MINISTRY OF DEFENCE

Military Aircraft Accident Summary

29 October 1992

MILITARY AIRCRAFT ACCIDENT SUMMARY

AIRCRAFT ACCIDENT TO ROYAL AIR FORCE

TORNADO GR1 ZA540

Date:	12 September 1991
Parent Airfield:	RAF Marham
Place of Accident:	South of Steep Holm Island, Bristol Channel
Crew:	1 Pilot 1 Navigator
Casualties:	2 Minor

CIRCUMSTANCES

1. ZA540 was a Tornado GR1 trainer variant allocated to a crew of two pilots for a low flying and weapon training sortie. The crew were flying at low level over the Bristol Channel when they noticed warning captions associated with the 'fly-by-wire' flying control system. Shortly afterwards, the crew heard a bang and felt a solid jolt from the rear of the aircraft. The flying control system was instantly degraded. A climb was initiated and the crew attempted to analyse the unusual emergency. The Captain noticed a further warning caption which indicated that part of the fly-by-wire system had suffered significant degradation and he felt that the flying controls had reverted to mechanical mode. The front seat pilot, handling the aircraft, was aware of the aircraft pitching and

rolling as he climbed.

2. As the aircraft passed 1000 feet a left hand engine fire was indicated causing the Captain to make a MAYDAY call. The front seat pilot closed down the left hand engine and selected maximum reheat on the right hand engine which appeared to operate normally. At least one further significant jolt was felt. At 5000 feet, without pilot input, the nose pitched down and the aircraft commenced a gentle roll to the left. Unable to control the aircraft, the crew ejected successfully. The aircraft was seen to impact the sea but neither the Accident Data Recorder nor any significant wreckage was recovered.

CAUSE

3. The investigation was severely hindered by the lack of wreckage recovered and the unsuccessful search for the Accident Data Recorder due to the failure of its Sonar Locating Beacon. The most likely cause of the accident was a hot gas leak from the Environmental Control System at the base of the fin which provided a source of ignition for a small fuel or hydraulic leak. The resulting fire caused vapour in an empty fuel pipe at the base of the fin to explode. The fire caused disruption to the numerous wires in the area leading to a progressive degradation of the flying control system. The primary mode of the Tornado flying controls is the fly-by-wire system but the controls are designed to revert to a

mechanical mode should particular faults be detected in the system. However, it is likely that the fire at the base of the fin heated the adjacent taileron mechanical control rods to a point where they became ineffective. This rendered the aircraft uncontrollable.

SUBSEQUENT ACTIONS

4. A study into improving the reliability and performance of the Sonar Locating Beacon is under way. A modification to provide commonality between front and rear cockpit Central Warning Panels is being examined to assist crews in their analysis of emergencies. The German Air Force and Italian Air Force have been consulted to ascertain whether any of their Tornado aircraft have suffered similar technical problems. The German Air Force has not suffered problems but the Italian Air Force has had two recent incidents involving hot gas leaks. The RAF is conducting a study to see if it can improve its engineering husbandry of the hot air system within the Environmental Control System. The replacement of the Tornado's alloy mechanical flying control rods, by stainless steel rods, is also under review.