EASA European Union Aviation Safety Agency	**CRI Consultation paper** **Equivalent Safety Finding**	Doc. No.: **ESF B-04/K** Issue : 1 Date : 16 Apr 2020 Proposed ☒ Final ☐ Deadline for comments: 08 May 2020

SUBJECT	:	**Cat. A Procedures: 2 ½ minute OEI Rating Application for First and Second Segment Profile and Definition of V_{COSS}**
REQUIREMENTS incl. Amdt.	:	**29.1587(a)(6)(ii) Amdt. 4**
ADVISORY MATERIAL	:	**AMC 29 General, referencing AC 29-2C Chg.4 as AMC to CS-29 Amdt. 4**

INTRODUCTORY NOTE:

The following Equivalent Safety Finding (ESF) has been classified as important 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.) 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.*"

IDENTIFICATION OF ISSUE:

When defining a Category A take-off procedure, as prescribed by CS 29.59 and 29.60, the take-off path must be such that a height of 1000 ft Above Surface Level (ASL) is reached through 2 climb segments:

1. The first climb segment starts when reaching V_{TOSS} with a positive rate of climb, and ends when the rotorcraft reaches a height of 61 m (200 ft) ASL. During this first climb segment, in compliance with CS 29.67 (a)(1), a minimum of 100 fpm rate of climb (RoC) with the One –Engine Inoperative (OEI) power, the landing gear down and V_{TOSS} is to be guaranteed.
2. The second segment starts at a height of 200 ft ASL and ends at 1000 ft ASL. It is supposed to be flown at a speed selected by the applicant (that can be depending on weight and/or ambient conditions). During this second climb segment, in compliance with CS 29.67 (a)(2), at least 150 fpm RoC must be guaranteed at Maximum Continuous Power OEI (MCP OEI), with the landing gear up atthe speed selected by the applicant. Typically, the speed selected is V_Y in order to maximise the climb performance.

Accordingly, CS 29.1587 (a)(6) requires the publication of the first and second segment climb gradients in the performance section of the Rotorcraft Flight Manual (RFM), in order to allow the crew to determine the take-off path and guarantee obstacle clearance.

In the certification basis of the product for which this ESF is applicable, AMC 29 General states that the AMC to CS–29 consists of FAA AC 29-2C — Change 4 dated 1 May 2014 with the changes/additions that are given in Book 2 of CS–29.

The AMC to CS 29.67 provided in FAA AC 29-2C Change 4 AC 29.67 (b)(1) contemplates and encourages selecting a single climbout speed, independent from weight and ambient conditions for the second climb segment in order to simplify cockpit procedures.

In the frame of the certification of a new engine installation, while for certain Category A take-off procedures the conventional take-off path is established as defined in CS-29, for some other procedures the Applicant is proposing a new take-off path. In this new take-off path, after V_{TOSS} acquisition, the crew is requested to continue climbing and accelerating to V_{COSS} (Climb-Out Safety Speed) – a speed that is midway between V_{TOSS} and V_Y - using the 2 ½ minute OEI power and maintaining V_{COSS} and 2 ½ minute OEI power throughout the second segment profile.

However, if, according to the new take-off path, the second segment climb gradients published in the RFM are based on the 2 ½ minute OEI power, this proposal would be literally not compliant to CS 29.1587(a)(6)(ii) since this CS requires determination of the gradients based on the maximum continuous power (MCP) OEI.

Therefore the Applicant is claiming an Equivalent Safety Finding for CS 29.1587 (a)(6)(ii).

JUSTIFICATION OF AN ESF

As a prerequisite to the equivalent safety finding, the Applicant shall demonstrate that the new take-off path can be flown in the entire Category A take-off and landing envelope with sufficient residual time before expiration of the 2 ½ minute OEI power and that is compliant with the Category A performance requirements spefcified in CS-29 Subpart B. Moreover, the safety intent of the CS can be met if the RFM performance data is consistent with the proposed new take-off path and provides information to the crew with the same level of safety as for a conventional procedure (in terms of presentation of the data, identification of the OEI power and speed for which they are valid) to allow the determination of distances and obstacles clearance.

Considering all the above, the following Equivalent Safety Finding is proposed:

Equivalent Safety Finding to CS 29.1587 (a)(6)(ii) Amdt 4

Category A Procedures: 2 ½ minute Rating Application for First and Second Segment Profile and Definition of V_{COSS}

Compliance with Category A CS-29 Subpart B requirements

The proposed Category A take-off procedures are compliant with all CS-29 Subpart B Category A requirements since:

- The procedure up to reaching V_{TOSS}, and a height of 35 ft ASL is unchanged with respect to a conventional procedure. Therefore the takeoff distance remains the same as for a conventional procedure.

- The acceleration from V_{TOSS} to V_{COSS} is carried out without interruptions as soon as V_{TOSS} is achieved. For conservativeness, path 1 gradients are published at V_{TOSS}, with the landing gear down. The acceleration to V_{COSS} allows climbing in Path 1 at a steeper gradient than V_{TOSS} being V_{COSS} a speed with a greater margin of power available.

- Path 2 is flown at V_{COSS} with 2 ½ minute OEI rating and the gradients will be published with 2 ½ minute OEI and with the landing gear up. The climb at V_{COSS} using 2 ½ minute OEI power allows for a steeper gradient to the completion of the take-off profile that clears closer obstacles when compared to a climb at V_Y using MCP OEI.

- The Weight Altitude Temperature (WAT) charts published in the RFM will be determined by imposing a minimum RoC at 2 ½ minute OEI (landing gear down for the first segment and landing up for the second segment) as limiting factors with sufficient safety margin with respect to the one requested by CS 29.67(a)(1) and 29.67(a)(2). In particular, during the second segment, the RoC at V_{COSS} will be always above the minimum RoC required by CS 29.67(a) (2).

- When reaching a height of 1000 ft ASL, sufficient time will be remaining to allow a level flight acceleration to V_Y before the 2 ½ minute OEI rating expiration (150 fpm RoC will be still available at V_Y and MCP OEI, 1000 ft ASL). This level flight acceleration will bring the rotorcraft to the same energy conditions as per a conventional procedure (V_Y at MCP OEI).

Residual time before the expiration of 2 ½ minute OEI

In order to demonstrate that the procedures can be implemented in the entire Category A take-off and landing envelope before expiration of the 2 ½ minute OEI rating, it has been verified with flight test data that sufficient residual time before the expiration of 2 ½ minute OEI rating is always available to accelerate to V_Y, even in the corners of the envelope.

Impact on RFM performance charts and procedures

- The Weight-Altitude-Temperature (WAT) charts presented in the Limitations Section are unchanged.

- Normal procedures will be presented considering the new approach, specifically the normal procedures will require to carry out the climb to a height of 1000 ft ATS at V_{COSS} and at a RoC that guarantees equal or steeper gradients than the emergency procedure.

- Emergency procedures will be adapted to depict the proposed climb paths and to include acceleration to V_Y to be achieved before the expiration of 2 ½ minute OEI.

- Gradients for the first segment will be published in the performance section in the conditions prescribed by CS 29.67 (a) (1), while for the second segment the gradients will be determined at V_{COSS}/2 ½ minute OEI, rather than in the conditions prescribed by CS 29.67 (a) (2).