ACCIDENT

Aircraft Type and Registration:	Piper PA-34-220T Seneca III, G-LENY
No & Type of Engines:	2 Teledyne Continental TSIO-360-KB piston engines
Year of Manufacture:	1982
Date & Time (UTC):	19 December 2007 at 1709 hrs
Location:	4 nm south of Oxford (Kidlington) Airport
Type of Flight:	Commercial Air Transport
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	4,268 hours (of which 1010 were on type) Last 90 days - 164 hours Last 28 days - 46 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft, with one pilot on board, was flying a non-precision approach to Runway 01 at Oxford (Kidlington) Airport when the accident occurred. It was night and the weather was poor. The aircraft commenced its final descent 2.3 nm before the correct descent point and continued to descend below the step-down Minimum Descent Altitude (MDA). It struck trees near the summit of a hill, 3.6 nm before the runway threshold, in what appeared to have been controlled flight. The pilot survived with serious injuries. No technical faults or defects were identified as contributory factors to the accident, which the investigation concluded was an instance of Controlled Flight Into Terrain (CFIT).

History of the flight

The aircraft pilot had been on standby duty at his home during the morning and was called at about 1230 hrs to operate a charter flight. The task was to fly from the operator's base at Oxford Airport to Denham Airport where the aircraft was to collect a single passenger and fly him to Plymouth City Airport. The aircraft was then to return to Oxford with only the pilot on board.

Normal pre-flight preparation included checking weather and route information at a computer terminal in a crew report area and examining the flights logs for the intended flights. The aircraft, which had not flown for six days, was fuelled to full tanks (466 ltr) which allowed for a flight time of about 5 hours.

The aircraft took off from Oxford at 1359 hrs and flew to Denham, 7.5 nm north of Heathrow Airport. The pilot's memory of the events preceding the accident was limited, but he did recall that the weather at Denham had been "murkier" than expected. He described having to fly a let-down through cloud using mainly GPS information. After a short stop at Denham, the aircraft flew on to Plymouth with one passenger on board. The passenger disembarked at Plymouth before taking off again at 1613 hrs for the return flight to Oxford. The aircraft was fully serviceable when it departed from Oxford, and there was no reason to believe that this was not the case when it took off from Plymouth on the accident flight.

The aircraft flew an almost direct track towards Oxford, cruising at FL50. As the aircraft neared Oxford, the pilot was in contact with ATC at RAF Lyneham and then at RAF Brize Norton. An Automatic Terminal Information Service (ATIS) broadcast was operating at Oxford which gave a visibility of 3,500 m in haze and overcast cloud at 500 ft aal. When the pilot first contacted Brize Norton ATC, at 1701 hrs, he requested "...POSITIONING FOR STRAIGHT IN FOR ZERO ONE AT OXFORD..." and reported that he was descending to 3,500 ft. The pilot was instructed to take up his own navigation towards Oxford, cleared to transit the Brize Norton control zone and further cleared to 3,000 ft on the Oxford QNH.

At 1703 hrs the pilot contacted Oxford ATC. He did not request nor receive Oxford weather information from Brize Norton or Oxford Approach and did not state to either controller that he had received the ATIS information. On his initial call to Oxford, the pilot said that he was joining for a 10-mile finals position and was asked by the controller to call again at 2 nm range. The pilot subsequently called at 4.5 nm range and was asked to report again when he was visual with the runway lights. The pilot acknowledged this instruction but no further transmissions were received from him.

When the aircraft failed to land at Oxford, an extensive search was initiated, involving helicopters and teams on foot. Poor weather hampered the search but the accident site was eventually located at 2015 hrs, close to the summit of a 539 ft hill, on the extended centreline, 3.6 nm from the Runway 01 threshold. The site was in thick fog at the time. The pilot was found 9 m from the burning wreckage. He was hypothermic and suffering from chest and limb injuries, as well as burn injuries to his lower legs. He was taken to hospital in Oxford and survived the accident.

Accident site

The aircraft crashed on Wytham Hill in Wytham Great Wood, which is approximately 3 nm west of the city of Oxford. The wood in the area of the crash site was very dense and the aircraft initially made contact with the tops of 60 ft tall trees sited on ground 500 ft amsl. The initial impact point was 3.6 nm from the threshold of Runway 01 and the tops of the trees were 310 ft above the runway threshold elevation.

The wreckage trail extended for 160 m on an average track of 025º(M). The first part of the wreckage trail was 90 m long and consisted of freshly cut branches, the right wing tip and composite material from the wing leading edge. The ground then sloped away towards the main wreckage site. There was no debris for the next 50 m, after which more cut branches, the left navigation light and the tail anti-collision light were found on the ground. During the last 20 m the aircraft sustained substantial damage when it struck several large trees.

From the distribution and damage of the wreckage, and burn marks to the trees, it was established that the left wing, from just outboard of the engine, failed and broke into four main sections after it hit a large tree, late in the impact sequence. The force of the collision was sufficient for one of the fuel tanks in the wing to explode and set a number of trees on fire. The fin and rudder also broke away after striking a large tree.

