EASA European Union Aviation Safety Agency	**Consultation paper** **Deviation**	Doc. No.: CPTS-0000367 Issue : 1 Date : 29 Feb 2024 Proposed ☒ Final ☐ Deadline for comments: 21 Mar 2024

SUBJECT	:	Uncontrollable High Thrust Failure Conditions
REQUIREMENTS incl. Amdt.	:	CS 25.901(c) at Amdt. 23 CS 25.1309(b)(1)(ii) at Amdt. 23
ASSOCIATED IM/MoC	:	Yes☐ / No ☒
ADVISORY MATERIAL	:	

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INTRODUCTORY NOTE:

The following Deviation (DEV) 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.*"

ABBREVIATIONS:

UHT	Uncontrollable High Thrust
EEC	Electronic Engine Controller
CIC/CNIC	Channel (Not) In Control
TC	Type Certificate
TRA	Throttle Resolver Angle

IDENTIFICATION OF ISSUE:

CS 25.901(c) specifies the following:

(c) The powerplant installation must comply with CS 25.1309, except that the effects of the following need not comply with CS 25.1309(b):
  (1) Engine case burn through or rupture;
  (2) Uncontained engine rotor failure;
  (3) Propeller debris release

Additionally, CS 25.1309(b) requires the following:

(b) The aeroplane systems and associated components, considered separately and in relation to other systems, must be designed so that –
  (1) Any catastrophic failure condition
    (i) Is extremely improbably; and
    (ii) Does not result from a single failure; and
  (2) …

The applicant has identified an architectural design deficiency wherein a malfunction of the control processor in the controlling channel of the Electronic Engine Controller (EEC) could:

- Corrupt the TRA signal transmissions between the safety processors of each channel such to "disable" the Uncontrollable High Thrust Accommodation function in both safety partitions and
- Induce an un-commanded high thrust event.

The applicant has demonstrated that no single failure of the Engine Control System (including processor failures) will lead to an unaccommodated UHT event, except the deficiency identified above. While the system has a deficiency with respect to design intent, the malfunctioning control processor would need multiple specific corruptions to disable idle detection and mis-control the engine to cause an unaccommodated UHT. The specific scenario requires all the following:

- The control processor has a malfunction that corrupts the TRA position signals provided by the safety Processor of the CNIC (channel not in control) which will disable the CIC (channel in control) UHT protection as TRA is not considered valid OR the malfunctioning control processor corrupts information in the specific manner to cause the safety processor to disable UHT protection,
- The malfunctioning control processor also corrupts the TRA position signals provided by the safety Processor of the CIC (channel in control) which will disable the CNIC (channel not in control) UHT protection as TRA is not considered valid, and
- The control processor causes a malfunction leading to excessive thrust from the engine.

While this combination of events is not quantifiable in terms of probability, and no physical failure can cause all of these specific malfunctions, it does represent a non-compliance to CS 25.901(c) and CS 25.1309(b)(1)(ii).

In order to address the above non-compliance case, the applicant will develop, certificate, put into production, and facilitate retrofit of an EEC software solution to resolve the design deficiency such that all aircraft are fully compliant with CS 25.901(c) at amdt 23 and 25.1309(b)(1)(ii) at amdt 23 after the issuance of the EASA Type Certificate (TC).

For the TC, the Applicant has requested a Deviation and proposes as mitigating factors a limitation in terms of number of flight cycles (and calendar time), that will minimize exposure to this failure condition, prior to incorporation of the required software modification, based on Gulfstream safety assessment that supports the failure condition is extremely improbable. This is justified with the fact that the deficiency and related malfunctioning is theoretical but it requires three conditions happening at the same time which makes it of very low probability.
The Applicant provides with data showing that the condition 'The control processor causes a malfunction leading to excessive thrust from the engine' has never happened in service.

Considering all the above, the following Deviation is proposed.

CPTS-0000367

Deviation

Uncontrollable High Thrust Failure Conditions

1. APPLICABILITY

This DEV is applicable to CS-25 Large Aeroplanes.

1.1 AFFECTED CS

CS 25.901(c) at Amendment 23
CS 25.1309(b)(1)(ii) at Amendment 23

1.2 PRE-CONDITIONS FOR APPLICATION OF THE DEVIATION

An analysis must be available to demonstrate that the deficiency of the EEC control processor need corruption of multiple specific signals to:

- mis-control the engine to cause an UHT
- and disable the UHT detection and accomodation function

Additionnally this analysis must describe in a consistent way that such kind of erroneous behaviour of this CEH is not expected to happen without corrupting any other EEC communication which would then be detected either by the crew or the EEC or AC monitoring systems.

2. APPLICABLE ESSENTIAL REQUIREMENTS FOR AIRWORTHINESS OF REGULATION (EU) 2018/1139 (ANNEX II)

The following paragraphs of the "Essential Requirements" for Airworthiness as defined in Annex II of Regulation (EU) 2018/1139 are related to the CS identified in 1.1 for which a non-compliance exists:

1.3 Systems and equipment (other than non-installed equipment):

1.3.1 The aircraft must not have design features or details that experience has shown to be hazardous

1.3.3 The aircraft systems and equipment, considered separately and in relation to each other, must be designed such that any catastrophic failure condition does not result from a single failure not shown to be extremely improbable and an inverse relationship must exist between the probability of a failure condition and the severity of its effect on the aircraft and its occupants. With respect to the single failure criterion above, it is accepted that due allowance must be made for the size and broad configuration of the aircraft and that this may prevent this single failure criterion from being met for some parts and some systems on helicopters and small aeroplanes.

3. STATEMENT OF DEVIATION

To address the non-compliance with the affected CS, the mitigating factors in chapter 4 shall be met. Compliance with the mitigating factors ensures compliance with the applicable essential requirements.

4. MITIGATING FACTORS

The following mitigating factors have been identified as alternative means to ensure compliance with the above identified essential requirements.

a) A flight cycle limitation of 1000 flight cycles or 3 years (whichever occurs first) will be added to each aircraft.