Certification of Rotorcraft and FHA Process

Presented to: AEA
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OUTLINE

Certification Process

– Installation of Complex Systems in Normal Category Rotorcraft
– XX.1301 & XX.1309 Comparison
– Guidance Material
– Compliance with 27/29.1309
– System Safety Assessment
– Items to be aware of…
– FHA/SSA Questions
Certification Process

1. **Application** (e.g. TC, ATC, STC, ASTC)
2. **Certification Basis** defined.
3. **Certification Plans:**
   - Detail how compliance will be shown for each rule (27.1309 analysis, ground test, flight test, etc.).
   - Define level of FAA involvement (delegation).
4. **Test planning & execution.**
5. **Data/Test Review:** FAA reviews/witnesses tests as necessary.
6. **TC/STC issued.**
Complex Systems in Small Rotorcraft

- **Subject equipment**
  - Attitude Direction Indicator
  - Synthetic Vision
  - AHRS i.e. MEMS technology
  - Air Data
  - Navigation
  - HTAWS
  - Traffic
  - Weather
  - RAD ALT
  - Autopilots / stability augmentation
  - System integration

- **Certification Bases** that range from CAR 6 to part 27 amndt. 46

- **Intended Function**
  - Will it only be used for Day/Night VFR?
  - Single/Dual Pilot
  - CAT A / CAT B

- **FHA / SSA**
  - Proper hazards classification
  - Proper design levels, including software
  - Requires input from various engineering disciplines and Pilots
14 CFR 2X.1301 Comparison

• **2X.1301**: Each item of installed equipment must-
  – Be of a kind and design appropriate to its intended function;
  – Be labeled as to its function and operational limitations
  – Be installed according to its limitations
  – Function properly when installed.

• Although the rule & its application are the same, they result in different requirements due to the platform’s design & operational differences.
2X.1309 Comparison

• 2X.1309: While there are some differences in the 14 CFR Parts 23, 25, 27, 29, in general, they all say that each item should be safe and reliable and not adversely affect any other system. Basically, this is the regulation that requires that hazards posed by the systems installed on aircraft must be addressed as part of the certification process.

• RESOURCES
  – AC 27/29.1309
  – SAE ARP4754 “Guidelines for Development of Civil Aircraft and Systems”.
  – SAE ARP4761"Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment".
  – Other published AC Guidance (e.g., 21-40,27-1B, 29-2B), FAA Orders, RTCA Documents.
27.1309 & 29.1309 Comparison

- It is assumed that the basic Part 27 aircraft will be certified VFR.

- 27.1309 on a VFR Helicopter does not address systems whose failure conditions are assessed to be higher than major (i.e. hazardous or catastrophic).
  - May require special conditions

- If the rotorcraft is to be certified for IFR flight, then you must use 27 appendix “B” which invokes some Part 29 rules including portions of 29.1309.
Guidance Material

- AC 27.1B, 27.1309 provides guidance for compliance to FAR 27.1309
- AC 29-2C, 29.1309 provides guidance for compliance to FAR 29.1309
- Both ACs recognize SAE-ARP 4761/4754 System Safety Assessment (SSA) process
- AC 20-174 for compliance to the new ARP 4754A.
Compliance to 27/29.1309

- **XX.1309 Compliance Data:**
  - Qualitative & Quantitative analysis required for Catastrophic, Hazardous, and for complex systems that have Major failure classifications.
    - FHA, PSSA, FTA, FMEA & CCA required.
    - Must Substantiate probability of failure reqmts.
  - Only Qualitative assessment required for non-complex Major and Minor systems.
    - No probability of failure substantiation required.
Safety Assessment Process

- **Functional Hazard Assessment (FHA)**
  - Aircraft Level & Systems Level FHAs
  - Used to Identify Effects (i.e. Failure Condition Categories) of System Failures on Aircraft

- **5 Failure Condition Categories**
  - Catastrophic
  - Hazardous/Severe-Major
  - Major
  - Minor
  - No-Effect
System Safety Assessment

hardware requirements

- **Catastrophic** - $\leq 1 \times 10^{-9}$ probability of Occurrence
- **Hazardous/Severe-Major** - $\leq 1 \times 10^{-7}$
- **Major** - $\leq 1 \times 10^{-5}$
- **Minor** - $\leq 1 \times 10^{-3}$
- **No-Effect** - no probability of occurrence reqmts.

- As defined in AC27/29.1309 & SAE ARP4761 "Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment".
System Safety Assessment
Software & AEH Requirements

- RTCA/DO-178B Software Level and RTCA/DO-254 AEH Level Commensurate with Failure Condition Category
  - Level A (Catastrophic)
  - Level B (Hazardous/Severe-Major)
  - Level C (Major)
  - Level D (Minor)
  - Level E (No Safety Effect)
Assessing the Effects of Failures

Integration of Cockpit Display Systems and Pilot Interface

• In addition to the systems engineering specialists, both flight test and HF evaluation of pilot-system interface is used to evaluate and classify the hazard level of a particular failure condition.
  – Especially if it involves the pilot–system interface (control or misrepresentation to the pilot of information)
Issues to be aware of:

- FHA should not be accomplished after system design and installation.
  - Primary purpose of FHA is to set design standards; not to appease FAA

- Do not use the equipment reliability to define failure classification.

- The highest hazard classification for equipment that is not required by certification or operational rules NOT is “minor”.
FHA / SSA questions for the group

• Should the hazard classification / threat to the aircraft and or occupants change for misleading information as a function of…
  – Its Required vs. non-required in CAR 6 / part 27?
  – What if it can be classified as “safety enhancing” equipment?
  – Its being installed to satisfy and Operational equipment requirements i.e. (135)?
Discussion Time:

Back to Kim…
Questions to industry and the FAA:

– Do we, the FAA and industry, understand the risk tradeoffs if we allow the installation of equipment with a lower level of certitude than our guidance allows?
  • Given the unique characteristics of rotorcraft
  • What are the risk tradeoffs and what do they buy us? Do we get a net gain in safety (as reflected by lower accident numbers)?

– How are we discouraging applicants and operators from installing safety enhancing equipment that is not required by any regulations?

– Are we going to exacerbate poor pilot decision making by providing a system that may provide a false sense of security (i.e. “snow tire syndrome”)