[redacted]

Part 1.4 Findings

All times LOCAL

DIAGNOSES OF CAUSES

INTRODUCTION

24. Although neither G-BYXR (663A) nor G-CKHT were fitted with either Flight Data recorders (FDR) or Cockpit Voice Recorders (CVR) the pilot of G-CHKT was able to provide a detailed account of the last moments of the flight of both aircraft immediately prior to the collision and witnessed the final moments of G-BYXR before it impacted the ground. Additional information from the glider data-logger and radar tapes as well as evidence from an eyewitness was available to the Panel to enable it to establish a good account of the circumstances leading to the accident. Witness 8 Exhibit 5, 7

AVAILABLE EVIDENCE

25. To assist the Panel the following evidence was available:

a. Aircraft Wreckage.

b. Surviving crew statement.

c. Witness statements, including eyewitnesses.

d. Expert witness statements and reports.

e. RAF Benson ATC transcripts.

f. NATS radar traces.

g. Data logger from G-CKHT

h. Photographs of wreckage at crash site.

i. Weather reports from RAF Benson meteorological office.

SPECIALIST ASSISTANCE

26. To assist the panel the following services were available:

[redacted]

[redacted]

a. RAF Centre for Aviation Medicine (RAFCAM).

b. RAF Benson Medical Officer.

c. Consultant Aviation Pathologist.

d. Command Flight Medical Officer (CFMO).

e. QinetiQ – Accident Data Recorder Systems.

f. London Air Traffic Control Centre (LATCC) Mil.

g. National Air Traffic Services (NATS).

h. Air Accidents Investigation Branch (AAIB).

i. VT Aerospace.

j. Grob Aircraft Gmbh.

k. Materials Integrity Group (MIG).

l. Directorate of Aviation Safety and Regulation (DARS).

m. Air Staff Service Inquiry Advisor.

FACTORS CONSIDERED BY THE PANEL

27. The Panel considered a number of factors to establish the cause of the collision and the inability of the Tutor crew to either recover the aircraft post collision or egress from the aircraft prior to impact with the ground. The Panel considered the following factors in its analysis of the accident:

Events Leading to the Collision

a. Aircraft Systems Integrity and Maintenance.

b. Meteorological Factors.

c. AEF Operations.

d. Inter-Agency Communication.

[redacted]

[redacted]

e. Fatigue.

f. The 'See and Avoid' Principle.

(1) Conspicuity - Glider.

(2) Conspicuity - Tutor.

g. Pilot's Medical Suitability for Role.

h. Distraction.

i. Supervision.

(1) OUAS/6 AEF Background.

(2) OUAS/6 AEF Orders.

(3) OUAS/6 AEF Workload and Resources.

(4) External.

(5) Medical.

Post-collision Events

j. Pre-flight Safety Briefing.

k. Control Restriction.

l. Tutor Pilot Incapacitation.

m. Tutor Abandonment.

DISCUSSION OF FACTORS

Events Leading to the Collision

28. **Aircraft Systems Integrity and Maintenance**. Tutor G-BYXR was certified as serviceable prior to its departure on the first of the Tutor pilot's 5 planned cadet sorties that afternoon. The aircraft had flown in the morning and no faults had been reported. No work, other than a refuel, had been carried on the aircraft in between the morning and the afternoon sorties. The accident occurred on the Exhibit 10

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[redacted]

third sortie of the afternoon and, although minor faults could have occurred during the first 2 sorties, there was nothing that caused the Tutor pilot to curtail his cadet flying. The wreckage was examined independently by both the Engineer member of the Panel and by the Engineering Inspector from the AAIB. No evidence was found of any indication of aircraft systems failure. The aircraft maintenance records confirmed that all maintenance requirements necessary prior to flight had been completed and that there was no scheduled maintenance due. Annex C

The Panel concluded that aircraft systems integrity and maintenance were not a factor in this accident.

29. **Meteorological Factors**. The weather on the day was so good that it was reported as the best gliding day in the UK for 3 years. Visibility was unlimited with very little cloud and this led to an increase in GA and glider traffic to above that normally experienced in the vicinity of RAF Benson. The British Gliding Association estimates that on the day of the accident there were in excess of 600 gliders airborne between the Bristol Channel and the London TMA; Lasham alone launched 128 gliders on the daily task. In the moments leading up to the collision the sun was at an azimuth of 214° (T) and elevation of 58.2° above the horizon at 4000 ft so would have been high in the Tutor's 5 o'clock position; G-CHKT was in the Tutor's 2 o'clock position as the 2 aircraft converged and so it is unlikely therefore that the Tutor pilot was dazzled by the sun. Witness 8 Exhibit 6 Witness 8 Exhibit 14

The Panel concluded that meteorological conditions were not a factor in this accident.

