Investigation of Factors Affecting Loss of Control of GA Aircraft

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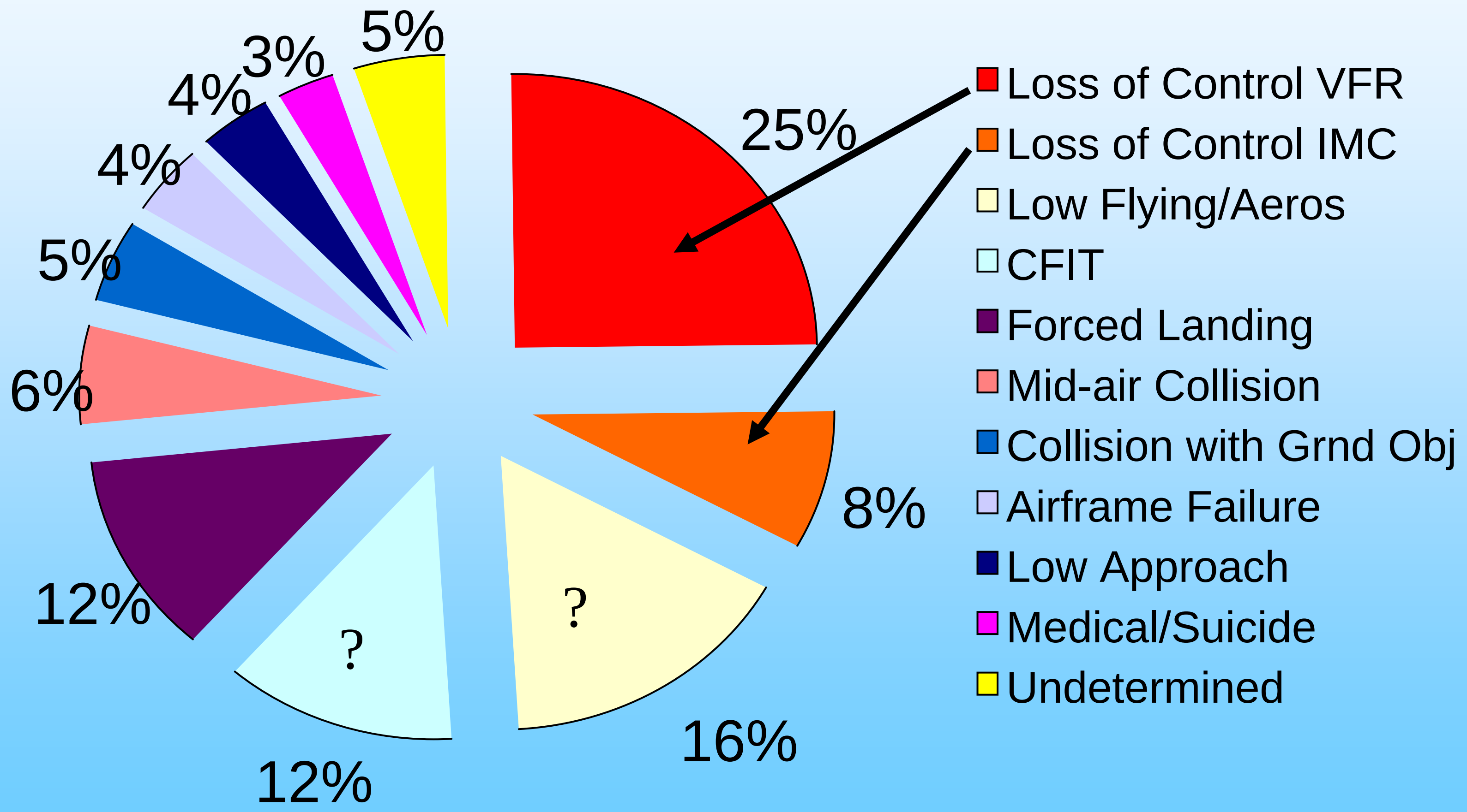
Contents

- Background
- Programme Objectives
- Key Design Factors
- Flight Test Programme
- Initial Findings
- Lessons Learned
- Next Steps

Fixed Wing <5,700kg (non-microlight) fatal accident causal factors: 1980 to 2006 (UK)