The aircraft came to rest inverted, with both engines and the remainder of the wings lying on top of the cabin. With the exception of the tail section, the aircraft cockpit and fuselage were destroyed by an intense post-crash fire. The upper part of the forward right cabin door was found separately; its damaged state indicated that the upper forward right fuselage had also made forcible contact with the trees.

Examination of the wreckage

The landing gear had been extended and from the flap operating lever, it was established that the flaps had been lowered to their first position (10 degrees). From the position of the trim screw jack it was established that the elevator trim was set at about the neutral position, which was consistent with the phase of flight. The steel components in the control systems were relatively undamaged and the control system appeared to have been intact prior to the impact. The pitch control mechanisms on both propellers were broken and the blades were all bent. From the damage sustained by both propellers and the width and length of the trail of broken branches, it was assessed that both engines were producing power as the aircraft flew into the trees. Moreover, the depth of two blade strikes on a large tree trunk indicated that, in the last 20 m, at least one engine was operating at a high power setting.

It was also established that the composite material found in the early part of the wreckage trail was from the right wing leading edge. Sections of this material were positively identified as coming from both the wing root and wing tip. The loss of the greater part of the fuselage and cockpit area in the fire prevented any examination of flight instruments or avionics components, including the automatic pilot system.

Airport information

Oxford (Kidlington) Airport (elevation 270 ft) is 6 nm north-north-west of Oxford. The main runway is orientated 01/19, is 1,319 m long and is equipped with an ILS on Runway 19 only. There is a secondary runway, 760 m long and orientated 11/29. A DME (coded “I-OXF”) is zero-ranged to the threshold of the runway in use, and an NDB (coded “OX”) is located on the airport. Runway 01 is equipped with high intensity bi-directional edge lighting with a low intensity omni-directional component. The threshold is equipped with high intensity green lighting and wing bars. Precision Approach Path Indicator (PAPI) lights are situated on the left side, 140 m from the threshold and set to an approach angle of 3.5º. Runway 01 had no approach lighting.

At the time of the accident the airfield lighting was all selected on and Runway 01 selected for use. The ILS was off and the NDB and DME were indicating ‘serviceable’. No pilot reports were received that evening about the reliability of the available navigation aids. The minimum Sector Safe Altitude (SSA) to 25 nm from Oxford in the direction of approach for Runway 01 was 2,300 ft.

Navigational information

Runway 01 was served by an NDB/DME approach, shown at Figure 1 in the same format as that available to the pilot. The procedure involved a descent to the intermediate altitude of 1,800 ft as the aircraft