30. **AEF Operations**. As laid down in its Strategic Plan 2008 - 2018, the Air Cadet Organization (ACO) aims to give each cadet an opportunity to fly once a year. AEF sortie lengths are restricted to approximately 25 minutes each and 6 AEF (having the largest number of cadets in its catchment area) aims for a sortie length of 20 minutes. 6 AEF is particularly restricted by the presence of the London TMA to its east, controlled airspace and high ground to the south and the Brize Norton control zone to the north west. There are also numerous minor airfields and gliding sites around the local area. Coupled with the need to fly short sorties, the 6 AEF pilots are restricted in their choice of operating area, especially if the cadets wish to carry out aerobatics, the base height for which is Exhibit 15 Witness 1,6

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[redacted]

3000 feet agl[1]. Both General Aviation (GA) and glider pilots also have to observe the airspace restrictions in the RAF Benson area and this can lead to increased airspace congestion close to RAF Benson. A snap-shot of flying activity taken between 1200 and 1330 in the RAF Benson local area on the day of the accident gives a good illustration of the congestion these restrictions can create on a good flying day and it shows at least 100 aircraft movements. Exhibit 16

31. In 2006, G-BYXR was involved in an AIRPROX[2] with a Puma helicopter operating out of RAF Benson. One of the recommendations of the subsequent report was to increase sortie lengths which would give 6 AEF pilots more freedom to choose operating areas further away from RAF Benson. This report was not fully staffed prior to the accident, therefore its recommendations were not approved or publicised. On the day of the accident a glider pilot saw a Tutor in close proximity and subsequently raised an AIRPROX[3]. Exhibit 17

32. On the day of the accident, RAF Benson Air Traffic Control (ATC) issued 2 separate 'All-stations'[4] warnings relating to high volumes of glider activity area surrounding RAF Benson. The first of these warnings was issued at 1305 just after the Tutor pilot took off. The Tutor pilot arrived at 6 AEF after lunch. As he was not present at that morning's brief he was personally briefed by OC 6 AEF. Although the brief did contain a general reference to increased levels of flying activity due to the exceptional weather conditions, no specific mention of gliders was made. The second warning was issued at 1345. Exhibit 11 Witness 6

The Panel concluded that both the AEF location and AEF sortie length were contributory factors in this accident.

33. **Inter Agency Communication.** Gliding is a weather dependent sport with flying routes being decided on the day after assessing the meteorological conditions. On the day of the accident Lasham launched 128 gliders with a launch rate of 70-80 gliders per hour. Since this was not publicised neither the Tutor pilot nor his Witness 6

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[1] Above Ground Level.

[2] An Airprox is a formalised process of reporting incidents in which a pilot considers that his airspace has been infringed in some way.

[3] The incident occurred on 15 Jun 09 at 1342BST. The pilot of a glider operating out of Bicester airfield had to take evasive action to avoid a collision with a light aircraft (later identified as Tutor by the pilot of a following glider).

[4] This term relates to those call-signs listening to RAF Benson ATC radio frequency

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[redacted]

supervisors had any way of knowing in advance that he was operating in an area through which so many gliders had been tasked to fly. In addition to this activity, the exceptionally good weather had generated increased levels of GA and glider traffic. There are currently no mandated mechanisms for a gliding club to publicise the routes that its gliders will fly. Similarly there were no mandated processes whereby routine AEF activities are notified. However, when an unusual activity such as a gliding competition is planned these are notified using the NOTAM[5] system.

The Panel concluded that the current lack of an effective mechanism to communicate easily between general aviation and other aviation organizations was a contributory factor in this accident.

34. **Fatigue**. The collision occurred during the Tutor pilot's third sortie in a planned series of 5. AEF pilots regularly fly a series of 5 sorties and of those pilots interviewed, none of them reported suffering from fatigue problems with this number of consecutive sorties. By chatting to his staff between sorties, OC 6 AEF is able to monitor his pilots for signs of fatigue and advises them to deplane and rest if necessary. With specific regard to the Pilot, OC 6 AEF mentioned that he did not notice anything unusual about him when he arrived to fly that afternoon. He was not aware of any illness or other issues that could have had an affect on his ability to carry out his task.

Exhibit 2

Witness 6

Witness 6

The Panel concluded that fatigue was not a factor in this accident.

35. The **'See and Avoid' Principle**. The 'see and avoid' principle and its limitations is a well documented subject area. The research report written by the Australian Transport Safety Bureau thoroughly investigates the limitations of the 'see and avoid' principle. The report concluded, in part, that:

Annex N

> *"The see-and-avoid principle in the absence of traffic alerts is subject to serious limitations. It is likely that the historically small number of mid-air collisions has been in a large part due to low traffic density and chance as much as the successful operation of see-and-avoid".*

[5] NOTAM stands for Notice to Airmen and is a system of bulletins published by National Air Traffic Service.

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It goes on to state that:

> *"The physical limitations of the human eye are such that even the most careful search does not guarantee that traffic will be sighted. A significant proportion of the view may be masked by the blind spot in the eye, the eyes may focus at an inappropriate distance due to the effect of obstructions as outlined above or due to empty field myopia in which, in the absence of visual cues the eyes focus at a resting distance of around half a metre. An object which is smaller than the eye's acuity threshold is unlikely to be detected and even less likely to be identified as an approaching aircraft."*

36. The human visual system is better at detecting moving targets than stationary targets, yet in most cases, an aircraft on a collision course appears as a stationary target in the pilot's visual field. The contrast between an aircraft and its background can be significantly reduced by atmospheric effects even in conditions of good visibility. An approaching aircraft in many cases presents a very small visual angle until a short time before impact. In addition, complex backgrounds such as ground features or clouds hamper the identification of aircraft via a visual effect known as 'contour interaction'. This occurs when background contours interact with the form of the aircraft producing a less distinct image. See-and-avoid can be considered to involve a number of steps. First, and most obviously, the pilot must look outside the aircraft. Second, the pilot must search the available visual field and detect objects of interest, most likely in peripheral vision. Next, the object must be looked at directly to be identified as an aircraft. If the aircraft is identified as a collision threat, the pilot must decide what evasive action to take. Finally, the pilot must make the necessary control movements and allow the aircraft to respond. Not only does the whole process take valuable time, but human factors at various stages in the process can reduce the chance that a threat aircraft will be seen and successfully evaded. These human factors are- not 'errors' nor are they signs of 'poor airmanship'. They are limitations of the human visual and information processing system which are present to various degrees in all pilots. Annex N