Source: *GASCo*

GA fatal accident causal factors cont'd…

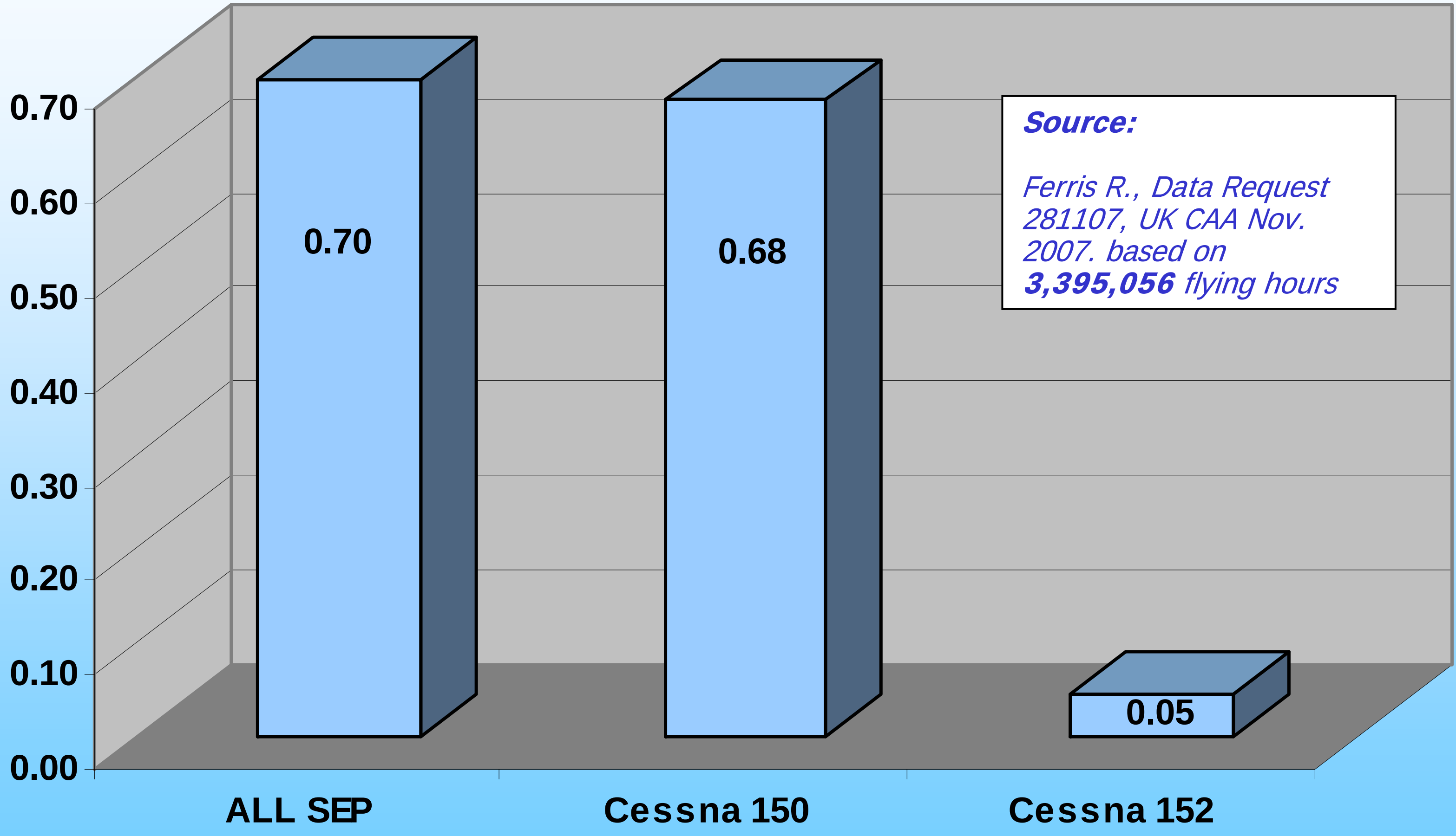
- UK, US, Canada & Australia, 300+ GA fatal accidents annually
  - Likely 100-200 LoC related
- Usually LoC at low level
  - Take-off, landing, go-around, forced landings
  - "Low, slow and dirty"

Programme Objectives

- Why does LoC happen?
- Why certain types and not others?
- How can we improve operational safety?
- “LoC-proof” future GA designs.

1984-2006: selected statistics

UK Fatalities per 100,000hrs



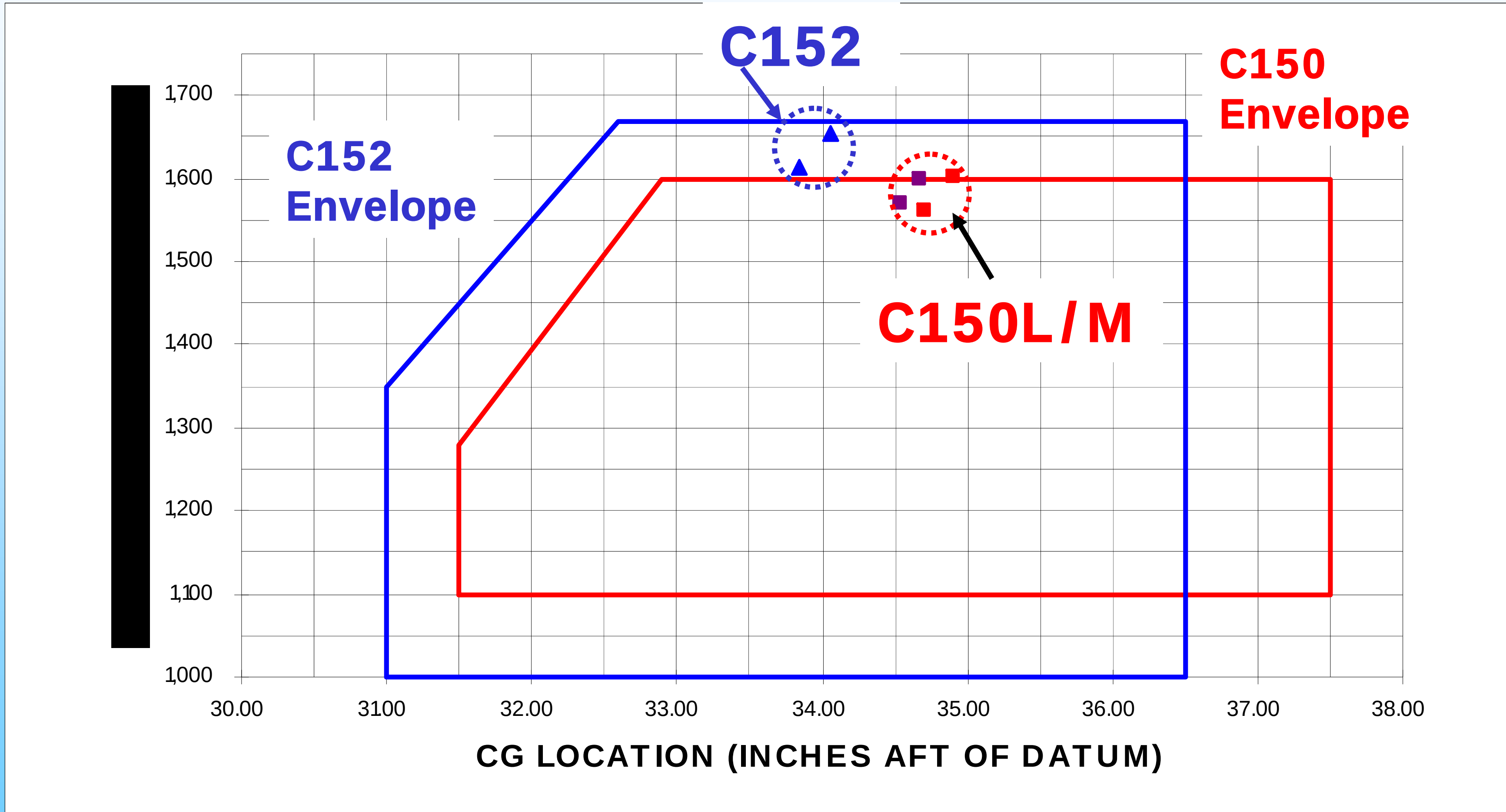
Spot the difference...?