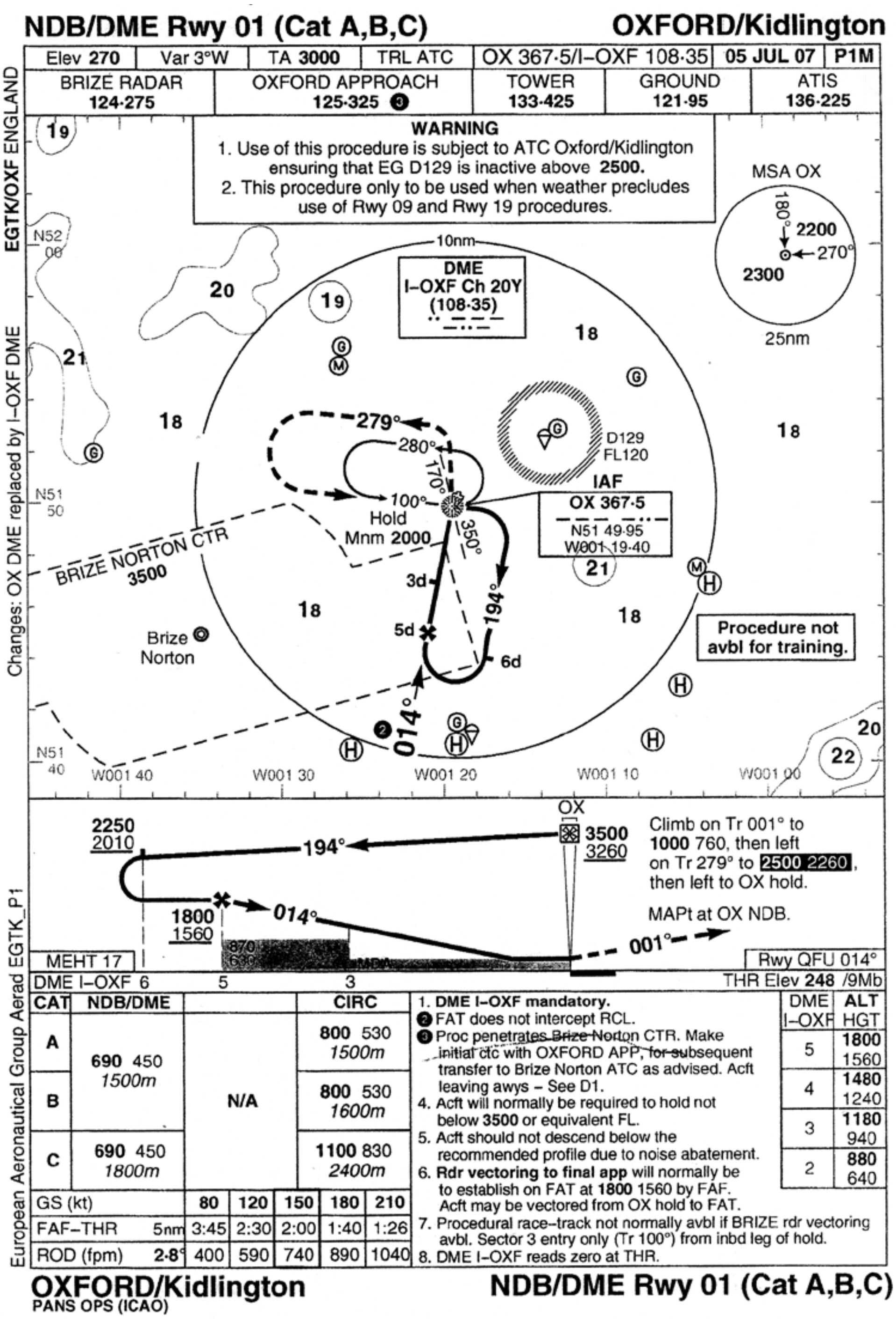

Figure 1

Runway 01 Approach Chart

established on the inbound course of 014°(M). Final descent started at the Final Approach Fix (FAF), which was at 5 DME. A step-down fix existed at 3 DME with an associated MDA of 870 ft amsl. The procedure MDA after the step-down fix was 690 ft amsl, equating to 450 ft above the runway threshold. The associated minimum required visibility was 1,500 m.

The full procedural approach was only to be flown if radar vectors were unavailable from Brize Norton ATC. The approach information published in the UK Aeronautical Information Publication (UK AIP), and also on the commercially produced charts in use by the operator included a number of notes and warnings. Among the notes was the item:

> *'**Rdr** (radar) **vectoring to final app** will normally be to establish on FAT[1] at **1800** 1560 by FAF'*

The Airport is situated adjacent to the eastern side of the RAF Brize Norton control zone, such that the instrument approach for Runway 01 penetrates the zone. It was therefore a requirement that inbound aircraft contact Brize Norton ATC for radar vectoring or procedural control until established on the final approach track. The procedure was notified as not being available for training purposes.

The approach chart included a table of altitudes against DME ranges, to assist a pilot to fly a Continuous Descent Approach (CDA). A note on the chart read:

> *'Acft should not descend below the recommended profile due to noise abatement.'*

The UK AIP also gave information on holding, approach and departure procedures in the UK. Concerning instrument approach procedures, the UK AIP states:

> *'…where an aerodrome is provided with one or more notified Instrument Approach Procedures, unless otherwise authorised by ATC, pilots requiring to use an Instrument Approach Procedure shall use only such notified procedures…'*

Footnote

1 Final Approach Track.

The UK AIP also reminded readers that PANS-OPS (ICAO document *"Procedures for Air Navigation Services – Aircraft Operations"*) stressed the need for flight crew and operational personnel to adhere strictly to the published procedures in order to achieve and maintain an acceptable level of safety in operations.

PANS-OPS included the method of calculating minimum heights and altitudes for instrument procedures. Where an FAF was defined, a minimum obstacle clearance of 75 m (246 ft) was specified. In relation to flying a non-precision approach containing step-down fixes (such as the approach to Runway 01 at Oxford), PANS-OPS stated:

> *'Where a stepdown procedure using a suitable located DME is published, the pilot shall not commence the descent until established on the specified track. Once established on track, the pilot shall commence descent maintaining the aeroplane on or above the published DME distance/height requirements.'*

The obstacle necessitating the step-down procedure for the approach was a viewing / study platform close to the final wreckage position, with an elevation of 616 ft.

Recorded information

Radar

Recorded data from the Clee Hill area radar, 68 nm from the accident site, was available for analysis. The data included primary and secondary returns, and Mode C altitude data transmitted to the nearest 100 ft. The Mode C data originated from an independent encoding unit on the aircraft, which was referenced to the International Standard Atmosphere sea level pressure of 1013.25 hPa. Based on the Oxford QNH of 1036 hPa, and using a correction value of 28 ft/hPa, Mode C values in this report have been converted to a corrected altitude. Figure 2 shows the aircraft's vertical profile from before the FAF; vertical error bars represent the Mode C resolution limitation.

The aircraft descended from its cruise level of FL50 as it tracked in an almost straight line towards a point 10 nm on the extended Runway 01 centreline. It levelled just before reaching the 10 nm point, at 1,744 ft (which correlated to the 1,800 ft intermediate altitude). At this point the aircraft commenced a left turn to establish on the inbound course, with an average groundspeed of 140 to 145 kt. From then on, the groundspeed reduced steadily until it stabilised at about 115 kt when the aircraft was descending on final approach (consistent with a typical approach speed for the aircraft of 120 kt).