37. The Panel has already established through interviews with 6 AEF pilots and RAF Benson ATC that on the day in question traffic density was higher than usual, neither aircraft were fitted with mutual collision avoidance systems and that traffic alerts may have been missed. The Panel concentrated on a number of other

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specific aspects of the 'see and avoid' principle:

a. **Conspicuity - Tutor.** The glider pilot initially heard the noise of a light aircraft. He immediately began to search and lookout for a light aircraft and caught a glimpse of an aircraft aligning to his left. He maintained his lookout and recognised the aircraft as a Tutor and it was approximately 200 - 300 ft away below and to his left. He saw the aircraft in plan view with both occupants clearly visible. The aircraft began to pitch up and, quickly assessing the risk of collision to be high, the glider pilot took avoiding action. Witness 8

The Panel concluded that Tutor conspicuity was not a factor in this accident

b. **Conspicuity - Glider.** High-performance gliders are designed with high aspect ratio wings and a low drag profile. Accordingly they have the smallest practical cross-section and as they are predominantly painted white for thermal reasons are difficult to detect even by a pilot who knows where the target is. A glider conspicuity trial was carried out in 2002 at RAF Bicester by Dr Tony Head of Cranfield University and the RAF Central Flying School. The study aimed to see what enhancements could be made to glider conspicuity given the ACOs application of Dayglo ® stripes to its fleet of gliders. The trial concluded that a black underside was marginally better than a pure white glider but that Dayglo ® stripes effectively reduced the range at which the aircraft was detected (similar to the disruptive pattern of a Zebra's stripes). G-CKHT was fitted with FLARM® which is an electronic aid to aircraft detection fitted to a small percentage of gliders in the UK; it only detects other gliders fitted with FLARM. G-BYXR was not fitted with FLARM as this is not a piece of equipment that is normally fitted to powered aircraft. Neither was it fitted with a Traffic Alert and Collision Avoidance System (TCAS)[6] which can alert aircraft to the presence of other aircraft that are similarly equipped. In this case TCAS would not have been effective against G-CKHT as it was equipped with FLARM®, not TCAS, therefore both aircraft were relying on the principle of 'see and avoid'. Annex O

c. In order to assess the likelihood of the Tutor pilot being able

[6] TCAS is an aircraft collision avoidance system designed to reduce the incidence of mid-air collisions between aircraft.

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[redacted]

to see the glider prior to the collision, the Panel reconstructed the events leading up to the collision using a similar glider and a Tutor. The reconstruction was planned using data from radar traces, the glider's data logger and the glider pilot's witness statement. The reconstruction was able to determine that in the seconds prior to the collision G-CKHT was initially to the right of G-BYXR at a similar level and on a converging heading; initially G-CKHT was on a relative bearing of 127° (M) from G-BYXR (663A) which is 42° right of the nose. At this point G-CKHT was between the rear of the canopy arch and forward of the leading edge of G-BYXR (663A) so it was not obscured by any part of the Tutor airframe. It would probably have been difficult to detect as a Standard Cirrus presents a very small target and there was little relative movement. From the perspective of the pilot of the glider, the Tutor would have been hidden behind his left wing tip. Following G-BYXR's dive to increase speed just prior to the final pitch-up G-CKHT was high in the 2 o'clock position and would have been visible to a pilot by looking up and to the right. The reconstruction showed that the underside of the glider would have presented a plan view with a good contrast between the glider and the blue sky. It should therefore have been visible to the Tutor pilot prior to his final pull-up manoeuvre. Exhibit 5

The Panel therefore concluded that although the glider may have been difficult to detect initially, overall, glider conspicuity was not a factor in this accident.

38. As has been previously stated, this particular day was one of the best flying days for many years. This resulted in a higher than normal level of GA and glider activity and, as a consequence, possibly increased the likelihood of a conflict arising. As discussed at para 37, the Panel concluded that aircraft conspicuity was not a contributory factor in this case. However, other limitations of the 'see and avoid' principle were considered to have been contributory.

39. The average person has a field of vision of around 190 degrees, although field of vision varies from person to person and is generally greater for females than males. The field of vision begins to contract after about age 35; in males, this reduction accelerates markedly after 55 years of age. The Tutor pilot was required to wear corrective flying spectacles and evidence gained from both the wreckage examination and post-mortem confirm that the pilot was Annex N

[redacted]

[redacted]

wearing his glasses. The lookout scan and work-cycle (as detailed in AP3225G and taught during Basic Flying Training) enables a pilot to conduct a thorough lookout scan of the area around his aircraft. In particular, pilots are taught to positively clear the airspace above and behind the aircraft prior to pulling up into any vertical manoeuvre. As the Tutor pilot was a very experienced instructor, the Panel considered it was highly unlikely that he would have commenced the final vertical manoeuvre had he seen the glider.

The Panel concluded that as the Tutor pilot did not appear to make any attempt to avoid the glider he had most probably not seen it. Therefore, the limitations of the 'see and avoid' principle were a contributory factor in this accident.

Furthermore, as the glider pilot had seen the Tutor and had taken avoiding action in order to prevent a collision, and the Tutor was not seen to take avoiding action, the Panel concluded that the controlled flight of Tutor G-BYXR (663A) into Standard Cirrus glider G-CHKT was the probable cause of this accident.

