MINISTRY OF DEFENCE

Military Aircraft Accident Summary

MILITARY AIRCRAFT ACCIDENT SUMMARY

OF RAF BOARD OF INQUIRY

Aircraft:	**Nimrod MR2 XV239**
Date of accident:	**2 September 1995**
Place of accident:	**Toronto, Canada**
Casualties:	**Seven fatal injuries**

SYNOPSIS

1. On the afternoon of 2 September 1995, the Nimrod was carrying out a display at the Canadian International Air Show (CIAS) when, during the final turn back towards the display line, it crashed into Lake Ontario, ½ mile off the waterfront at Toronto. The aircraft sank immediately and all seven crew were killed instantly. The Inquiry determined that the captain made an error of judgement in modifying one of the display manoeuvres to the extent that he stalled the aircraft at a height and attitude from which recovery was impossible. The Inquiry considered that contributory factors could have included deficiencies in the flight deck crew's training and in the method of supervision which could have allowed the captain to develop an unsafe technique without full appreciation of the consequences.

BACKGROUND

2. The display aircraft and crew, under the supervision of a flight commander, had deployed to Canada on 23 August for displays at Canadian Forces Base Shearwater and the CIAS. The captain, one of three Nimrod display pilots, was approaching the end of his

first display season in which he had successfully flown 13 displays as well as several practice ones. In addition to the captain, there were six further crew members on board - a co-pilot, a flight engineer, a navigator and three rear crew members. This represents the minimum number of crew permissible for safe effective operation of a Nimrod.

CIRCUMSTANCES

3. In excellent weather, with a light on-shore wind, the aircraft took off on time for its display. Upon completion of the safety checks, it ran in for the standard Nimrod display sequence which features two orbits and two dumb-bell turns. The latter manoeuvres each involved a turn away from the display line, a climb to not above 1,000 ft, followed by a turn in the opposite direction and descent, to fly back parallel with the display line. Having completed the two orbits, the first dumb-bell turn was completed uneventfully. After a slow flypast with undercarriage down, the aircraft entered its final manoeuvre, the second dumb-bell turn. It was seen to turn away approximately 75° to starboard under full power before the flaps were retracted to 20° and the undercarriage raised. The nose was then pitched up into a climbing attitude of 24°. As the aircraft passed 950 ft, engine power was reduced to almost flight idle, following which the speed reduced rapidly to 122 knots, below the 150 knots recommended and taught for that stage of the display. The aircraft was rolled to 70° of port bank, shortly afterwards reducing to 45°, and the nose lowered to 5° below the horizon. During this turn the airspeed increased slightly and the G-loading increased to 1.6G. However, the combination of the low airspeed and the G-loading led the aircraft to stall, whereupon the port wing dropped to 85° of bank and the nose dropped to 18° below the horizon. Full starboard aileron and full engine power were applied in an attempt to recover the aircraft but, by this stage, there was insufficient height to recover and the aircraft hit the water.

AIRCRAFT DAMAGE

4. The aircraft broke up on impact with the water and was destroyed.

SALVAGE OPERATION

5. The wreckage and bodies were recovered after a prolonged search by divers of the Directorate of Marine Services (Navy) assisted by Canadian military and civilian agencies.

INVESTIGATION

6. The Inquiry had a considerable amount of evidence to assist its investigation. This included data from the aircraft's Data Acquisition Recorder Unit and Central Tactical System, eyewitness accounts, video footage and still photographs, as well as evidence from the Department of Transport's Air Accidents Investigation Branch. The Inquiry was able to determine that all relevant aircraft systems and instruments were in all probability operating normally until impact and was therefore able to rule out mechanical and structural failure as likely causes of the accident. The Inquiry therefore concentrated on the human aspects, and in particular the captain's handling of the aircraft. It established that, during a display on 6 August, the captain had crossed the display line on exiting his second dumb-bell turn. The expected procedure in cases such as this would be for the captain to analyse the reasons for the error with his supervisors in advance of his next scheduled supervised practice, which took place on 21 August. He did not raise this matter and instead, on arrival in Canada, progressively amended the technique used by tightening this particular turn by reducing engine power during the climb which immediately preceded it in the display sequence.

In so doing, he disregarded the briefed recommended speed for the dumb-bell manoeuvre and reduced the speed of the aircraft to such an extent that safety margins were removed and the aircraft stalled.

7. The investigation also identified a number of factors, each of which may have contributed to the cause of the accident. These included some deficiencies in the regulations pertaining to Nimrod display flying and inadequate advice on stall warning speeds in the aircraft documentation. It also identified scope for improving the display crew selection process, and in their training and supervision. Specifically, the Inquiry considered that the absence of a more structured training syllabus covering theory, simulation and airborne instruction left the captain without a solid base on which to develop his techniques. The Inquiry established that, although supervision had been carried out in accordance with extant regulations, the lack of a formal requirement for airborne supervision in Nimrods had given the captain scope to develop unsound techniques unbeknown to his ground-based supervisors.

SAFETY RECOMMENDATIONS AND ACTIONS

8. The Inquiry's main recommendations focused on a thorough review of Nimrod display training, the supervision of display crews and improvements to the aircraft's stall warning system. As a result, a complete review of Nimrod display flying was carried out; this addressed the underlying rationale, the number and nature of displays, crew selection and training and supervisory procedures. Future Nimrod displays will be carried out by a single, specially-selected crew made up of instructors from the Operational Conversion Unit working under an improved training and supervisory regime. Staffs have also initiated a wider study of stall and manoeuvre stall training to ensure that the lessons learnt from this accident are disseminated across other aircraft fleets.