Flight Crew Operations Manual Bulletin
for
The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207

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Subject: Cold Fuel Operations Procedures for RR Trent 800 Series Equipped 777 Airplanes

Reason: To inform flight crews of new procedures to prevent, or address, the loss of thrust response or thrust rollback when operating with cold fuel.

As the result of a recent thrust rollback incident on a second RR Trent 800-powered 777-200ER, revision 2 of this bulletin revises the condition statement on the Engine Response non-normal checklist and also revises the Cold Fuel Operations supplementary procedure. In addition, the Background Information and Operating Instructions of the bulletin have been updated.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Investigations into an accident involving a RR Trent 800-powered 777-200ER and a subsequent thrust rollback incident involving another RR Trent 800-powered 777-200ER have identified the potential for a restriction in fuel flow under certain conditions, resulting in thrust rollback and failure to achieve a commanded thrust. The restriction can be caused by ice building up within the fuel supply system, then breaking free and collecting downstream at the engine Fuel Oil Heat Exchanger (FOHE). It must be emphasized that the investigations are still on-going, but knowledge gained to date has led to the development of procedures to address this potential condition.

Water is present in jet fuel and is uploaded into the aircraft during each refueling. The airplane's water scavenge system and periodic sumping can prevent excessive water build-up within the tanks. However, these measures cannot remove all water present in the tanks. Since water is always present in jet fuel, ice will form as the fuel temperature cools below 0 degrees C. The unusual circumstances of the accident flight include burning from the main wing tanks for an extremely long period of time at low fuel temperatures and at lower than average fuel flows, stretching back into the previous flight, with the fuel temperature remaining below 0 degrees C after fueling.

During the accident flight, the fuel temperature reached a low of -34 degrees C during cruise, and warmed to only -22 degrees C on approach, both of which are unusually cold for the 777 fleet. Step climbs were conducted using lower power settings for passenger comfort. Laboratory testing has shown that ice can accumulate within the tank and fuel system at cruise power settings. Over many hours at low power settings, it is believed that ice accumulation can reach a significant amount. Periodic high fuel flows, such as used in VNAV step climbs, help keep the system clear of large amounts of ice

Laboratory testing has shown that the FOHE will effectively melt typical amounts of ice that travel downstream from the fuel supply system. If too much ice arrives at one time, a partial blockage can occur. The amount of restriction will vary depending on the amount of ice, but the fuel flow always remains higher than idle and engine flameout will not occur. Depending upon the amount of ice, the restriction may go away on its own.

However, laboratory testing has also shown that reducing the fuel flow to min idle fuel flow will always clear any amount of ice at the FOHE within a few seconds. This reduction in fuel flow reduces the amount of cold fuel entering the FOHE, allowing the hot oil to quickly melt the ice. Full thrust capability is then completely restored. Testing has also shown that the FOHE is not susceptible to ice restriction if the fuel temperature is -10 degrees C or warmer.

During the subsequent thrust rollback incident, the thrust rolled back to a level above idle on only one engine during level cruise flight at FL 390, approximately 40 minutes after a VNAV step climb. The indicated EPR dropped below the commanded level, causing a large command EPR sector to appear on the EPR indicator of the affected engine. The flight crew performed the Engine Response non-normal checklist, which cleared the restriction and restored full capability to the engine for the remainder of the flight. The other engine operated normally throughout the flight.

Reviewing over 1.2 million flights of this airplane model/engine type did not reveal any other instance where the thrust rolled back during cruise or after a step climb in this manner.

Data from the flight data recorder of the thrust rollback aircraft shows that two VNAV step climbs occurred, one 55 minutes prior to the rollback and another one 15 minutes later (40 minutes before the rollback). It is suspected that ice was released within the fuel system during the first step climb, traveled downstream and formed a restriction at the face of the FOHE of the affected engine. While the restriction was not large enough to cause an immediate rollback, the oil temperature rose uncharacteristically on that engine. The second step climb was successfully completed in this condition 15 minutes later, 40 minutes before the restriction caused the thrust to roll back.

The flight profile of the thrust rollback aircraft was quite different from the flight profile of the accident aircraft. While the flight of the thrust rollback aircraft was long range and colder than average, it was not as cold as that experienced with the accident aircraft. The fuel temperature encountered by the thrust rollback aircraft was not exceptionally low, reaching a minimum of -22 deg. C, which occurred during cruise around the time of the rollback. In addition, the fuel temperature at takeoff was above 0 deg. C, precluding the need to accomplish the fuel recirculation procedure. Also, the step climbs of the two aircraft were performed differently. The step climbs of the thrust rollback aircraft were performed using VNAV while the accident aircraft step climbs were performed at lower thrust settings for passenger comfort.