40. **Pilot's Medical Suitability for Role**. The Tutor pilot suffered from the condition Ankylosing Spondylitis (AS). This affected the mobility of his upper spine and neck. He was severely kyphotic (permanent bending of the spine) and stood awkwardly. In the Tutor he would sit in a slouched posture to ensure that his head and eyes were level. The following sub-paragraphs provide a brief summary of pertinent dates in the pilots medical history: Exhibit 9 Witness 25

a. Joined the RAF in 1964. Exhibit 18

b. Permanently medically downgraded to A3G2Z1(unfit ejection seats) in 1971. Exhibit 18

c. 'Difficulty with vertical lookout' mentioned by consultant rheumatologist in 1997. Exhibit 9

d. Review of condition prior to posting to USA in 1999, returned from USA 2005. Exhibit 18

e. Retired from RAF 2005. Exhibit 18

f. Tutor cockpit assessment carried out by OC 6 AEF in 2005, no problems highlighted. Exhibit 19

[redacted]

[redacted]

g. Joined 6 AEF Nov 05. Exhibit 20

41. He was medically downgraded in 1971 to A3G2Z1(Unfit Flying High Performance Ejector Seat aircraft) and in 1976 was granted a medical waiver exempting him from carrying out parachute drills due to the risk of pathological fracture in the vertebral column. Nevertheless, he was allowed to become an instructor on the Bulldog aircraft. He underwent regular annual aircrew medical examinations and was continually passed as fit to fly albeit with a reduced MES. In 1997 he underwent a medical examination for a civilian medical for his Private Pilot's Licence. The military consultant rheumatologist conducting this medical noted that "in certain types of aircraft would no doubt have difficulty with vertical lookout." He passed the Tutor pilot fit to fly Cessna type aircraft (which do not have glazed roofs and so there is less of a requirement to look up) and his operational type which was the Nimrod. Neither of these aircraft required the same lookout scan as a Bulldog although the report did not specifically recommend that he should not fly this aircraft. The Tutor pilot flew the Bulldog with 6 AEF between 1997 and 1999 before being posted abroad on a non-flying appointment. Exhibit 9 Exhibit 8 Exhibit 9

42. After his retirement from the regular Service he rejoined 6 AEF to fly the Tutor in 2005. As part of the employment process HQ Air Cadets requested and were granted a medical waiver, this removed the requirement for the Tutor pilot to attend a formal medical board at OASC, RAFC Cranwell. During his annual medical examination (PME) in 2005 the SMO at RAF Benson queried the Tutor pilot's fitness to fly. The then OC 6 AEF carried out a cockpit assessment and reported that the Tutor pilot could move his head and eyes and see the outer tips of the tailplane and could see above the aircraft but does not quantify to what extent. The Panel questioned several UAS students who had flown with the Tutor pilot. They gave varying opinions ranging from having 'no issues at all' through to 'having concerns' about his ability to perform an effective lookout. However, no one voiced any concerns formally. The statement made in the letter from OC AEF in which he stated that "he had no concerns of his ability to lookout for other aircraft: by moving his head and eyes he was able to see above the aircraft and to the rear to the outer tips of the tailplane." is at variance with that written by the consultant rheumatologist in 1997 but no further investigation was carried out. Further medical evidence from DSMRC Headly Court in 1999 suggests that the pilot's range of rotational movement Exhibit 19a, 19b, Witness 7 Exhibit 19c Witness 2 - 5 Exhibit 19c Exhibit 9

[redacted]

[redacted]

was limited to about 50% of that of a healthy person and the post mortem reported that his neck vertebrae were rigidly fused which would have made it difficult for him to look up. Annex M

43. Leaflet 5-08 of Air Publication (AP) 1269A gives specific guidance on the treatment and management of patients with AS, the Panel can find no evidence that the Tutor pilot's AS was managed in accordance with AP1269A following his posting to the USA and subsequent return to the UK. Following his retirement from the RAF and appointment as an AEF pilot there was no requirement for the RAF medical services to manage his condition as this would have been the responsibility of his GP. Exhibit 21

44. In 2008 the Tutor pilot volunteered to attend 115(R) Sqn at RAF Cranwell to refresh his QFI category; there is currently no requirement for any pre-employment assessment for QFIs who are returning to role. During his course at Cranwell the Tutor pilot flew with a number of instructors all of whom offered differing opinions as to his ability to lookout effectively with some expressing severe doubt as to his ability to conduct an effective lookout scan. The consensus of opinion among the instructors of 115(R) Sqn seemed to hinge on the fact that the Tutor pilot had a full flying medical and that they could not question his fitness to fly even when they could see that he could not carry out as full a lookout scan as is required of an able-bodied pilot. Although there was doubt as to the Tutor pilot's ability to lookout the Panel noted that the Tutor pilot was only assessed by one senior supervisor, who flew the Tutor pilot's final handling test and "has no recollection of the flight". This flight was not specifically to assess his lookout but a general test of his ability to fly and instruct. The only assessment as to his lookout ability was carried out by means of a discussion among the 115(R) Sqn QFIs, chaired by OC 115(R) Sqn in the presence of the Tutor pilot. OC 115(R) Sqn's final report mentions that the Tutor pilot "has to work hard to try to complete a comprehensive lookout scan". Witness 18,19,22,24,25,26 Witness 23 Exhibit 22

45. Based on the subjective and sometimes conflicting witness statements and limited quantative evidence, it is the opinion of the Panel that the Tutor pilot's medical condition would have made his effective scan and lookout ability considerably more difficult. It is therefore possible that he may not have been able to visually clear the airspace above his aircraft adequately prior to pulling up for the manoeuvre that resulted in the collision.