What's the difference?

	Cessna 150L ('74) Cessna 150 M ('75)	Cessna 152 ('80)
Powerplant	100 hp Continental	110 hp Lycoming
Weight (lbs)	1600	1670
CG Range (in)	31.5~37.5 (19.9~30.1 %MAC)	31~36.5 (19.1~28.4 %MAC)
Flap Range (deg)	0~40, no detents	0~30, detents @ 0/10/20/30
Flap Activation/Monitoring	2-way switch, LH Door post Indicator	Gated 4 position switch, adj. indicator
CR Speeds@60% Pwr/2000'/Std T(KTAS)	89	91
V_{S0} (KCAS) Pwr Off/Aft CG/MTOW: L(30)	42	41
L(40)	41	N/A

Is it CG?

- Typical CGs, 2POB + Wf to MTOW



Flight Test Programme

	Phase 1			Phase 2*	
	A/c 1			A/c 2	A/c 3
Baseline	CG1	CG2	CG3	CG1	CG1
	Mid	Mid-Fwd	Mid-Aft	Mid	Mid
C152	1 53%	4	6 62%	-	-
F150L	2 52%			-	-
F150M	3 57%	5	7	-	-

Methods & Equipment

- TPS basics
  - Handheld force/displacement/timing
  - Portable CVR
- Headset mounted video for debrief
- Appareo FDR

