Proposed Equivalent Safety Finding
related to CS 29.1195 (b)(2) at Amdt 3 "Fire extinguishing systems"

Introductory Note:

The hereby presented Equivalent Safety Finding has been classified as an important Equivalent Safety Finding and as such shall be subject to public consultation, in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) of which states:

"*2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency.*"

STATEMENT OF ISSUE

Depending on product design and characteristics, the applicable Certification Specifications (CS) (i.e. for Large Aeroplanes, Large Rotorcraft, Small Rotorcraft, Normal, Utility, Aerobatic, or Commuter Category Aeroplanes, …) and the kind of operations, fire extinguishing systems are either required by CS/SC rules or installed upon applicant initiative as part of its own safety policies.

CS identify some specific product areas where fires are likely to occur and require provision for an extinguishing capability (in engine Designated Fire Zone (DFZ), combustion heater compartment, APU DFZ, cargo compartments (AFT, FWD,..)).

Some design are proposing multipurpose fire extinguishing system, meaning a single fire extinguishing system shared between multiple areas where fire extinguishing capability is needed. Such multipurpose system is, most of the time, limited in performance since not capable of performing all its intended fire extinguishing functions concurrently.

Introduction of this kind of extinguishing system architecture may be seen as conflicting with some aircraft requirements like, for instance, for independence, availability of the number of discharges and compatibility with the foreseen kind of operations.

Consequently, EASA consider that it results in partial loss of the required CS29 engine fire extinguishing function due to the use of a common system for the cargo/baggage compartment fire extinguishing function, despite the last is not required per se by CS29 regulations It is acceptable for EASA provided that the overall rotorcraft safety balance can be demonstrated with adequate compensating factors for the engine CS 29.1195 (b)(2) requirement.

DESIGN DESCRIPTION

For twin engine Large Rotorcraft, it is proposed to install a single multipurpose fire extinguishing system intended to serve the LH engine, the RH engine and the cargo/baggage compartment (bottle 1 is used for ENG1 or ENG2, bottle 2 is used for ENG1 or ENG2 or cargo/baggage compartment).

ESF JUSTIFICATION

The compensating factors/precautions that provide an ESF for CS 29.1195 (b)(2) are as follows:

1- Design compensating factors in engine installation regarding fire protection:

The following design characteristics of the helicopter are claimed as design compensating factor considering that they exceed the minimum required by CS 29:

- With respect to CS 29.1195(b)(2), the sizing of (engine) Halon fire extinguishing system exceeds the minimum specified by the AC 20-100 for Halon 1301
- The test measuring Halon concentration in the engine compartment was conducted in a penalizing configuration, which represents an additional margin with respect to the expected Halon concentration with serial design,
- With respect to CS 29.1187(b), the air renewal within the engine compartment is higher than the recommended ratio (for CS-25 aircraft), which minimizes the persistence of flammable vapour and the fire re-ignition risk,
- The drain scuppers are in stainless steel, hence fireproof, while CS 29.1183(b) does not require fire resistance of a drain system,

Additional design features are also contributing to the reduction of the engine compartment fire risk as follows:

- The P3 pipes are fireproof, therefore their integrity in case of engine compartment fire ensures that no P3 air flow would add any hazard to an existing fire by delivering hot pressurized air on an existing fire,
- The helicopter fuel system does not contain a booster pump as the engine incorporates its own fuel suction system; therefore this design feature minimizes the amount of fuel that might be introduced in the engine compartment during the transient phase before closure of the fuel Shut Off Valve,
- There are no oil pipes inside the Designated Fire Zone except for those covered by the engine type certification,
- The engine starter / generator technology does not include high current collector / brushes as conventional starter / generators; it includes only low current slip rings and brushes substantially reducing the potential source of ignition.

2- Compensating factors at rotorcraft level:

Further to the above mentioned design compensating factors, the following elements resulting from the introduction of a cargo fire extinguishing system are considered as additional safety benefits at helicopter level:

- Opportunity for the crew to leave a hostile environment in case of cargo fire, this will reduce the exposure to Hazardous situation that may result from a landing/ditching in such hostile environment.
- After "FIRE" in cargo/baggage compartment, if the FIRE is extinguished thanks to the bottle n°2, it is then requested to "LIMIT DURATION OF FLIGHT" as per the definition of the Flight Manual, i.e. "*Land at the nearest site at which technical assistance may be expected. Extended flight is not recommended. Duration of flight is left to the pilot's discretion taking into account the operational environment*".
    - In case of FIRE resuming in the cargo/baggage compartment, a LAND IMMEDIATELY procedure is performed in better conditions.
- The possibility to use an engine fire bottle to treat a fire in the cargo/baggage compartment leads to "LIMIT DURATION OF FLIGHT" in safer condition (AEO flight) than in case of one engine fire event (OEI flight).

3- Safety Precautions regarding fire extinguishing systems:

- Design precautions are taken to prevent errors of fire extinguishing systems installation
- Risk of inadvertent triggering of the cargo extinguishing system by the crew in an emergency situation, which would be detrimental to engine fire extinguishing system availability, is also minimized by the design arrangement of the overhead control panel where cargo fire the extinguishing push-button is well separated from the engine fire extinguishing controls.

4- Additional consideration:

- safety approach mitigating reduction of engine fire extinguishing system availability:

  Even if the reduction of the engine fire extinguishing system availability may be considered as significant, in practice, as the independency of the cargo and engine fire events will be demonstrated, the reduction of this availability associated to an actual engine fire is negligible on the A/C overall safety, hence lower than the typical reliability of a standard fire extinguishing system. Spurious fire detection in cargo/baggage compartment has also been considered in this rational.

- consequence on the Engine fire Emergency Procedure:

  After fire in cargo, if the fire is extinguished thanks to bottle 2, bottle 1 is still available for the engine compartment. Then the engine fire procedure is to be used in the same manner as if one bottle would have been used for a first attempt in the engine compartment.