The Panel therefore concluded that the Tutor pilot's medical

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[redacted]

condition was a contributory factor.

46. **Distraction**. The Tutor is fitted with neither a CVR nor an ADR and it was impossible for the Panel to tell which occupant was flying the aircraft at the point of collision. The major difference between an air experience flight and a pure passenger ride is that the cadets are given the opportunity to handle the aircraft's controls. The Cadet was on his second air experience flight in a Tutor and it is on this second flight that cadets may experience aerobatics if they so wish. As a QFI it would not be unusual for the Tutor pilot to teach a basic aerobatic manoeuvre to his passenger and then allow the passenger to fly that manoeuvre. The collision between G-BYXR (663A) and G-CKHT happened during the third in a series of similar aerobatic manoeuvres which the panel has assessed to be loops given the height change and lack of heading change observed on radar; this ties in with the QFI's teaching methodology of demonstrate-teach-practice, ie demonstrate a loop, teach the student how to fly the loop and then let the student practice a loop. If the Cadet was flying the aircraft just before the collision it is possible that the Tutor pilot was distracted from his look out scan. Whilst this possibility cannot be discounted, it is the opinion of the Panel that the extensive instructional experience of the pilot should have reduced the potential for any distraction, if indeed the Cadet was handling the aircraft.

Exhibit 4

Exhibit 5

The Panel was therefore unable to determine whether distraction was a contributory factor in this accident.

Supervision

47. **OUAS/6 AEF Background**. 6 AEF is one of the largest and busiest of all the AEFs. It has a large number of pilots on strength although this is currently under review by OC 6 AEF who is attempting to rationalise the number of pilots registered to fly. This AEF has a history of high achievement and has exceeded its tasked hours in the last 3 years[7]. It flew 2961 hrs against a tasking of 2880 hrs in 08/09 flying 6991 cadet sorties; 3004 hrs against a task of 2880 hrs in 07/08; and 3880 hrs against a task of 3590 hrs in 06/07.

Witness 6

48. **OUAS/6 AEF Orders**. When the Panel enquired about relevant orders and procedures, there appeared to be gaps in OC OUAS' and OC 6 AEF's working knowledge of those orders relevant

Witness 1, 6

[7] Taken from the OUAS Pre AFV - Air Staff Input reports dated 11 May 09, 24 Apr 08, and undated from 07.

[redacted]

[redacted]

to their respective posts. In particular, there appeared to be confusion as to the requirement for supervisory checks to be carried out iaw TGOs. During the ensuing discussion it was clear to the Panel that the order relating to 'Newly Arrived Instructors' as defined at TE125.100.3 had been interpreted in such a way as it did not apply to the Tutor pilot. The reason given was that, in the opinion of the OUAS supervisory chain, the Tutor pilot was not a newly arrived instructor. He had been operating on the AEF for some time so he already knew the local operating areas, AEF routines/practices, and his flying abilities had been subject to regular checks without any issues being raised. No reason was given for the omission to conduct the annual Sqn Cdr check; OC OUAS was aware of the need to conduct the check and had simply not got around to it. Exhibit 23 Exhibit 8 Witness 1

49. When asked for copies of their respective Terms of Reference (ToRs) neither post holder could provide them. OC OUAS could remember signing something 'about 4 years ago' but could not recall if this was a copy of his ToRs or a Directive issued by OC 1 EFTS. OC 6 AEF does not recall ever having any ToRs issued; his predecessor has provided a copy of the ToRs with which he was issued. Witness 1, 6

50. The issue of ToRs/Directives was taken up with HQ 1 EFTS, but they could neither produce a copy of the signed orders nor tell the Panel where these orders were published. It seems the file which may have held the signed copy of OC OUAS's ToRs/Directive had been destroyed as part of the normal file management process. In informal discussion with Wg Cdr UAS, 1 EFTS, it was stated that ToRs are not routinely issued however, since he has taken up his post, each newly appointed UAS commander has been issued with a Directive from OC 1 EFTS. No evidence of the Directive issued to OC OUAS could be found.

51. The Panel decided to investigate further and looked at the Pre-FSV reports. These showed that although the flying task was being adequately managed evidence suggested that supervisory standards were inadequate. As an example, in the report for 07/08 TGOs were found to be at the incorrect amendment state; the same observation was made in the following year. The Panel concluded from this that the FSV process was not as robustly managed as it could have been and in particular no process to ensure the follow-up actions required to fix observations was in place.

52. **OUAS/6 AEF Workload and Resources.** OC OUAS stated

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[redacted]

that he has been operating without a deputy for some 12 - 14 months. HQ 1 EFTS had successfully recruited to fill this vacancy but unfortunately the new recruit has since left the organisation. The lack of a deputy has resulted in OC OUAS concurrently filling the post of CFI, CGI, and FSO while also managing the flying and ground training programmes. When asked what tasks he had dropped, OC OUAS stated that he was not aware of consciously dropping any activity but he had noticed a significant increase in his workload. For a time he was the sole instructor on OUAS and his feeling was that this, together with the other tasks already mentioned, left him little time for supervisory tasks. Witness 1

53. Despite being one of the busiest AEFs, 6 AEF has the same full-time establishment as other less busy AEFs eg UGSAS. 6 AEF has regularly over achieved against its allocated task and therefore the Panel concluded that its current establishment was adequate. However, it was evident that the lack of a deputy in OUAS had caused OC 6 AEF extra work. The main additional task was that OC 6 AEF had to provide instructors to assist OC OUAS. Witness 2

