EASA European Union Aviation Safety Agency	**Consultation paper** **Deviation**	Doc. No.: CPTS-0000364 Issue : 1 Date : 19 Feb 2024 Proposed ☒ Final ☐ Deadline for comments: 11 March 2024

SUBJECT	:	Fuel Feed Icing Threat
REQUIREMENTS incl. Amdt.	:	CS 25.951(c) at Amdt. 23
		CS 25.952(a) at Amdt. 23
		CS 25J951(c) at Amdt. 23
		CS 25J952(a) 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:

APU	Auxiliary Power Unit
CRI	Certification Review Item
SC	Special Condition

IDENTIFICATION OF ISSUE:

CS 25.951(c) requires the following:

Each fuel system must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 26.7°C (80°F) and having 0.20 cm^3 of free water per litre (0.75 cm^3 per US gallon) added and cooled to the most critical condition for icing likely to be encountered in operation.

CS 25.952 (a) requires the following:

Proper fuel system functioning under all probable operating conditions must be shown by analysis and those tests found necessary by the Agency. Tests, if required, must be made using the aeroplane fuel system or a test article that reproduces the operating characteristics of the portion of the fuel system to be tested.

CS 25J951(c) requires the following:
Each fuel system for an essential APU must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 26.7 °C and having 0.20 cm3 of free water per liter added and cooled to the most critical condition for icing likely to be encountered in operation.

CS 25J952(a) – requires the following:
Proper fuel system functioning under all probable operating conditions must be shown by analysis and those tests found necessary by the Agency. Tests, if required, must be made using the aeroplane fuel system or a test article that reproduces the operating characteristics of the portion of the fuel system to be tested.

On January 17, 2008, a Boeing Model 777-200 series aeroplane equipped with Rolls-Royce Model RB211 TRENT 895-17 turbofan engines crash landed short of the runway at London Heathrow Airport. It was determined that an un-commanded reduction in thrust occurred on both engines as a result of reduced fuel flows. The investigation conducted by UK Air Accidents Investigation Branch (AAIB) determined that under certain conditions, over a period of low fuel temperatures, ice may accumulate in the aeroplane fuel feed system and then be fed or released downstream to the engines. Ice may also collect and create a restriction within the engine fuel system because of insufficient fuel heating to melt the ice. A restriction in fuel flow to the engine(s) may result in failure to achieve a commanded thrust level, which is considered an unsafe condition due to thrust loss leading to forced landing.
UK AAIB issued the following safety recommendation to EASA (EASA reference UNKG-2008-049):
"review the current certification requirements to ensure that aircraft and engine fuel feed systems are tolerant to the potential build-up and sudden release of ice in the fuel feed system".

In reaction to this safety recommendation EASA issued special condition SC GVI E-12 which requires, in addition to the above mentioned CS-25 specifications, that the aircraft/engine/APU fuel system is:

- either designed to prevent the accumulation of ice and release towards the aircraft/engine/APU supplying system,
- or be designed tolerant to the accumulation of ice and release towards the aircraft/engine/APU supplying system without significant adverse effect(s) on the powerplant systems

The applicant must establish the threat(s) (quantity of ice, temperature) that can be released.

These additional requirements address the potential additional issue that ice may accrue (and be hazardously released) instead of being evenly dispersed (as it is assumed by CS 25.951(c), CS 25.952(a), CS 25J951(c) and CS 25J952(a)). The applicant originally planned to demonstrate compliance via analysis, but it was eventually determined that such analysis was based on data not representative of the design under certification. The applicant therefore determined that compliance with the above CS-25 specifications, complemented with the SC (GVI E-12), will be done by test to demonstrate that the fuel system is capable of sustained operation and functions properly under probable operating conditions where ice may form in the fuel system.

Because the test methodology has not yet been developed, the applicant has not completed the demonstration of compliance and requested a deviation from the above requirements using mitigating factors based on stringent inspection instructions that will reduce the risk of icing forming in the fuel system. The applicant has additionally stated that the design of the aeroplane has been assessed against the potential threat and it incorporates design features that would prevent such threat and it is similar to other aeroplane design with positive service experience.
FAA issued Exemption 21744 to address the same non compliance, which is taken into account for the issuance of this deviation.

Considering all the above, the following Deviation is proposed.

CPTS-0000364

Deviation

Fuel Feed Icing Threat

1. APPLICABILITY

This DEV is applicable to CS-25 Large Aeroplanes that have not completed the compliance demonstration to the requirements in 1.1, but for which a partial assessment is available.

1.1 AFFECTED CS

CS 25.951(c) at Amdt. 23
CS 25.952(a) at Amdt. 23
CS 25J951(c) at Amdt. 23
CS 25J952(a) at Amdt. 23

As modified by the following conditions from SC GVI E-12:

The aircraft/engine/APU fuel system is:

- *either designed to prevent the accumulation of ice and release towards the aircraft/engine/APU supplying system,*
- *or be designed tolerant to the accumulation of ice and release towards the aircraft/engine/APU supplying system without significant adverse effect(s) on the powerplant systems*

The applicant must establish the threat(s) (quantity of ice, temperature) that can be released.

1.2 PRE-CONDITIONS FOR APPLICATION OF THE DEVIATION

The certifications basis of the aeroplane must include the references provided in section 1.1 above.

The applicant must demonstrate compliance with the mentioned CS-25 specifications, although the demonstration of compliance with the SC is not completed.

An analysis must be available to demonstrate that the aeroplane incorporates design features to help mitigate ice accretion in the fuel system.

An analysis must demonstrate that the aeroplane is similar to other aeroplane models which have an excellent in-service history with neither engine nor APU performance anomalies that could have been attributed to fuel icing.

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 to Regulation (EU) 2018/1139 are related to the SC identified in 1.1 for which a non-compliance exists:

1.2. Propulsion

1.2.2. The propulsion system must produce, within its stated limits, the thrust or power demanded of it at all required flight conditions, taking into account environmental effects and conditions.

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.

1.3.2. The aircraft, including those systems, and equipment required for the assessment of the type design, or by operating rules, must function as intended under any foreseeable operating conditions, throughout and sufficiently beyond, the operational envelope of the aircraft, taking due account of the system or equipment operating environment. Other systems or equipment not required for type-certification, or by operating rules, whether functioning properly or improperly, must not reduce safety and must not adversely affect the proper functioning of any other system or equipment. Systems and equipment must be operable without needing exceptional skill or strength.

1.3.4. Information needed for the safe conduct of the flight and information concerning unsafe conditions must be provided to the crew or maintenance personnel, as appropriate, in a clear, consistent and unambiguous manner. Systems, equipment and controls, including signs and announcements must be designed and located to minimise errors which could contribute to the creation of hazards

3. STATEMENT OF DEVIATION

To address the non-compliance with the affected SC in 1.1, the mitigating factors in section 4 below shall be met. Compliance with the mitigating factors ensures compliance with the applicable essential requirements for airworthiness.

4. MITIGATING FACTORS

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

a) The Aeroplane Flight Manual Preflight Checklist must require that the fuel sump drains be checked and drained prior to the first flight of the day.