Operating Instructions

The circumstances that differentiate the accident flight from millions of other flights led to the previously attached (but now incorporated) conservative Cold Fuel Operations supplementary procedure and the Engine Response non-normal checklist. The goal of these procedures is to assure continued safe operation of RR Trent 800-powered 777s by preventing a long term accumulation of ice beyond the level manageable by the FOHE.

The circumstances of the thrust rollback flight has caused the Cold Fuel Operations supplementary procedure and the Engine Response non-normal procedure to be revised (see attachments). The attached Cold Fuel Operations supplementary procedure should now be accomplished within 2 hours (revised from 3 hours) of top of descent when fuel temperature is colder than -10 degrees C; and the Engine Response non-normal procedure (non-normal checklist) should be accomplished if the engine(s) did not reach commanded thrust or rolls back, and fuel system icing is suspected (indicated EPR is below commanded EPR and fuel temp is below -10 degrees C).

Perform all step climbs using VNAV or maximum climb thrust.

During initial descent, maintain idle thrust for a minimum of 30 seconds.

The appearance of a command EPR sector (when actual EPR is less than commanded EPR), as experienced in the thrust rollback incident, is a symptom that can be used to differentiate between a cold fuel icing rollback from a type of rollback where the command EPR also rolls back with the actual EPR, such as occurs with P20 probe icing.

As with the previous release of this bulletin, these revised procedures are not required if fuel temperature is -10 degrees C or warmer.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-111 R2 "In Effect" (IE).

This bulletin will be incorporated in the June 15, 2009 revision of the Flight Crew Operations Manual. The affected LEP, index and table of contents pages will be updated at that time. This bulletin will be cancelled when Boeing is notified that service bulletin (TBD) has been incorporated into the customer's fleet.

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Engine Response

[RR Engines]

Condition:	One or both engines do not reach commanded thrust or roll back, and fuel system icing is suspected (Indicated EPR is below commanded EPR and fuel temp is below -10 degrees C).
Objective:	To clear ice from the fuel system by reducing engine fuel flow while descending, then checking for proper engine response.

1 Select a lower altitude on the MCP.

2 FLCH switch . . . . . .Push

3 Thrust levers (both) . . . . . Idle

4 WING ANTI-ICE selector . . . . . OFF

5 ENGINE ANTI-ICE selectors (both) . . . . . OFF

6 Maintain idle thrust for 30 seconds.

7 If thrust asymmetry compensation is inoperative, manual control inputs are required to compensate for asymmetric thrust conditions.

8 Left thrust lever . . . . . .Advance to maximum

9 Check for normal engine indications. Engine may accelerate very slowly especially at high altitudes. The time from idle to maximum thrust may be as long as 30 seconds.

10 Left thrust lever . . . . . Retard to idle

11 Right thrust lever . . . . . .Advance to maximum

▼ Continued on next page ▼

▼ Engine Response continued ▼

12 Check for normal engine indications. Engine may accelerate very slowly especially at high altitudes. The time from idle to maximum thrust may be as long as 30 seconds.

13 Right thrust lever . . . . . Retard to idle

14 WING ANTI-ICE selector . . . . . AUTO or ON

15 ENGINE ANTI-ICE selectors (both) . . . . . AUTO or ON

16 Resume normal operation.

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Cold Fuel Operations

[RR Engines]

CAUTION: Do not do this procedure and balance fuel at the same time. Balance fuel before or after doing the procedure.

Within 2 hours of top of descent (TD), but not less than 15 minutes before top of descent (TD), check fuel temperature.

If fuel temperature is colder than -10 degrees C:

Do one of the following:

(1) Perform a step climb using maximum climb thrust (VNAV preferred), or

(2) Select or verify CLB thrust on the thrust limit page and verify cruise speed is set to 0.84 Mach or less. Then:
- manually advance thrust levers to maximum (autothrottles may be overridden). After reaching maximum climb thrust, hold for 10 seconds or until reaching 0.86 Mach, whichever occurs first,
- check engines have achieved maximum climb thrust and respond normally,
- retard thrust levers to cruise power and resume normal operations.

If fuel temperature is -10 degrees C or warmer, no crew action required.

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