54. This lack of manpower has been recognised by HQ 1 EFTS and seems to be part of a wider UAS/AEF manning issue. The Panel considered that the increased reliance on FTRS posts on UASs appears to have resulted in difficulty with recruitment and retention of suitable staff. Exhibit 24

55. Notwithstanding the above, day to day flying operations on OUAS inc 6 AEF appear to be conducted in a safe and appropriate manner. Both OCs OUAS and 6 AEF seem to have a good relationship and are working very hard to meet their task. The Panel noted that OUAS and 6 AEF regularly exceeded their tasked hours and received praise from 1 EFTS for doing so. The Panel felt that this situation had probably engendered a task-focussed, can-do attitude towards achieving the flying task. Unfortunately this seems to have been at the expense of some aspects supervision with the result that the more mundane activities such as amendments to publications were not being carried out as conscientiously as they should have been. Exhibit 25

56. The Tutor pilot had not flown with CFS Exam Wing within 2 years of appointment and had not flown 'a squadron commander's check' as required by Training Group Orders. Pilot currency was being managed by the use of an electronic spreadsheet which was found to contain a number of inaccuracies. The Panel conducted a Exhibit 23 Exhibit 26

[redacted]

[redacted]

check of the F5000's held by OC 6 AEF. It was found that in addition to the Tutor pilot, there were 3 other pilots who were out of currency on 14 Jun 09 with regard to CFS checks. These pilots fulfilled the requirement shortly afterwards, 2 in Jul and the 3rd in Aug. No other out of date currencies were discovered. As a direct consequence of this recent investigation, the Panel noted that OC 6 AEF was conducting a review of all AEF pilot currencies and was checking the accuracy of the information held on his management database (spreadsheet). There were no other observations on the day-to-day flying supervision of OUAS and 6 AEF. Pilots were briefed on NOTAMS and other warnings pertaining to the local operating area before flying and were closely supervised during the flying operation, updated as necessary with information germane to their task. It was noted by the Panel that the 6 AEF Flying Supervisor was not aware of the 'All-stations' radio calls issued from RAF Benson ATC. Although some of the 6 AEF pilots had been flying over that period, no-one thought these calls sufficiently out of the ordinary to raise a concern with the Flying Supervisor. The Panel concluded that the 1 EFTS system of flying supervision is sufficiently robust but only if it is adhered to; in this instance supervisory checks had been overlooked.

57. **External**. The Tutor pilot undertook a QFI refresher course at 115(R) Sqn at RAF Cranwell in order to relieve the workload on OC OUAS and OC 6 AEF. During his course at RAF Cranwell some of his instructors expressed doubts as to his ability to lookout effectively. These concerns were aired during a meeting to discuss the pilot's suitability for role. Despite these doubts he only flew with one senior supervisor and that was not specifically to check his ability to lookout; nevertheless the Tutor pilot was awarded a Competent to Instruct (CtoI) (UAS) category. The Panel considers that a more thorough investigation, including a full cockpit check, may have established the Tutor pilot's ability to lookout although the Panel accepts that such a check was not mandated. The Panel also noted that HQ 1 EFTS staff officers who award the CtoI qualification are, by their own rules, exempt standardisation by CFS and so miss the opportunity to be refreshed on the standards required as laid down in the Flying Instructors Handbook (Air Publication 3225). Witness 18,19,22,24,25,26 Witness 28 Exhibit 23

58. **Medical**. The pilot's medical condition has been discussed previously. The Panel found difficulty in assessing the full medical history and supervision of the Tutor pilot due to patient confidentiality issues. The Panel has established that the Tutor

[redacted]

[redacted]

pilot's RAF and NHS medical histories were not fully evaluated or coordinated in order to make an informed decision as to the pilot's suitability to fulfil his AEF role. Additionally, an opportunity to assess and quantify his lookout was missed in 2005 when the cockpit check was carried out without the presence of the FMO. Witness 7

The Panel concluded that the management of the Tutor pilot's medical condition and his supervision as a pilot during his light aircraft flying career in the RAF and whilst on the AEF was not sufficiently robust. In particular, there was a reluctance to question the Tutor pilot's medical fitness for role and therefore the Panel considers that supervision and management were contributory factors in this accident.

Post-collision Events

59. Both the SI Panel Engineering member and the AAIB engineering investigator conducted a thorough and independent examination of the wreckage. At the point of collision the glider G-CKHT was at approximately 90° of right bank in a slightly nose-down attitude. The Tutor, G-BYXR (663A) was in a near vertical climb with a low forward speed and its left wing leading edge, just forward of the pitot probe, collided with the glider's fin and removed the glider's right-hand horizontal stabilizer. A small piece of the leading edge of the left wing (approximately 0.5 m) and the pitot probe broke off G-BYXR (663A). Examination of the wreckage showed that there were no signs of other damage to either aircraft in the collision. The Tutor's canopy, cockpit and propeller remained intact prior to the aircraft impacting the ground. This, and the relative slow speed of both aircraft (the glider pilot stated that he was concerned about his aircraft stalling and the Tutor was just moving through the vertical as it climbed into its manoeuvre), led the Panel to conclude that at the point of collision the impact speed and energy would have been relatively low. This resulted in minimal damage to the Tutor and the manufacturer has concluded that the aircraft should have been flyable after the collision with G-CKHT. Witness 8

Annex C

Following the collision the Tutor entered a brief spin before recovering and diving into the ground at high speed. It has been assessed that this was at between 70° and 80° nose down at a speed in excess of 215 Kts. Eyewitnesses remember seeing the Tutor trailing blue smoke during its terminal dive which suggests that the engine was probably at a high power setting which would have been set in preparation for the pull-up into manoeuvre. The time from collision to impact with the ground has been estimated Witness 8 Exhibit 7

Exhibit 5

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[redacted]

from radar Mode C readout evidence as approximately 24 seconds.