  +Garmin 296 GPS supplement / positional awareness

Methods & Equipment

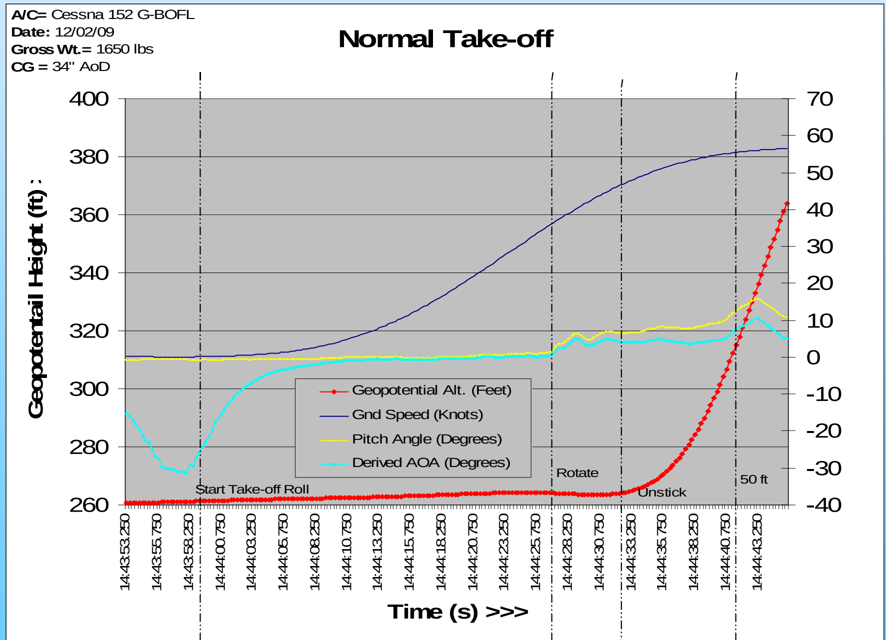
Appareo GAU 1000A FDR

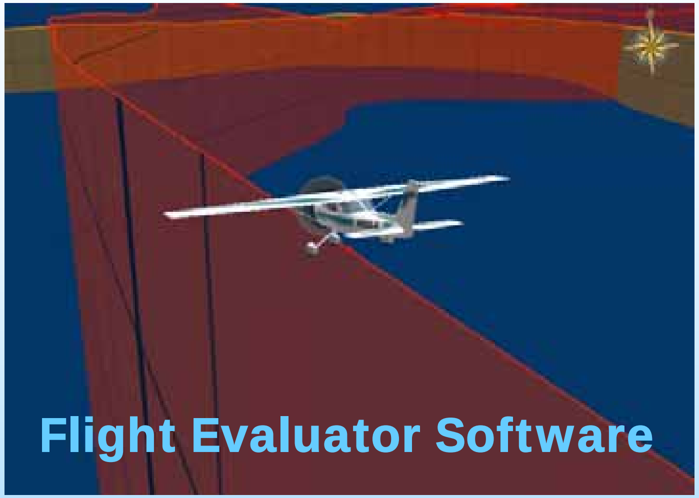
- 16 Channels@ 4Hz
- WAAS enabled GPS
- 3 x Gyroscopes
- 3 x Accelerometers
- Barometric pressure sensor
- Solid state compass
- AS Flight Analysis software
- US$ 2000

Methods & Equipment

Flight Analysis software

- 2d/3d playback
- Google earth integration
- Instrument panel
- Own or external GPS
- Data export

