**Proposed Deviation on Water icing in fuel**

**Applicable to Airbus A330 / A340**

## Introductory note:

The following Special Condition has been classified as an important Special Condition and as such shall be subject to public consultation, in accordance with EASA Management Board decision 02/04 dated 30 March 2004, 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

On 17th of January 2008, a British Airways Boeing Model 777-236 powered by two Rolls-Royce Model RB211 Trent 895–17 turbofan engines operating flight BA038 Beijing – London crash-landed short of London Heathrow runway.
The subsequent investigation led by the Air Accidents Investigation Branch (AAIB) of the United Kingdom established that an un-commanded reduction in thrust occurred on both engines as a result of reduced fuel flows. The investigation determined that under certain conditions, over a long period of low fuel temperatures, ice may accumulate in the main tanks and/or in the associated engine fuel feed systems. The release of the accumulated ice, as a result of increased fuel flow, of increased ambient temperature and of airframe deformation resulting from turbulent conditions during approach, could create a restriction within the engine fuel feed system, at the front end of the Fuel Oil Heat Exchanger (FOHE). A restriction in the engine fuel feed system, if not corrected, may result in failure to achieve a commanded thrust level, with subsequent forced landing of the aeroplane.

The AAIB determined that no abnormal water concentrations were identified in the fuel system, and subsequent analysis of fuel samples have shown the fuel met all applicable standards, including that for water content.

In November 2008 a second occurrence affected a Delta Airlines 777-200ER en route from Shanghai to Atlanta. The aircraft experienced uncommanded rollback of engine #2 during cruise; the problem was cleared after application of the relevant AFM procedure and descent to 31 000 feet. The root cause of the roll-back was not determined.

On 19th of May 2009, an Etihad A330-242 operating a flight from Abu Dhabi to Manchester had to perform a go-around at Manchester, the runway being obstructed by a vehicle. Both engines initially responded correctly; however, after the initial acceleration engine #1 stagnated and the corresponding engine stall warning was displayed in the cockpit. As per procedure the crew throttled back the engine, which recovered. At this stage, the subsequent investigations conducted by Airbus and Rolls-Royce have established, by eliminating other scenarios, and, based upon the fact that

there was evidence of engine fuel flow reduction that ice blocking the Fuel Oil Heat Exchanger (FOHE) is a possible cause of the incident.

The Trent 500 (installed on Airbus A340-500/600), the Trent 700 (installed on Airbus A330) and the Trent 800 (installed on Boeing 777) FOHE's have a common design feature with front face protuberant tubes, which allow fuel circulation. The protuberant tubes design was introduced to allow particles and debris coming from the aircraft fuel system to be collected without disturbing the correct functioning of the engine fuel system. The in-service experience and testing made in the frame of the London Heathrow event suggest that this design, while meeting all applicable JAR/CS E requirements, is vulnerable to clogging by ice, which is liberated from the aircraft fuel system. Test results from Boeing rig tests suggest that some ice may accumulate in the aircraft fuel system piping and then may be released due a sufficient level of fuel flow increase when the engine is re-accelerated. Historically, at aircraft level the compliance to § 25.951(c) does not require quantifying the volume of ice accumulated in the pipes and lines.

Following the Boeing 777 / Trent 800 accident at London-Heathrow, FAA mandated aircraft procedures mitigating the risk. On 13th of July 2009, the EASA issued an Airworthiness Directive (AD) rendering mandatory the replacement of the Trent 800 FOHE with a revised designed having a flush front face. It is intended to issue a similar AD applicable for the Trent 500 and the Trent 700.

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The flush front face FOHE is considered as giving an improvement against blockage from ice release coming upstream. The modified FOHE developed for Trent 500 and Trent 700 will be certified at engine level and at aircraft level for A330 Trent 700 and A340 Trent 500.

For this last certification, the basis will use assumption regarding the icing threat. This assumption is that common threat exists on Airbus aircraft as established on B777. As a result to this assumption, similarity approach as a first step using the quantified benefit defined at FOHE level will be used for certification.

As a second step and as complement, compliance with 25.951(c) and 952 (a) shall be demonstrated by Airbus by tests and /or analysis to establish how much ice can be released from the aircraft fuel system. The scope of this activity has yet to be fully established but it will certainly take months before the results are available as certification data allowing Airbus to show full compliance with 25.951(c) and 25.952 (a).

Considering the following facts:
1) Impracticability to introduce mitigating operational procedures
The practicality of interim procedures as put in place on Boeing 777 on Airbus application could be questionable. This as aircraft fuel systems are so different and the phenomenon itself complex. As an indication, requiring engine re-acceleration before top of descent to get ice released from the a/c fuel system to the engine fuel system up to the FOHE does not permit to reach estimated fuel flow needed to purge ice build up. As a consequence, on Airbus aircraft obtaining the desired thrust level in cruise does not seem practical to mitigate the threat.

2) The improvements associated with the modified FOHE
Recognizing that scale of the ice threat has still to be defined and that the aircraft manufacturer will need to perform extensive activities to show compliance with 25.951(c) and 25.952 (a), it is none-the-less established that the modified FOHE is a definitive improvement over the current one featuring protuberant tubes.

3) Potential unsafe condition
The risk analysis performed by both manufacturers indicates that there is a requirement for a rapid introduction of the modified FOHE within the Airbus A330 and A340 fleets.

The EASA has determined that then overall safety balance lies with granting a temporary deviation to 25.951(c) and 25.952 (a) allowing a rapid introduction within the fleet of the modified FOHE. Airbus must submit a detailed compliance plan within 6 months after the modification approval and show compliance within 18 months after the modification approval.