60. The seat harnesses and canopy jettisoning mechanism were subjected to further testing by the Materials Integrity Group; no evidence of mechanical failure was found. Therefore the Panel focussed its investigation on discovering why no apparent attempt was made to recover the aircraft post collision and/or why aircraft abandonment was unsuccessful. Annex J

61. **Pre-Flight Safety Briefing.** Prior to flying in a Tutor all passengers are required to watch the Tutor specific safety video. This covers all pertinent aspects of flying in a Tutor from fitting the AEA, strapping-in, how to behave in the air and abandoning the aircraft. The video strikes a balance between reassuring passengers who may be nervous and giving enough information to allow a safe flight and successful abandonment should it be required. There is no opportunity for passengers to reinforce their learning by practising the abandonment drill or the deployment of the parachute. The briefing is considered to be adequate in most respects. However, the Panel noted that the video gives the impression that the pilot will manage the emergency situation and provide any additional direction to the passenger that may be required. The video did not account for potential pilot incapacitation. Exhibit 13

The Panel concluded that the lack of reinforcement training into aircraft abandonment was an aggravating factor in this accident.

62. **Control Restriction.** The Panel determined that at the point of impact with the ground the Cadet's harness was unfastened and the aircraft canopy was in the unlocked position. Investigation has shown that it is possible for the negative-g strap to fall and jam between the control column and the seat causing a control restriction. This could limit up elevator movement to approximately 9°. In addition, as it is not known when the Cadet's harness was undone, it is possible that, unrestrained, the Cadet could have potentially restricted control movement. Airborne experiments were conducted and proved that 9° of up elevator was sufficient to recover the aircraft from a dive with the height available to the Tutor pilot. Furthermore, tests were then conducted into the effect of stick-free flight. The result of these tests concluded that the aircraft would adopt a 70° to 80° degree nose down attitude without any control input; this was consistent with the descent profile of the Annex C Annex P

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Tutor prior to ground impact. Therefore, although the Cadet's harness was undone, at an undetermined point prior to ground impact, the Panel concluded that neither the Cadet's harness nor the Cadet himself were likely to have caused a control restriction.

Therefore, the Panel concluded that a control restriction was not a factor in this accident.

63. **Tutor Pilot Incapacitation.** Following the collision it is possible that the Tutor pilot became incapacitated. Research has shown that persons with AS could be predisposed to suffer severe upper spinal trauma following minor accidents (whiplash type injuries in car accidents, falls in the street). The forces in the collision were severe enough to cause the glider pilots head to smash through the canopy of his aircraft. It is therefore possible that the Tutor pilot could have been subjected to unexpected forces which resulted in his incapacitation.

Exhibit 27, 28
Annex K

Witness 8

The Panel concluded that pilot incapacitation may have been an aggravating factor in this accident.

64. **Tutor Abandonment.** In common with many military light training aircraft the Tutor has a manual abandonment procedure which requires the crew to jettison the canopy, unstrap, jump out of the aircraft and manually deploy the parachute. This abandonment procedure has been used successfully in a number of RAF aircraft types although not in either of the 2 Tutor accidents. As previously stated[8], the pre-flight briefing video implies that the pilot will assist with the abandonment procedure.

65. The mid-air collision occurred at 4100 ft AMSL[9]. The time to impact with the ground was calculated at approximately 24 seconds leaving the Tutor crew little time to abandon their aircraft. To ensure sufficient time to carry out an abandonment procedure, the Tutor Flight Reference Cards recommended a minimum abandonment height of 1500 feet agl. During a spin this minimum height increases to 3000 feet agl due to the increased rate of descent. It is worth noting that once the glider pilot had seen the Tutor he had some advance warning of an impending collision so had mentally prepared himself to abandon his aircraft.

Exhibit 5

Witness 8

[8] Discussed under Pre-flight Safety Briefing at para 48.

[9] Above Mean Sea Level.

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66. The pilot's harness was found to be locked following impact with the ground. The Cadet's harness was found undone and the canopy was unlocked. Investigation revealed that the canopy jettison handle had not been removed to enable the canopy to be jettisoned. These facts led the Panel to consider that this may have been an attempt to abandon the aircraft. If this was the case, the abandonment procedure was not carried out in accordance with the instructions contained in the pre-flight safety briefing video. The Panel therefore considered whether the pre-flight briefing video provided sufficient training to enable a passenger to carry out the abandonment procedure and concluded that the following factors had a bearing on the outcome: Annex C

a. **Insufficient time to complete the procedure.** The very high rate of descent after the collision was estimated from the NATS radar trace to be in excess of 14,000ft/min. This would have given only about 24 seconds from collision to impact with the ground leaving very little time to successfully abandon the aircraft.

b. **Lack of effective reinforcement training.** The canopy was not jettisoned because the canopy jettison handle had not been removed. Current training policy for AEF flights does not give the opportunity to practise the abandonment drill prior to flight.

c. **Difficulty.** Eyewitnesses have stated that the Tutor aircraft was spinning immediately after the collision. The resulting disorientation and shock could have made a successful completion of the abandonment procedure very difficult for an inexperienced passenger.