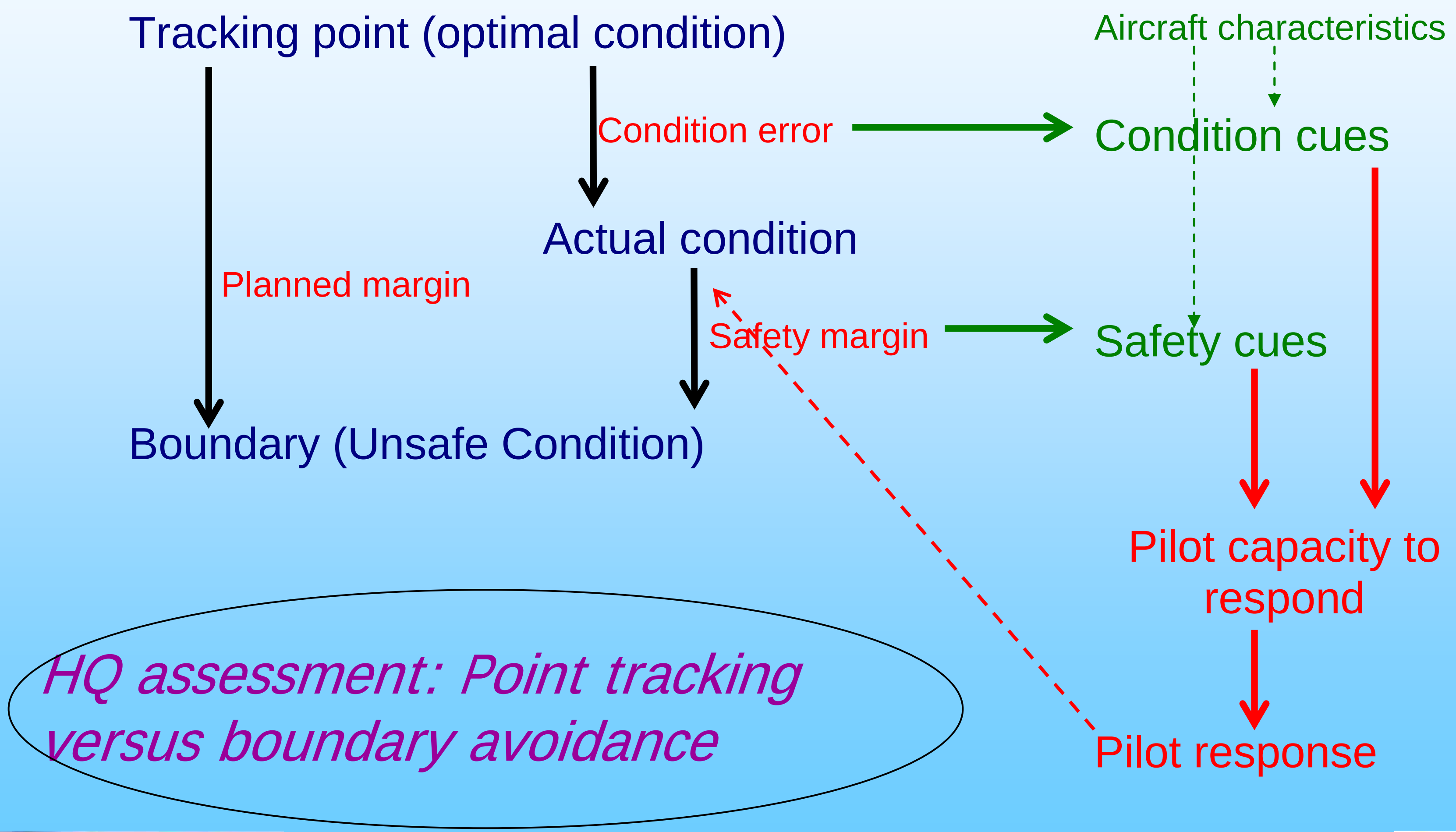




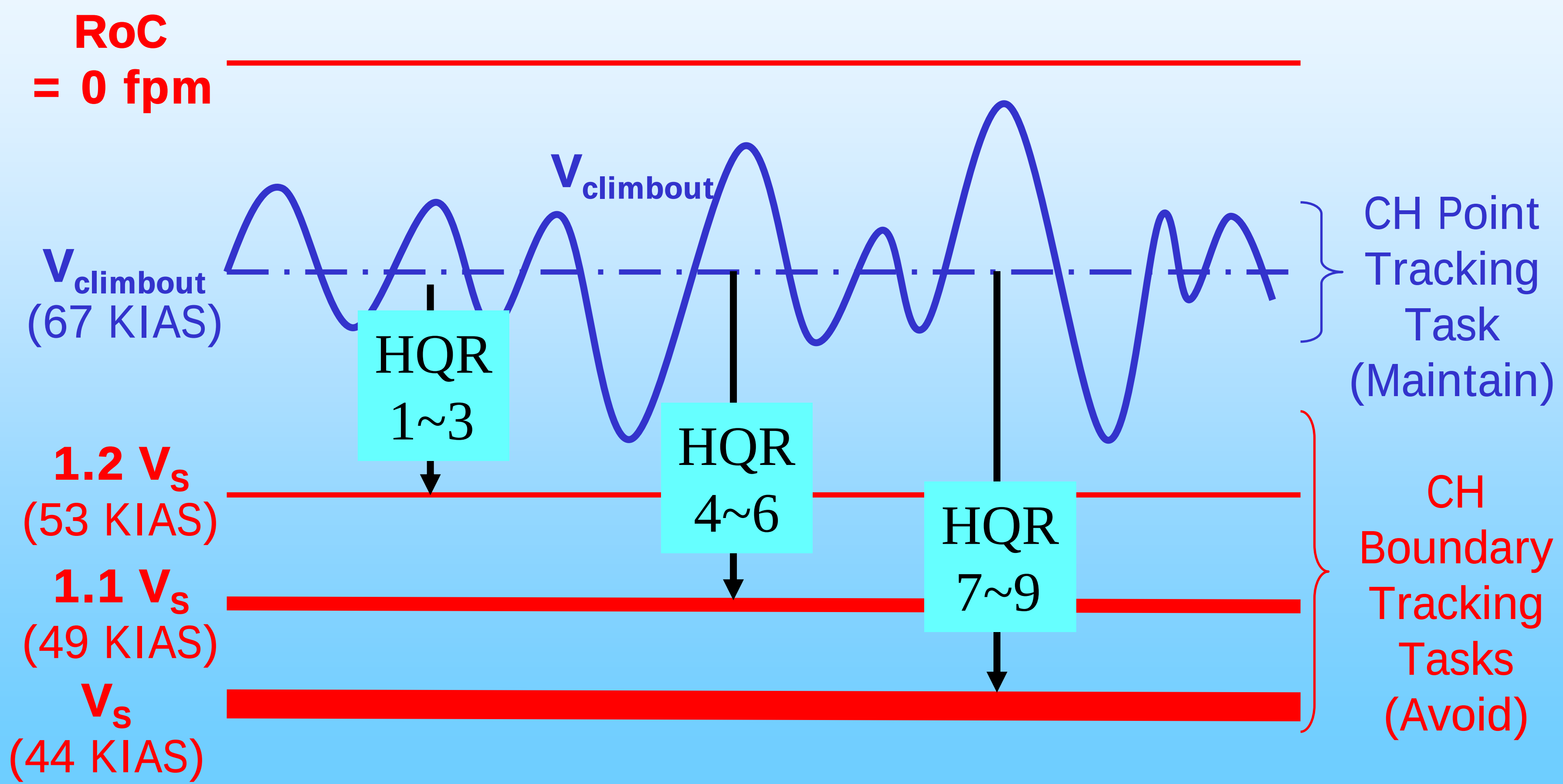
FDR Parameters

- Time
- Lat/Long
- True Gnd Speed
- Pitch/Roll/Yaw Attitude
- Pitch/Roll/Yaw Rate
- Geo-potential Altitude
- Normal, Lat., Long. Accelerations & Velocities

