ACCIDENT

Aircraft Type and Registration:	Boeing 777-236 ER, G-YMMM
No & Type of Engines:	2 Rolls-Royce RB211 Trent 895-17 turbofan engines
Year of Manufacture:	2001
Date & Time (UTC):	17 January 2008 at 1242 hrs
Location:	Runway 27L, London Heathrow Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 16 Passengers - 136
Injuries:	Crew - 4 (Minor) Passengers - 1 (Serious) 8 (Minor)
Nature of Damage:	Aircraft damaged beyond economical repair
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	12,700 hours (of which 8,500 hours were on type) Last 90 days - 85 hours Last 28 days - 52 hours
Information Source:	Inspector's Investigation

All times in the report are in UTC

The investigation

In view of the sustained interest within the aviation industry, and amongst the travelling public, it is considered appropriate to publish an update on the continuing investigation into the accident involving a Boeing 777, G-YMMM, which occurred on 17 January 2008. This report is in addition to the Initial Report, published on 18 January 2008, a subsequent update published on 23 January 2008 and a Special Bulletin published on 18 February 2008.

History of the flight

The flight from Beijing to London (Heathrow) was uneventful and the engine operation was normal until the final approach. The aircraft was configured for a landing on Runway 27L and both the autopilot and the autothrottle were engaged. The autothrottles commanded an increase in thrust from both engines and the engines initially responded. However, at a height of about 720 ft the thrust of the right engine reduced to approximately 1.03 EPR (engine pressure ratio); some seven seconds later the thrust on the left engine reduced

to approximately 1.02 EPR. The reduction in thrust on both engines was the result of a reduced fuel flow and all engine parameters after the thrust reduction were consistent with this. Parameters recorded on the Quick Access Recorder, Flight Data Recorder and non-volatile memory from the Electronic Engine Controller (EEC) indicate that the engine control system detected the reduced fuel flow and commanded the fuel metering valve to open fully. The fuel metering valve responded to this command and opened fully but with no appreciable change in the fuel flow to either engine.

Engineering examination

Extensive examination of the aircraft and detailed analysis of the recorded data have revealed no evidence of an aircraft or engine control system malfunction. There is no evidence of a wake vortex encounter, a bird strike or core engine icing. There is no evidence of any anomalous behaviour of any of the aircraft or engine systems that suggests electromagnetic interference. The fuel has been tested extensively; it is of good quality, in many respects exceeding the appropriate specification, and shows no evidence of contamination or excessive water. Detailed examination of the fuel system and pipe work has found no unusual deterioration or physical blockages. The spar valves and the aircraft fuel boost pumps were serviceable and operated correctly during the flight. The high pressure (HP) fuel pumps from both engines have unusual and fresh cavitation damage to the outlet ports consistent with operation at low inlet pressure. The evidence to date indicates that both engines had low fuel pressure at the inlet to the HP pump. Restrictions in the fuel system between the aircraft fuel tanks and each of the engine HP pumps, resulting in reduced fuel flows, is suspected.

Environmental conditions

During the flight there was a region of particularly cold air, with ambient temperatures as low as -76ºC, in the area between the Urals and Eastern Scandinavia. The Met Office described the temperature conditions during the flight as 'unusually low compared to the average, but not exceptional'. The lowest total air temperature recorded during the flight was -45ºC, and the minimum recorded fuel temperature was -34ºC. The specified fuel freezing temperature for Jet A-1 is not above -47ºC; analysis of fuel samples taken after the accident showed the fuel onboard the aircraft complied with the Jet A-1 specification and had a measured fuel freezing temperature of -57ºC. The aircraft was operated within its certified flight envelope throughout the flight.

Continuing investigation

The focus of the investigation continues to be the fuel system of both the aircraft and the engines, in order to understand why neither engine responded to the demanded increase in power when all of the engine control functions operated normally. Under the direction of the AAIB, extensive full scale engine testing has been conducted at Rolls-Royce, Derby, and fuel system testing is ongoing at Boeing, Seattle.

The engine test cell at Rolls-Royce was altered to enable the introduction of calibrated restrictions at various locations in the engine and aircraft fuel feed systems to replicate the engine fuel and control system response. The primary challenge at Boeing is to create the environmental conditions experienced on the flight over Siberia, at altitudes up to 40,000 ft, in which to test a representation of the aircraft fuel system. These tests are collectively aimed at understanding and, if possible, replicating the fuel system performance experienced on the day and the potential for formation of restrictions.

In addition, work has commenced on developing a more complete understanding of the dynamics of the fuel as it flows from the fuel tank to the engine.

A data analysis team, working with statisticians from QINETIQ, are reviewing and analysing the recorded data from a large sample of flights on similar aircraft. No individual parameter from the flight of G-YMMM has been identified to be outside previous operating experience. The analysis is concentrating on identifying abnormal combinations of parameters.

The Federal Aviation Administration, the European Aviation Safety Agency, the Civil Aviation Authority and British Airways are being kept fully briefed on the progress of the investigation.

Operational changes

No operational changes are currently recommended by either the AAIB, Boeing or Rolls-Royce.