The aircraft maintained level flight until starting to descend at about 7.3 nm from the runway threshold (equivalent to 7.3 DME), at which point it was established on the inbound radial. At 5.5 DME the aircraft track started to drift slightly right of track, and at the 5 DME FAF, when the final descent should have commenced, the aircraft was indicating 1,144 ft altitude, 656 ft below the recommended approach profile. It had also just started to drift to the right of the inbound track. To this point, the rate of descent was about 500 ft/min.

The aircraft continued to descend at a slightly increased rate until the last radar return, at 1708:36 hrs. The aircraft was at 4.5 nm range and 944 ft altitude, 696 ft below the recommended profile. This was just before the pilot made his last radio transmission. Based on the observed

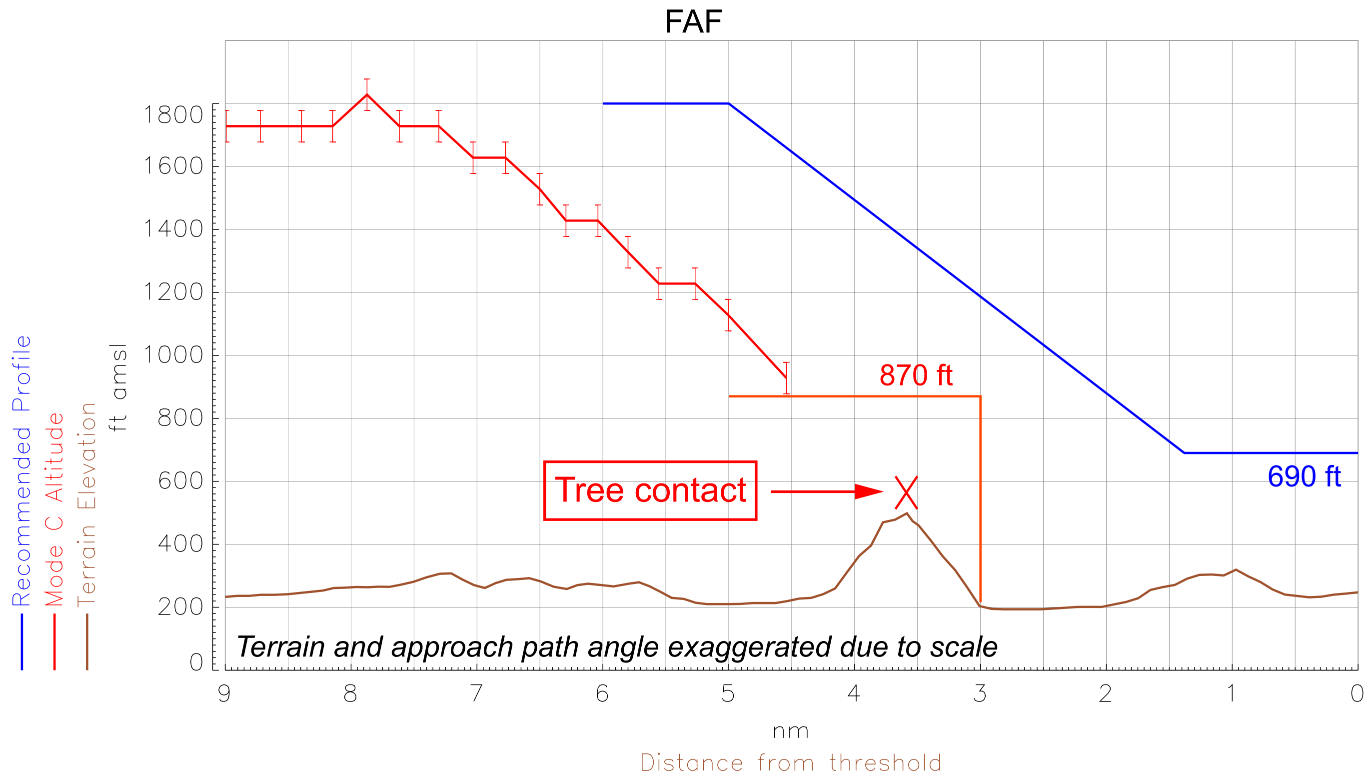

Figure 2

Approach profile

rate of descent, the aircraft would have descended below the step-down MDA of 870 ft just after the last radar return, at about 4.4 nm. The last radar position placed the aircraft 1,700 m from the point of first impact with the trees, at an altitude of 944 ft and 130 m right of the inbound course.

Between the last radar return and the first contact with the trees, the rate of descent would have been between 700 and 900 ft/min. As Figure 2 shows, the radar data does suggest a slight increase in rate of descent in the latter stage. Based on the average groundspeed at that point, the aircraft would have hit the trees 30 seconds later. The average rate of descent from starting descent at 7.3 DME to the point of impact was about 600 ft/min, which would have been the rate required to follow the recommended profile from the FAF.

If the final descent rate was as predicted, the aircraft descended through the procedure MDA of 690 ft about 650 m and 11 seconds before the first point of contact. Had the aircraft levelled at the procedure MDA of 690 ft, the aircraft would have cleared the trees on its track by approximately 130 ft, and would have cleared the trees on the adjacent highest ground by about 90 ft (using an average tree height of 60 ft).

Radiotelephony (R/T) information

The pilot called Brize Norton at 1701 hrs and reported that he was descending to 3,500 ft altitude on the Oxford QNH of 1036 HPa. He said "...REQUEST FURTHER DESCENT AND POSITIONING FOR STRAIGHT IN FOR ZERO ONE AT OXFORD THROUGH YOUR ZONE". The controller cleared the pilot to descend to 3,000 ft and placed him under a Radar Information Service. The controller then said "...TAKE UP YOUR OWN NAVIGATION FOR OXFORD...". He cleared the aircraft through the control zone, and asked the pilot to advise when he wanted to change to the Oxford Frequency. The pilot then advised that he was content to change to Oxford ATC and, after rechecking that he was clear to penetrate the control zone, changed frequency. The entire exchange between the pilot and Brize Norton ATC lasted less than two minutes. The frequency was not busy, so controller workload was unlikely to have been high.

Just after the pilot contacted Brize Norton, the controller there contacted the Oxford controller by land line and pre-notified her of the inbound aircraft, saying "HE'S COMING STRAIGHT IN FOR ZERO ONE". The Brize Norton controller asked for and received the Oxford QNH, and the exchange ended.

Just after 1703 hrs, the pilot contacted Oxford, saying "….JOINING FOR A TEN MILE FINAL FOR ZERO ONE IF THAT'S OK..." The controller acknowledged this and gave the QNH. She also instructed the pilot to call at 2 nm finals, which he acknowledged. Just before 1709 hrs the pilot transmitted "FOUR AND A HALF MILES FINALS (call-sign)". The controller instructed the pilot to call when the runway lights were in sight, to which he replied "WILCO (call-sign)" at 1708:55. When compared with the radar data, this call was calculated to have been only 11 seconds prior to the accident, with the aircraft at an estimated 4 DME and at 690 ft, 180 ft below the minimum altitude for the aircraft's position on the approach. There were no further calls from the pilot.

Pilot information

After some years flying gliders and tug aircraft, the pilot trained in the USA for an FAA Commercial Pilot's Licence and Instrument Rating, which he subsequently converted in the UK to a JAR licence, issued in January 2003. At the end of that year he joined the aircraft operator, at its Oxford base, and completed conversion training on the PA-34 Seneca III in early 2004. At the time of the accident he was also qualified to fly the Piper PA-31 (Navajo Chieftain), PA-31T (Cheyenne I and II) and PA-42 (Cheyenne III), and was a Line Training Captain on the PA-34. The pilot had not flown the PA-34 since 24 August 2007, but because he had flown the PA-31 more recently and the two aircraft were of the same class, the applicable recency on type requirements were met.

From the pilot's training files, it was established that he was correctly licenced and qualified for the flight and that all recurrent training and checking had been completed. The pilot was well regarded by the operator's management team and considered to be a cautious and sensible pilot.

In the two days before the accident, the pilot had flown a PA-31T to Tenerife South in the Canary Islands, returning via Faro, Portugal, to land back at Oxford at 1655 hrs on the day before the accident. Although these were relatively long flights, his duty times were within prescribed limits and he considered himself to be well rested and in good health when he reported for duty on the day of the accident.

Pilot approach techniques

The pilot believed that he would have sought the latest ATIS weather information and given the reported overcast cloud at 500 ft, it would have been his intention to fly an instrument approach. His technique for flying a non-precision approach was to descend to MDA as soon as the procedure allowed and then to fly level until either acquiring the required visual references or reaching the missed approach point. Although he would frequently use the autopilot, he could not be sure that he would have used it during the accident approach.

The pilot believed he would have used the aircraft's GPS navigation system to assist with the approach. Using this equipment, deviation from a desired inbound course to a GPS waypoint could be selected for display on the aircraft's horizontal situation indicator, and this is what the pilot normally did. Raw NDB data would still be available, along with both DME and GPS ranges. The pilot would normally configure the aircraft with the first stage of flap prior to the approach and select landing gear down just prior to the FAF. From memory, he thought that the FAF for Runway 01 was at 7 or 8 DME.

Approach charts for a range of airfields were kept in a manual in the aircraft, which the pilot would normally position on the seat beside him. However, he kept a copy of the Runway 01 approach stuck to his kneeboard for easy reference. At interview, the pilot asserted that he would not have deliberately flown below the MDA for the approach (690 ft). However, he was unaware that the approach contained a step-down MDA of 870 ft to 3 DME. The pilot said that he had, in the past, flown the approach without reference to the published charts as he was familiar with it.

Meteorological information

The Met Office provided a report on the prevailing weather situation. A large high pressure cell was situated over the North Sea and Germany, resulting in a south-easterly airflow over the area. Although the airmass was essentially dry, low temperatures near the surface resulted in localised very low cloud and patches of mist.

Meteorological observations were made at 1650 hrs at RAF Brize Norton and RAF Benson, 18 nm from Oxford Airport. Brize Norton (elevation 288 ft) reported 4,000 m visibility in mist with broken cloud at 500 ft, while Benson reported 1,200 m visibility in mist with clear skies, which resulted in lower temperatures and hence the lower visibility. The latest usable visual satellite imagery was timed 1530 hrs, and showed low cloud or fog in the Oxford area. Given the reported winds, it is probable that the observed weather was low stratus rather than fog at this time. The atmospheric temperature structure suggested that a broken to overcast cloud base would be expected at around 800 to 900 ft amsl (around 300 ft above the hill top). The cloud tops would probably have been about 2,000 ft amsl, with clear skies above. Imagery showing cloud top temperatures suggested a very shallow sub-zero temperature layer may have existed at the top of the cloud layer.

The Oxford ATIS code "K" for 1620 hrs was applicable at the time of the accident. This gave a surface wind from 060º/10 to 15 kt, visibility of 3,500 m in haze and overcast cloud at 500 ft (770 ft amsl). The ATIS broadcast concluded with the instruction "ON INITIAL CONTACT WITH OXFORD ATC CONFIRM THE QNH AND INFORMATION KILO RECEIVED". Air traffic controllers and other flying staff at Oxford generally agreed that both cloud base and visibility gradually reduced during the afternoon, and probably reached their worse at, or not long after, the time of the accident.

Weather assessments were sought from pilots of other aircraft, including the crews of the two helicopters involved in the search. The pilot of an executive jet which landed 10 minutes before the accident recalled that he entered cloud at about 1,000 to 1,200 ft on the approach to Runway 01, and that there was no cloud immediately above this layer. No ground lighting was seen until the runway lights were sighted very late on the approach, with the aircraft at MDA. Pilots of each of two helicopters which were involved in the search for G-LENY reported a cloud base at about 700 ft initially, with a mix of very low cloud and fog. By 1830 hrs, the low cloud had largely dispersed, but ground fog persisted.

Air Traffic Control procedures

Oxford Airport was not equipped with radar, so Approach Control was procedural only. At the time of the accident the Tower and Approach positions were combined, operated by a single controller. A Letter of Agreement between RAF Brize Norton ATC and Oxford ATC detailed the air traffic procedures to be applied between the two units in respect of aircraft operating to and from Oxford Airport. Brize Norton ATC normally provided a Lower Airspace Radar Service to aircraft in the area, as well as a service to departing and arriving Oxford aircraft when controller workload permitted.

The Letter of Agreement listed three options for aircraft making an instrument approach to Runway 01. They were:

a. A radar vectored diverse approach onto the final approach track,
b. A radar vectored approach to the FAF from the 'OX' holding pattern,
c. A procedural approach from overhead the 'OX' NDB.

The radar vectored approaches were listed as the preferred options; there were no 'self-positioning' or 'straight in' options.

Responsibilities of the Brize Norton and Oxford controllers were listed in the Letter of Agreement for radar vectored and procedural approaches to Runway 01. In the case of a radar vectored approach, the Brize Norton controller was to obtain clearance from Oxford ATC for the approach and then to vector the aircraft to a 7 nm final approach point at 1,800 ft on Oxford QNH. For a procedural approach, the same controller would be required to issue a clearance for the full approach and notify Oxford of any relevant traffic information.

There was some ambiguity in the procedures relating to weather information at the time of the accident. The Letter of Agreement was subsequently amended to the effect that the Brize Norton controller would confirm that inbound pilots had received the latest ATIS information.

When the operator's management pilots were asked about instrument approach procedures at Oxford, they replied that inbound aircraft would often be allowed to self-position to final approach and to descend at the pilot's discretion to the intermediate altitude of 1,800 ft. The pilot of G-LENY also stated that this was the case.

Search and Rescue (SAR) activities

The pilot's last transmission was at 1709 hrs. When the aircraft had not landed after five minutes, and the pilot had made no further transmissions, the controller attempted unsuccessfully to contact the aircraft. She alerted Brize Norton ATC to the situation, who also attempted to contact the aircraft. The Brize Norton Approach controller alerted the Distress and Diversion (D&D) Cell at the London Area Control Centre, whilst the controller at Oxford alerted the local emergency services. She also requested that a Police Air Support Unit helicopter be made available but this was not possible due to fog at its RAF Benson base.

The crew of a private S-76 helicopter which was flying through the Brize Norton area was asked by Brize Norton ATC to assist with the search for the missing aircraft. The crew flew the helicopter along the approach and immediate go-around tracks for Runway 01 but reported that the weather was very poor and that they could not locate the aircraft. Meanwhile, D&D were able to establish the aircraft's last radar position, which was passed via Brize Norton to the helicopter.

The crew eventually located what was possibly a fire but this was under dense fog so could not be confirmed as such. The position of this was passed to Brize Norton who relayed the information to the Area Rescue Co-ordination Centre (ARCC) at RAF Kinloss, shortly before fuel considerations forced the helicopter to resume its onward flight. The position reported by the S-76 crew was later confirmed as being that of the crash site.

An S-61 SAR helicopter from Lee-on Solent on the south coast was tasked by the ARCC via the Maritime Rescue Co-ordination Centre (MRCC) at Southampton. The helicopter was scrambled at 1818 hrs and lifted off at 1825 hrs. The crew encountered worsening conditions as they neared the accident area and decided to fly an instrument approach at Brize Norton before assessing the weather and the available search options. The helicopter remained on the ground for about 15 minutes before the cloud base, which was estimated to be varying between about one and two hundred feet during this time, lifted sufficiently to allow the search to begin. The helicopter eventually took off again and reported "on scene" at 1940 hrs.

When the S-61 arrived in the search area, the low cloud had dispersed and the crew could clearly see the runway lights at Oxford. With the aid of infra-red (IR) and night vision equipment, they could see search teams in the general area but not the crash site itself. Fog persisted in the accident area, and the moist conditions reduced the effectiveness of the IR equipment. It was not until an improvement in the conditions allowed the helicopter to safely descend lower that, at 2015 hrs, a positive identification was made of the aircraft wreckage and of the pilot lying close by. Ground search teams were directed to the site before the helicopter finally departed the scene at 2045 hrs.

Actions by the aircraft operator

The operator's senior flight operations staff indicated that the company had a policy whereby a non-precision approach should be flown as a continuous descent approach (CDA), observing the recommended profile if one was published. However, this policy was not reflected in written procedures in the operations manual. The pilot of G-LENY had been advised during a past proficiency check to adopt a CDA procedure for non-precision approaches, although he had chosen to continue using his favoured 'step down' technique. The operator had identified the lack of formal procedures and was in the process of introducing written Standard Operating Procedures (SOPs) during the investigation.

Analysis

General

The aircraft crashed during a non-precision approach at night and in poor weather, after descending below the step-down fix MDA applicable to the initial part of the approach. The aircraft travelled for a substantial distance after it first hit the trees, level or in a shallow descent at first. Damage to the trees and condition of the propellers indicated that both engines were producing power during the accident sequence.

The pilot had been navigating the aircraft satisfactorily until the point that radar contact was lost and, although it was begun early, the final decent was steady and controlled. The aircraft was correctly configured for the approach and flying in trim at the correct airspeed. The pilot had been in contact with ATC and made his last call only 11 seconds before the time at which it was calculated that the aircraft hit the trees. The pilot gave no indication at any point that he was managing an abnormal or emergency situation.

If a technical malfunction or failure had caused the accident, it either occurred after the pilot's last radio transmission or he was unaware of its presence. Had such an event occurred, it did not cause a significant change to the aircraft's ground track or descent profile after the aircraft was lost from radar. The aircraft appeared to have been in controlled flight when it hit the trees. Had an engine failure occurred (though there was no evidence of such), it obviously did not lead to a loss of control. The aircraft would have been capable of climbing with one engine failed.

Survivability

The pilot was extremely fortunate to survive the accident. Damage to the upper forward door, which became detached, pointed to significant disruption of the forward right fuselage structure and windshield. From the pilot's burn injuries and the place he was found, it is most likely that he escaped from the disrupted fuselage after impact, rather than being thrown from it.

Flight instruments

The flight and navigation instruments were destroyed in the post-crash fire, along with a substantial amount of the pitot/static system, so could not be examined. However, a number of related scenarios were considered. These were: incorrect altimeter setting, altimeter misreading, pitot/static system problem, and erroneous navigational indications.

When the pilot first contacted Brize Norton ATC, he said he was flying with reference to the Oxford QNH, and the radar data showed that the aircraft descended to, and maintained, the correct indicated altitude prior to its final approach. The pilot had recently been flying aircraft equipped with single-pointer altimeters, and the potential for misreading the more complicated three pointer arrangement is widely recognised. However, the aircraft levelled correctly at an indicated 1,800 ft prior to the approach, and a subsequent misreading during the final descent was unlikely. This is because, at almost any point on the final approach, if the pilot had mistakenly added 1,000 ft to the indication, the resultant value would have been above the starting altitude, and hence would have been nonsensical[2].

It is unlikely that the pitot/static system was affected by icing. The airmass was dry, possible exposure to icing conditions would have been very brief, and the aircraft was not normally susceptible to icing-related instrument problems. An iced or otherwise blocked static line would also have affected the other pressure instruments and Mode C altitude encoder, but no unusual parameters were seen on radar. It was not possible to rule out an internal altimeter malfunction or complete static line blockage in the critical last stages of the flight, after the aircraft had been lost to radar. However, the descent profile does not easily support it and the 'window of opportunity' after radar data ceased is so narrow as to make the scenario improbable. A standby altimeter provided an indication cross-check.

The aircraft was being navigated correctly with reference to the inbound course but descended about 2.3 nm before the correct final descent point. The pilot's range call of 4.5 DME was within 0.2 nm of the actual range, so an erroneous range display is unlikely. Additionally, two separate range sources (DME and GPS) were available to the pilot. If Oxford Airport had been selected as the reference GPS waypoint, the indicated range would have over-read by only 0.3 nm, and would have placed the aircraft closer to the runway than the equivalent DME range. This would account for the slight discrepancy described above.

