
00:20:37
”(*)”
Crew Input
ATC
00:20:37
”Air Sweden two nine four do you read”
F/O

Findings

- IRU 1 produced erroneous parameters (pitch, roll and heading) without any indication of a fail message.
- The erroneous recorded parameters from IRU 1 were displayed on PFD 1.
- After autopilot disconnect, the aeroplane remained in level flight until the elevators commanded the aeroplane pitch down.
- The aeroplane was aerodynamically and structurally intact at least until VD and MD was exceeded.
- No evidence of an inflight break-up has been found.

Findings

- Information about declutter, unusual attitude and chevrons concerning the PFD units could only be found in the manufacturer's PRM.
- Information about the removal of comparator cautions in declutter mode could not be found in any manual.
- The declutter function, concerning the comparator cautions, was different between the simulator and the aeroplane.
- No callouts were found in the operator's manuals for the abnormal procedure EFIS COMP MON, neither are such callouts prescribed by regulations.
- There are no regulatory requirements for standard callouts for abnormal or unusual situations.

Factors as to cause and contributing factors

- The accident was caused by insufficient operational prerequisites for the management of a failure in a redundant system.
- Contributing factors were:
  - The absence of an effective system for communication in abnormal and emergency situations.
  - The flight instrument system provided insufficient guidance about malfunctions that occurred.
  - The initial manoeuver that resulted in negative G-loads probably affected the pilots' ability to manage the situation in a rational manner.

Recommendations

- ICAO, EASA, Transport Canada, FAA:
  - Ensure that a general system of initial standard calls for the handling of abnormal and emergency procedures and also for unusual and unexpected situations is implemented throughout the commercial air transport industry.
- EASA, Transport Canada, FAA:
  - Ensure that the design criteria of PFD units are improved in such a way that pertinent cautions are not removed during unusual attitude or declutter modes.

The final report

- Published after 11 months
- No submissions
- Still waiting for some recommendation responses
- Report available in English at havkom.se

Questions and dialogue