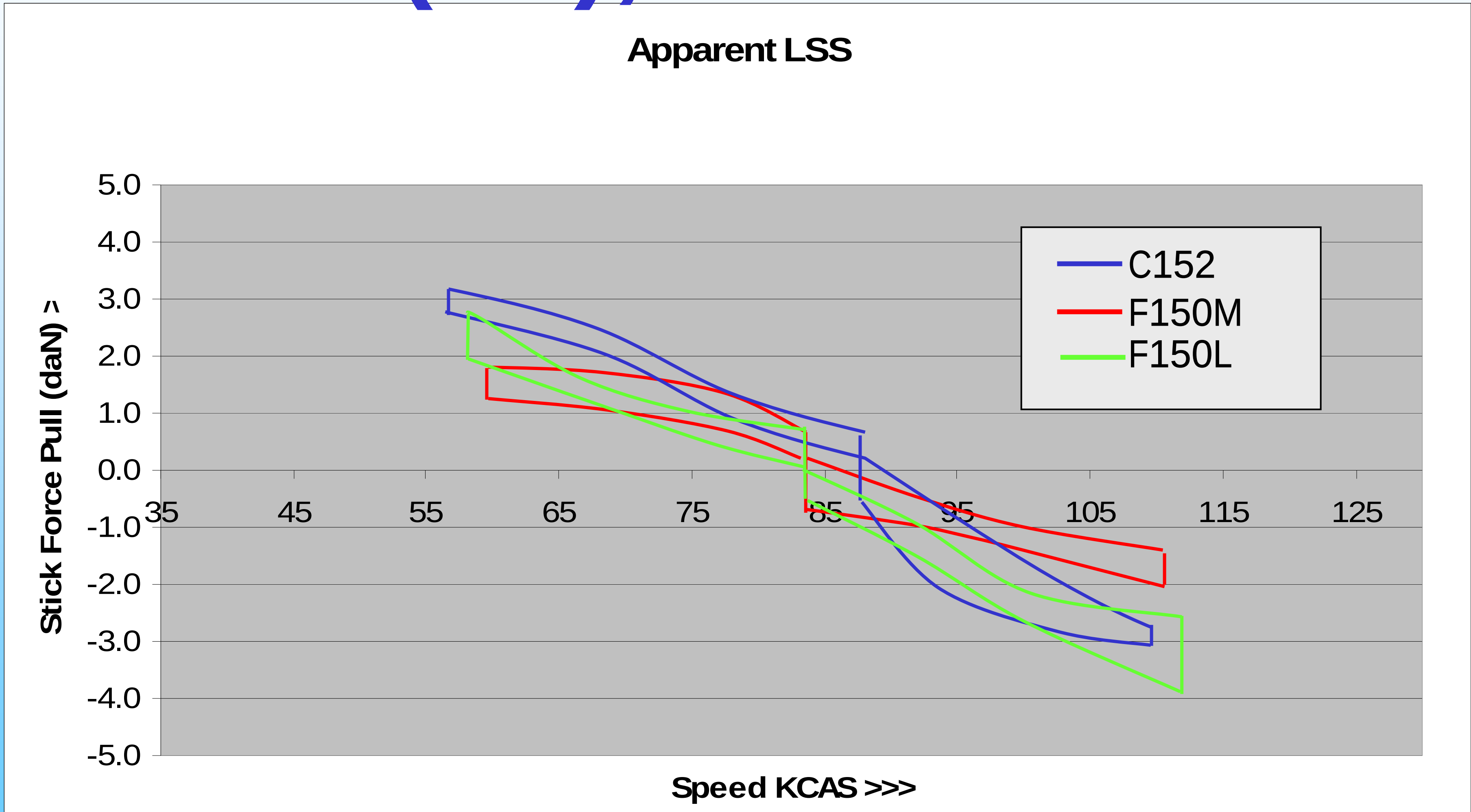
BFSL safety model – the questions



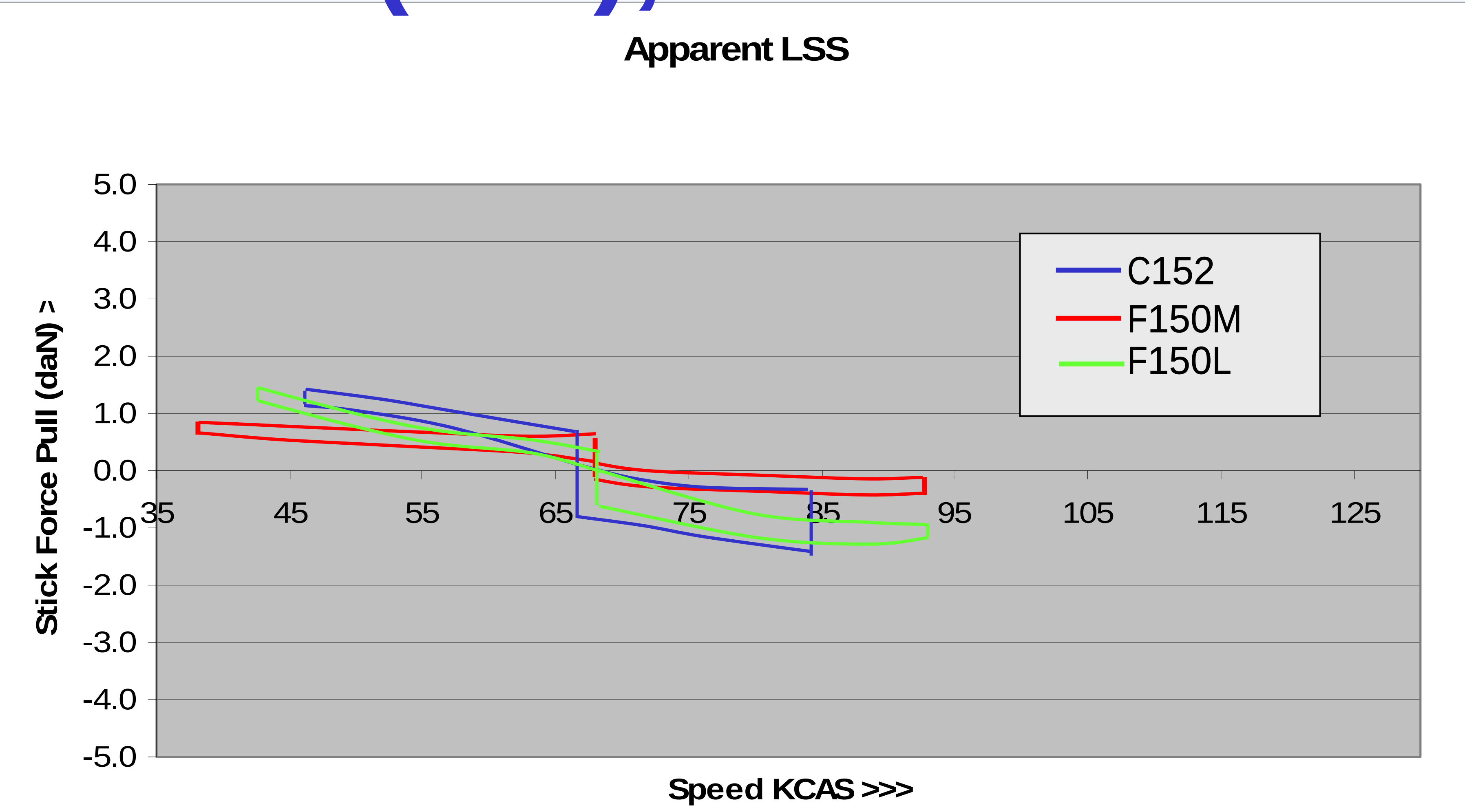
Cooper-Harper task selection - Climb out speed control



