Loss-of-Control In-Flight Mitigation through Installation of Stability Augmentation and Autopilot Systems in Light Helicopters

Report

Helicopter Safety Enhancement No. 70
Output No. 3

Prepared by H-SE-70 Team in partial fulfillment of USHST efforts to encourage use of technologies that can reduce the risk of fatal helicopter accidents

February 9, 2021

Prepared for the USHST for promotion through industry stakeholders and safety advocates
USHST Accident Data 2009-2014:
50% of fatal helicopter accidents are from 3 causes

• Loss-of-Control In-Flight
• Inadvertent IMC
• Low-Level Ops

THIS DISCUSSION
Promote Stability Augmentation & Autopilots in Light Helicopters
(2021)

Promote IFR Capability in Light Helicopters
HAI / AEA / GAMA / VFS white paper (2015)

• Prevent LOC
• Shift culture from low-level Wx avoidance
• Provide ability to better survive unintended IMC
Providing Stability – Key ingredient

**Naturally Stable**

- Airplane naturally returns to straight and level
- Easily enhanced by Aerodynamic trim tabs on control surfaces

**Naturally Unstable**

- Limited ability to stabilize mechanically
- Aircraft pitch follows rotor pitch (tends to continue pitching)

Stability improves ability to deal with distractions, momentary disorientation, and reduced visibility situations
Function and Capability

- **Force Trim**
- **SAS - Attitude Hold**
- **Basic Coupled Modes**
  - HDG, ASPD, ALT, VS
- **Advanced Modes** (typically found in IFR / Specialized)
  - NAV (GPS/VOR), APPR (ILS/LPV), GA, HOLD, Approach to Hover)
- **Safety Enhance Modes**
  - Envelope protection
  - Auto-level / Save me attitude recovery
  - Hover Assist
  - Automatic Hover Departure
  - Autorotation Assistance
  - Integration with safety systems (TAWS / TCAS)
  - Auto-Land (incapacitated pilot)
Certification Environment

**Performance Based Standards**
Similar to Part 23 re-write

**HIRF and Lx Policy**
Similar to PS-ACE-23-10
(FAA has accepted MOC issue papers on alternate methods)

**Pending Rule Revision**
14CFR 27.1309 (approved but on hold)
Will Remove need for Special Condition to certify VFR Autopilots

**SAFETY CONTINUUM**
(PS-ASW-27-15)
Creates 4 Classes within Part 27 Sliding Scale of Requirements (2017)

**NORSEE**
(PS-AIR-21.8-1602)
Reduces Cert Requirements for Non-Required Safety Enhancing Equipment (2016)

**REGULATION**

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Will Remove need for Special Condition to certify VFR Autopilots

**VFR Certifications**

**IFR Certifications**
(2019)

**IFR Certifications**
(2019)
Currently Available (at time of White Paper)

**OEM:**
- Bell: 407GXi VFR / IFR 3-axis (Bell AP)
  407GX VFR 2-axis (Bell AP)
  505 (Genesys 2-axis)
- Leonardo: TH-119 IFR 3-axis
  (Honeywell AP / Genesys integration)
- Robinson: R44/R66 new
  R44 field retrofit kits
  (Genesys AP w. Robinson-Specific features)*
- Airbus:
  (Partnered with 3rd party solutions)

**3rd Party Solutions:**
- Genesys: HeliSAS 2-axis and 3-axis autopilot available in multiple aircraft
- Thales: Compact Autopilot System (CAPS)
- Garmin: GFC-600H—recently certified in the H125
- SAFRAN: Formerly SFIM helicopter AFCS

* Currently VFR – IFR variant in work
MEMS AHRS (micro-electromechanical system)
  - Has greatly reduced cost of sensors

Force Trim
  - Spring & clutch vs Geared EMF

Series/Parallel vs Parallel only
  - Series $\rightarrow$ Hands-on SAS & perf. benefit
  - Parallel only $\rightarrow$ cost/ installation ease
    (Pilot feels AP input as pressure when hands-on)

2-axis (pitch & roll)

3-axis (yaw)
  - Yaw damp in power changes
  - Turn coordination
  - Heading at low speed

4-th axis (collective)
  - Airspeed control in precision approach
  - Allows advanced features
END

Questions?