MINISTRY OF DEFENCE

MILITARY AIRCRAFT ACCIDENT SUMMARY

AIRCRAFT ACCIDENT TO ROYAL AIR FORCE TORNADO GR4 ZA599

AIRCRAFT:	**Tornado GR4 ZA599**
DATE:	**17 May 2002**
LOCATION:	**Humber Estuary**
PARENT UNIT:	**13 Sqn, RAF Marham**
CREW:	**Two**
CASUALTIES:	**Two minor**

Issued by: Directorate of Air Staff, Main Building, Whitehall, London SW1A 2HB

July 2004

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SYNOPSIS

1. On 17th May 2002, Tornado GR4 ZA599 was flying from RAF Marham on a routine low level flying training mission. Whilst flying at low level the crew were alerted to a problem on the central warning panel (CWP). Over the next 1 minute and 18 seconds they were faced with multiple unrelated captions and symptoms of failure. Shortly before the aircraft crashed, the controls stiffened and the aircraft performed a violent and uncommanded pitch down that the pilot could not correct. The crew ejected successfully, and the aircraft crashed into the River Humber close to Brough. The Inquiry concluded that the accident was caused by mechanical control rod failure resulting from a fuel fire in the spine of the aircraft.

BACKGROUND

2. The Tornado operates its flying control surfaces, such as the tailerons, via an electronic 'fly-by-wire' Command Stability Augmentation System (CSAS). This is backed up by a mechanical control mode, which the system reverts to in the event of multiple CSAS failures. The wires for the CSAS system are routed through the spine of the aircraft, as are the mechanical control rods for the back-up mode. If a fire occurs in this area of the fuselage, there is no fire detection or suppression system and it is possible for both the CSAS wires and the mechanical control rods to be damaged.

CIRCUMSTANCES

3. Tornado GR4 ZA599 took off from RAF Marham at 1355 hrs, in good weather, on a low-level flying training sortie. As the aircraft passed to the north of Hull, heading west, the audio warning tone sounded and three warnings associated with the CSAS illuminated on the CWP. Other unrelated captions then began to illuminate on the panel and the pilot turned the aircraft towards RAF Waddington, at 1000 ft above ground level, maintaining visual flight conditions. The pilot diagnosed a Rear Fuselage Fire and carried out the single action listed for this emergency. The red Auxiliary Power Unit (APU) Fire caption illuminated and the pilot decided to recover the aircraft to RAF Scampton, the nearest military runway. He transmitted a Mayday call on the UHF Guard frequency and received a brief reply. The pilot then felt the controls stiffen and the aircraft performed an abrupt uncommanded pitch down. The pilot successfully initiated Command Ejection for himself and the navigator. At approximately 1450 hrs Tornado GR4 ZA599 crashed into the Humber Estuary.

RESCUE/SALVAGE OPERATION

4. After ejection, the navigator discovered that the aerial for his SARBE 7 rescue beacon was missing from his life saving jacket (LSJ). He successfully boarded his dinghy and was quickly picked up by a Search and Rescue (SAR) Sea King helicopter. The pilot was unconscious until he entered the water, whereupon he

discovered that the lanyard connecting him to his personal survival pack (PSP), containing his dinghy, had snapped. Drifting downstream, he began to fire his emergency miniflares to attract attention. The Humber Inshore Rescue Boat located him and he was transferred to the SAR Sea King. Both ejectees were transported to hospital.

AIRCRAFT DAMAGE

5. The aircraft was destroyed upon impact with the water.

INVESTIGATION

6. The recovered wreckage had suffered massive impact damage. Much was difficult to positively identify and many components had simply disintegrated. The salvage team were able to recover 73% of the wreckage (by weight), and statements from the crew of ZA599, plus the initial Accident Data Recorder (ADR) audio and data traces, allowed the Inquiry to rule out many possible causes. Examination of the wreckage showed evidence of heat damage in three zones of the rear fuselage, indicative of a fire or hot gas leak. After lengthy and detailed investigation, the Board determined that the most likely sequence of events leading to the loss of ZA599 was that fuel had leaked from a fuel tank vent line through a faulty coupling located in the rear fuselage, and had been ignited by a hot intercooler ejector pipe which carried hot air from the engine. The fire damaged the CSAS and other electrical wiring, as well as the mechanical flying control rods. The CSAS degraded to mechanical mode, placing the mechanical control rods under tension, at which point they suffered a heat induced structural failure. The pilot no longer had control of the flying control surfaces and the aircraft abruptly pitched nose down settling in a 28° dive, with a descent rate of 20,000 ft per minute, before impacting the Humber.

SAFETY RECOMMENDATIONS

7. The Board made the following recommendations, which are being actioned:

a. The survivability and redundancy of the Tornado flying control system is reviewed.

b. The integrity of the vent and pressurisation lines is reviewed and action taken to minimise the risk of fuel leakage.

c. Potential ignition sources in the spine are identified and measures taken to minimise their occurrence.

d. Consideration is given to providing warning of overheating and fire suppression in vulnerable areas of the spine of the aircraft.

e. The LSJ antenna extension assembly is redesigned and equipment fit for purpose is provided at the earliest opportunity.

f. When actioning an emergency where a loss of control is likely aircrew are advised to avoid built up areas where possible.

g. A full examination of the PSP lowering line and all associated equipment is undertaken to identify risks, possible failure modes and remedial actions.