

allow them to define measures to be taken to return the aircraft to service. It was in this context that the airworthiness authorities defined the following measures:

- Installation of flexible linings in tanks 1,4,5,6,7 and 8.
- Reinforcement of the electrical harnesses in the main landing gear bays.
- Modification of Flight Manual procedures so as to inhibit power supply to the brake ventilators during critical phases of flight and revision of the MMEL to ensure that technical operational limitations cannot be applied for the tyre under-pressure detection system.
- Installation of Michelin NZG tyres and modification of the anti-skid computer.
- Modification of the shape of the water deflector and removal of the retaining cable.
- A ban on the use of volatile fuels and an increase in the minimum quantity of fuel required for a go-around.

## 4.2 Recommendations Specific to Concorde

The investigation did not bring to light the need for any other urgent recommendations. However, on several points, some improvements specifically linked to Concorde seem desirable in the light of information from the investigation. These improvements, which are the subject of the following recommendations, were brought to the attention of the French airworthiness authorities and were taken into account in the context of the aircraft's return to service.

### 4.2.1

For any transport aircraft, it is essential that feedback, through analysis of in-service incidents, be as effective as possible. Taking into account the small number of aircraft in service and their limited operations, in-service experience on Concorde is particularly limited. It is, however, both an ageing and a complex aircraft. It has been noted that the rate of malfunctions in certain systems or equipment was higher than current rates on other aircraft. Consequently, the BEA recommends that:

- **the airworthiness authorities, the manufacturers and the operators of Concorde reinforce the means available for the analysis of the functioning of aircraft systems and in-service events and for the rapid definition of corrective actions.**

### 4.2.2

The Concorde Flight Manual stipulates that a red alarm must lead to an immediate reaction by the crew.. In the same manual, dealing with an engine fire is consistent with this general instruction. However, the Air France Operations Manual requires that no action be taken before reaching four hundred feet. Consequently, the BEA recommends that:

- **Air France ensure that the emergency procedures in the section on Concorde utilisation in its Operations Manual be coherent with the Flight Manual.**

### 4.2.3

Recording the engine parameters which allow engine speed to be determined only every four seconds slowed down and complicated some work essential for the technical investigation. This characteristic also tends to mask certain facts during examination of incidents for which it would not be possible to devote as much time and effort as for the 25 July 2000 accident. In contrast to Air France's Concorde aircraft on the day of the accident, British Airways aircraft are equipped with recorders that allow the parameters from all four engines to be recorded every second. Consequently, the BEA recommends that:

- **Air France equip its Concorde aircraft with recorders capable of sampling at least once a second the parameters that allow engine speed to be determined on all of the engines.**

### 4.2.4

The technical investigation brought to light various malfunctions relating to the operation of the aircraft, for example the use of non-updated flight preparation data, the absence of archiving of certain documents or incomplete baggage management. Equally, omitting the left bogie spacer was a consequence of non-respect of established procedures and of the failure to use the appropriate tool. Consequently, the BEA recommends that:

- **the DGAC undertake an audit of Concorde operational and maintenance conditions within Air France.**

## 4.3 General Recommendations

Beyond specific improvements to Concorde, the investigation showed the need for progress in safety in various areas. This general progress is the subject of the following recommendations.

### 4.3.1

Tests and research undertaken in the context of the investigation confirmed the fragility of tyres against impacts with foreign bodies and the inadequacy of the tests in the context of certification. Recent examples on other aircraft than Concorde have shown that tyre bursts can be the cause of serious damage. Consequently, the BEA recommends that:

- **the DGAC, in liaison with the appropriate regulatory bodies, study the reinforcement of the regulatory requirements and demonstrations of conformity with regard to aviation tyres.**

### 4.3.2

The investigation showed that a shock or a puncture could cause damage to a tank according to a process of transmission of energy from a projectile. Such indirect processes, though known about, are complex phenomena which had never been identified on civil aircraft. Equally, the ignition of the kerosene leak, the possible forward propagation of the flame, its retention and stabilisation occurred through complex phenomena, which are still not fully understood. Consequently, the BEA recommends: