EASA
European Aviation Safety Agency

Fly By Wire
An EASA Perspective on Helicopter Requirements

Dr. Alex Smerlas / Cedrik Harang
Rotorcraft Section
Certification department

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What will you hear from us today?

- 1 / Status of Fly By Wire Requirements - Where we are and where do we go
- 2 / How do we get there?
- 3 / Lessons learned, so far, recommendations for the future

1 / FBW-Where we are

- For 30(+) years FBW control laws were developed (“Rascal”-NASA(Ames), Bell 205 NRC (FRL)… etc)
- ADS-33(C),(D)…etc were used as “harmonisation tool” / HQRs
- Many different test pilots trained, but no harmonised flight requirements in civil world.
- Fixed wing experience
- Unknown dynamics still pose risk in development. Flight testing is very risky – without the “usual” compensating factors of the past (e.g. FW projects).
- Civil mission profiles need simple Control Law “Moding” (for civilian pilots)
- All items above must be safely exercise within the financial commitments/constraints of the civil market
- Dramatic change will take place in education on how to fly helis

1 / FBW-Where do we go

- Certification:
  - Bell 525 – first civil application for a “FBW” rotorcraft
  - FAA, TCCA and EASA actively cooperate to harmonise requirements given that:
    - It is the first civilian helicopter of such kind
    - The experience of each of the authorities although similar – it is not identical
  - Maximising safety implies heavy simulator use for certification (Something not trivial for the helicopter industry)
    - Need to arrive to a representative (to the “unknown” helicopter being certified) simulator configuration.
    - Need to safely verify the envelope corners without unjustified risk
  - Significant difference in pilot understanding of “what the helicopter does” (when it is doing all automatically).

How do we get there? (1)

The FAA has come up with significant improvements in the rules;

The EASA as VA reviewed these and has come up with 3 Basic Special Conditions to be fulfilled:

a) Control Margin Awareness
b) Envelope Protection
c) Flight Crew Awareness and Modes of Operation

+ Interaction Systems/Structure and some additional interpretative material on various topics (e.g. control signal integrity, compliance demo for flight control laws, project specific)

Simulator “credit” will be briefly visited.

How do we get there? (2)

- Control Margin Awareness:
  - Not directly being felt in FBW. Classical “stops” do not represent the dynamics encountered by the blade/hydraulic loop; the crew does not directly feel it, before its effects appear;
  - Compensating factors to be implemented for the whole Flight Envelope (not understood only as H-V)
  - May combine tactile, visual, aural alerting
  - Applied for the controllability limits – not necessarily each axis.
  - Whatever awareness method must avoid nuisance.

How do we get there? (3)

- Flight Envelope Protection:
  - To protect a helicopter from the structural, aerodynamic or operating limits;
  - Control Laws can dramatically change when approaching or exceeding limits; must be compatible with :
    - Structure limits
    - Safe and controllable manoeuvring (controllability, see subpart B)
    - Rotor speed, blade stall, engine, transmission
    - Etc……
  - Following failures not shown to be extremely improbable in the protection measures, the rotorcraft must be capable of continued safe flight and landing
  - Standard pilot skill or strength

How do we get there? (4)

- Flight Control in all attitudes
  - Control responses to be appropriate in all attitudes: must not disturb the crew to recover.
  - Traditional AFCSs downgrade or disconnect automatic features: pilot intervention must be gradual and not abrupt in all conditions, e.g.
    - Unusual attitudes
    - Very quick/rapid rotational velocities (beyond normal operations)
  - The flight control system shall continue to operate;
  - The design of the flight control laws, including any automatic protection function shall not hinder aircraft recovery; and
  - Critical flight displays shall continue to provide support to recovery actions

How do we get there? (5)

- Simulator credit
  - Being developed alongside the aircraft with configuration accurately controlled - as if was the aircraft itself
  - Compatible with the flight test schedule (only basic steps ahead)
  - Needless to mention: rehearsal of all testing
  - Configuration management
  - Representativeness vs the test needs:
    - Initial idea for tracking and deviations from CS_FSTD
    - **Limited for those flight manoeuvres that are intended to be demonstrated on the simulator**
    - For each case to be demonstrated the flight dynamics representation must be argued and demonstrated.
    - Documentation structure will assist at a later stage the CS_FSTD demonstration
  - To be used for basic understanding of appropriateness of control law response and thorough evaluation of the failure cases (due to level of complexity and integration)
  - To be given certification credit for the dangerous envelope areas

Lessons learned – so far

- Technology:
  - Known due to previous experience already accumulated in previous years certain areas of the world
  - Success from failure – as usual – are extremely close
  - Development still risky. Risk may increase due to objectively unknown areas
  - Applications on other products, e.g. RPAS, general aviation
- Certification:
  - Following a project is difficult: step-by-step changes can not be tracked.
  - Needs continuous involvement and very good cooperation
  - Need to provide credit to industry's activities without interfering all the time within the schedule.
  - Mutual trust is a prerequisite for success – can only praise the authority/industry relations
- Organisational
  - Need to achieve the above activities within a very demanding civil market.

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Thank you

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