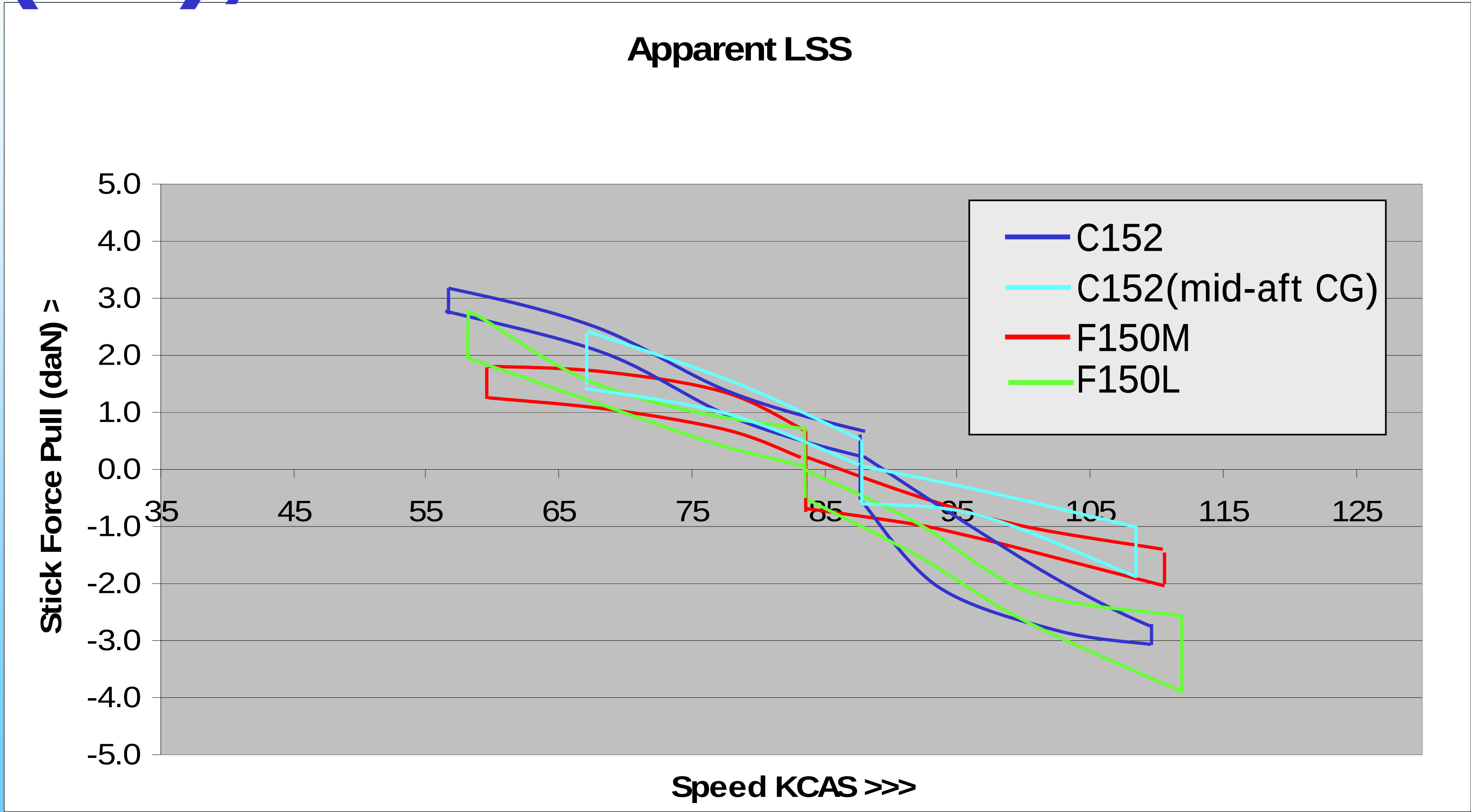
Comparison of Apparent LSS (CR), 150M vs 152



Comparison of Apparent LSS (L30), 150M vs 152



Comparison of Apparent LSS (CR), 150M vs 152/CG mid-aft



Initial findings

- Apparent LSS
  - Low speed LSS much steeper in C152 than C150 models
  - C150 / LAND / PLF →MCP, near-neutral
  - Indications of CG dependency
  - Possible cliff-edge change?
- Flaps
  - Large out of trim forces on retraction
  - C150 Flap indicator widens scan
  - Readability issues
- Stall
  - Power on / flapped stall: C150 only attitude warnings, spin risk
- Visible pitch attitude changes constantly close to GND

Mike's lessons – academic FT

- Equipment portability
- Limited budget – time is money
- Use a 'calibrated' TP
- Data reduction takes considerable time
  - plan for this time between sorties
  - design test cards for data reduction
- Don't rely on the technology
- Reporting – brevity vs academic rigour
- Be prepared for the unexpected!