The Panel concluded that the current Tutor abandonment system, including training, was an aggravating factor in this accident.

67. **Human Factors.** Due to the volume of concurrent investigations into aircraft accidents the Panel had only limited access to the services of the RAF CAM Behavioural Psychologist (BP). The Panel completed the investigation without an independent specialist report from the BP. Human Factors have been analysed by the Panel within the discussion of factors. It is the Panel's opinion that Human Factors pertaining to both the pilot and the supervisory chain were key and that opportunities to identify

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and manage the risks identified were missed.

68. **Orders and Regulations**. The Panel considers that the following orders and regulations have not been complied with:

a. **TGO(E)125.100.4**. Neither the Tutor pilot's Sqn Cdr nor Flt Cdr had conducted an annual flying instructors check (the Tutor pilot gained his CtoI(UAS) qualification on 10 Jun 08 and his check was due on 10 Jun 09).	Para 48.
b. **TGO(E)115 Annex B**. The Tutor pilot had not flown with CFS Exam Wing within 2 years of his appointment.	Para 56.
c. **TGO(E)125.100.3**. The Tutor pilot's Squadron Commander had not flown an arrival check with him following the award of his CtoI (UAS) qualification.	Para 56.
d. **AP1269A, Lflt 5-08**. The effective management of the Tutor pilot's medical condition was not maintained once he had been posted to the USA (the pilot was appointed on a ground tour in Mar 00 and returned to the UK in Mar 05).	Para 58.

SUMMARY OF CAUSES AND FACTORS

69. **Cause**. The accident was caused by the controlled flight of Tutor G-BYXR (663A) into Standard Cirrus glider G-CKHT. Para 39

70. **Contributory Factors**. The Panel concluded that the following factors contributed to the accident:

a. AEF location and sortie length.	Para's 30 - 32
b. The current lack of an effective mechanism to communicate easily between GA and other aviation organisations.	Para 33
c. The Tutor pilot's failure to see and avoid G-CKHT.	Para's 35 -37
d. The Tutor pilot's medical condition.	Para's 38 - 43
e. Supervision, at all levels.	Para 47 - 58

71. **Aggravating Factors**. The panel considered that the following were aggravating factors in the accident:

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a. Lack of aircraft abandonment reinforcement training. Para 64 - 66

b. The Tutor abandonment system, including training. Para 64 - 66

72. **Possible Aggravating Factors.** The Panel considered that the following may have aggravated the final outcome:

a. Pilot incapacitation. Para 63

OBSERVATIONS

73. The Panel made the following observations:

a. The role of HQ CFS is to advise on the suitability of pilots for instructional duties. The Panel found no evidence that HQ 1 EFTS is required to consult with HQ CFS before employing QFIs who are returning to role. Once concerns were raised at 115(R) Sqn with regard to his ability to lookout, HQ CFS could have provided independent advice on his suitability for role.

b. The parachute worn by crews in the Tutor, although similar to that worn in the ACO gliders, has the D-ring on the right hand side whereas it is on the left on the glider parachutes. It is likely that AEF passengers could also be flying gliders with the ACO and vice-versa. This could lead to cognitive failure following aircraft abandonment.

c. In addition, as the training currently provided to AEF passengers does not include parachute drills, it may be appropriate to employ systems that could increase the likelihood of survival following a successful emergency egress. These include:

i. **Static Line.** This system negates the need for a manual deployment of the parachute because the parachute is attached to the aircraft and deployed at full extension of the static line which then snaps and allows the occupant to make a normal parachute descent. This system is currently in use on the Epsilon light trainer used by the French Air Force and is widely used on gliders in Germany.

ii. **Barometric Release.** A barometric release system is a standard fit in sport parachuting. The barometric

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release system triggers the release of the parachute at a pre-determined height during free-fall. It relies on rate of change of height and therefore avoids deploying the parachute during normal aircraft rates of descent.

d. **Ballistic Recovery System (BRS).** The BRS was developed to allow for the safe recovery of an aircraft and its occupants following an emergency. The BRS deploys a large parachute which is attached to the aircraft and negates the need for the crew to physically abandon the aircraft. It does have draw backs such as a significant weight penalty but it has been successfully deployed it the USA. The BRS can be retrofitted to a number of aircraft.

e. Throughout this investigation, it appears to the Panel that more robust questioning of the Tutor pilot's suitability by the relevant branches would have helped to uncover any problems he may have had in his role. As it was, the Medical branch placed reliance upon the fact that the Flying branch thought he was a capable operator and the Flying branch placed reliance upon the fact that he had been signed medically fit to fly; neither branch robustly questioned the Tutor pilot's overall continued suitability for role.

f. The first few days of this investigation proved to be more difficult than necessary because of the lack of a clear MOU between the MOD and AAIB. This highlighted the need for the AAIB and MOD (RAF) to clarify the separation necessary between the procedures and processes of a Service Inquiry and an AAIB investigation, when the aircraft involved is civilian registered yet operated by the RAF.

g. Following the initial presentation of findings to AOC 22(Trg) Gp, an investigation was directed into the 'fitness for purpose' of all 1EFTS QFIs and VR pilots. This was conducted by OC 1 EFTS who reported to Director Flying Training that all 1 EFTS QFIs and VR pilots were 'fit for purpose'.

h. Throughout this investigation the Panel has experienced difficulty in gaining access to information contained within medical documentation due to patient confidentiality. RAF Legal and RAF Medical Legal are discussing this issue currently.

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