Guy's lessons – test conduct

- "Safe" GA aircraft can still bite, and without inanition
  - Brief for all emergencies
- Flying club environment
  - Sub-optimal aircraft
  - At-least 1 in 3 W&CG schedules contain errors
    - Consider re-weighing
  - Weather press-on-itis
    - Check everything
    - Know and stick to no-go criteria
  - Keep talking

Next Steps...

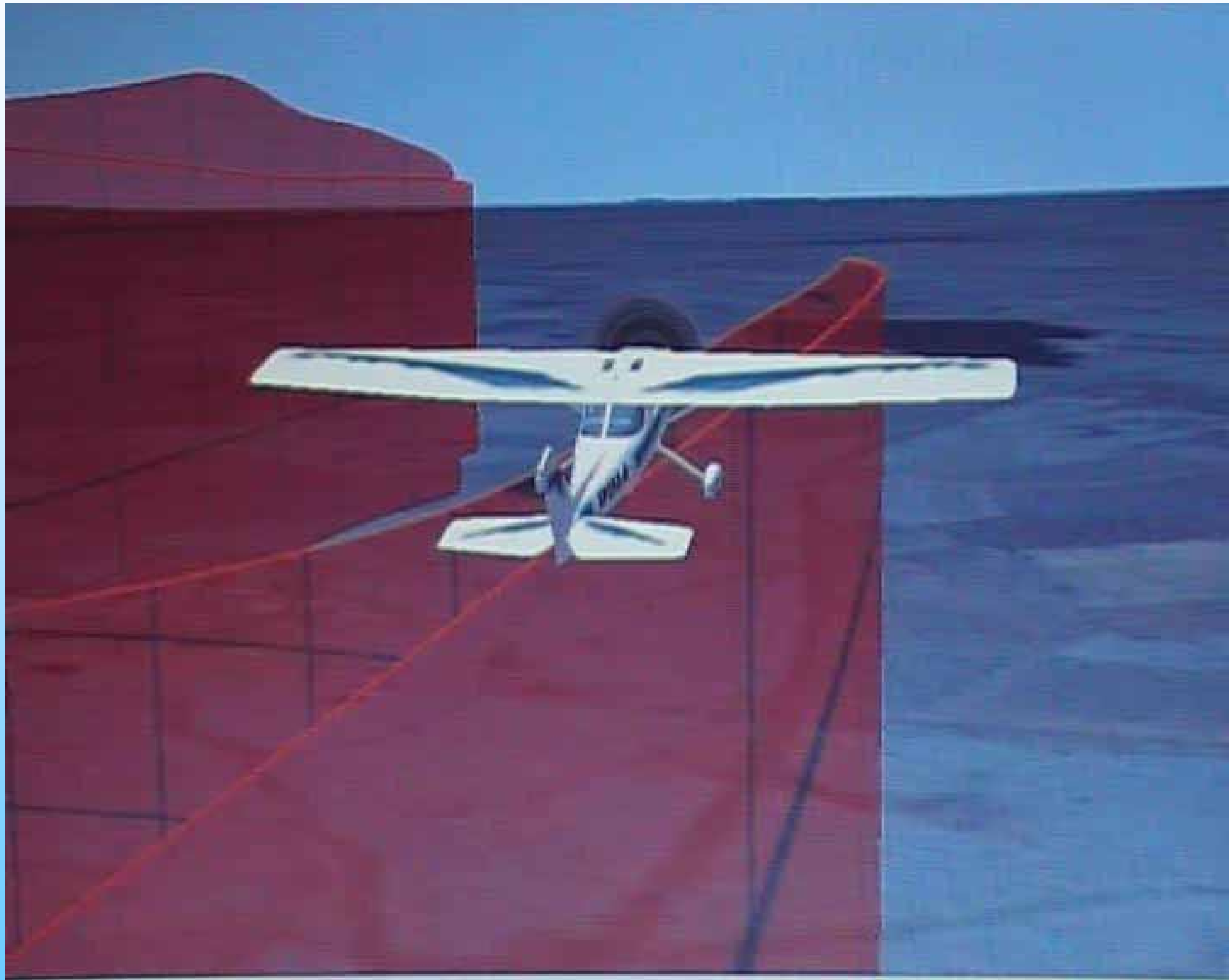
More aircraft

– Are we looking at the fleet?
– Critical cases

Simulator work

– Cycle pilots through critical cond.
– Pilot workload measurement
– Find the HQR 3-4, 6-7, 9-10 boundaries
– Be willing to crash!

FDR + CVR: F150L PLF Stall



Questions?

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