CFIT factors

Although the pilot had not flown the aircraft type since the previous August, he met the recency requirements for that class of aircraft. He was in current flying practice and, by the time the aircraft started its final approach, had flown the aircraft that evening for more than two hours, including two approaches and landings. It was therefore considered that recency on type was not a factor in the accident. Recorded transmissions showed that the pilot had not become incapacitated.

The poor weather and consequential lack of ground reference, was almost certainly a major contributory factor in the accident. Although the pilot did not acknowledge receipt of the ATIS weather information, it is probable that he had received it, as he correctly quoted the QNH on first contact with Brize Norton. However, neither the controller at Brize Norton nor Oxford challenged the pilot for the correct ATIS code, nor passed him any weather update.

When the pilot contacted Brize Norton ATC, his request for "POSITIONING FOR STRAIGHT IN FOR ZERO ONE" was ambiguous because he did not state whether he desired radar-vectoring or self-positioning. Given that the Oxford weather was available to the Brize Norton controller (and was similar to that at Brize Norton), it could be concluded that the controller knew the pilot intended flying an instrument approach. However, it should be noted that, in military parlance, a request for a 'straight in' approach is taken to be a request for a visual approach. Self-positioning for the approach was not an option under the Letter of Agreement, yet the Brize Norton controller allowed the pilot to continue with this type of approach, effectively issuing no more

Footnote

2 Although not identified as a contributory factor in this accident, the operator undertook a fleet-wide standardisation of altimeter displays, converting aircraft with three pointer altimeters to single pointer displays.

than a zone crossing clearance and descent to 3,000 ft. Knowing that the pilot was not intending to fly the full procedural approach, the Brize Norton controller would also have known that the pilot would need to descend to 1,800 ft before commencing final approach, which was below the SSA of 2,300 ft. If the controller had imposed radar vectoring to 7 nm finals and 1,800 ft, it is unlikely that the pilot would have started such an early final descent or, if he had, it is possible that the controller would have seen it on radar and queried it with the pilot. When the Brize Norton controller pre-noted the aircraft to the Oxford controller, he repeated that the aircraft was "COMING STRAIGHT IN FOR ZERO ONE". The controller in effect passed on the ambiguity to the Oxford controller.

Pilot actions

From the report of the pilot who landed shortly before the accident, the pilot of G-LENY was probably clear of cloud when he let down to the intermediate altitude of 1,800 ft. The final descent, apart from starting early, appeared in all respects to be controlled and deliberate. The pilot had flown the approach from memory in the past and recalled at interview that the descent point was at 7 or 8 DME instead of the actual figure of 5 DME. However, the observed rate of descent was initially shallower than would be expected, considering the pilot's preferred method of flying a non-precision approach. Although it is therefore possible that the pilot was flying the approach from memory, it is equally possible, and perhaps more likely, that he was initially flying a mixed IF/visual approach in the belief that he would become visual with the runway before reaching MDA. It is likely that he was flying without reference to the approach chart.

At about the 5 DME point, the aircraft deviated slightly to the right of the inbound course and the rate of descent appeared to increase slightly. It is probable that this occurred soon after the aircraft entered cloud, which it is thought to have encountered at about this stage on the final approach. The deviations are unlikely to have been associated with an emergency situation, as the pilot had yet to make his final R/T call which made no mention of such. The displacement and rate of descent then remained largely unchanged until contact with the trees. Although no definite reason can be found for these slight deviations, their position and nature could very well coincide with an autopilot disconnection. If, as has been discussed, the pilot was flying a mixed IF/visual approach and encountered weather at this stage, it is quite possible that he increased the descent rate to ensure the aircraft arrived in good time at MDA, possibly disconnecting the autopilot at the same time.

The pilot's chosen method of flying the approach was a recognised technique and not inherently dangerous. However, for an approach with a step-down fix, it was less forgiving of inaccurate flying or navigational errors in that the aircraft may intentionally fly into closer proximity to terrain than would normally be the case using the CDA method.

The Runway 01 approach chart contained information which assisted pilots to fly a CDA, and a note on the chart specifically stated that pilots should employ this technique for noise abatement reasons. Had the pilot observed this instruction and adhered to the published range/altitude profile, the aircraft would have remained above the step-down MDA of 870 ft until after the 3 DME point.

The pilot was unaware that a step-down MDA existed and had flown the approach with the intention of descending directly to the procedure MDA of 690 ft. Thus, the risk of losing standard terrain separation would always have been present whenever the pilot flew the approach, as he had done many times on the past. The risk increased with an early descent, which made it much more likely that the aircraft would descend below 870 ft before the 3 DME point was passed. By starting the descent 2.3 nm early, the aircraft was placed on an almost direct flight path to the initial contact point on Wytham Hill.

Had the aircraft leveled at the procedure MDA of 690 ft, the aircraft would have cleared the trees, but with a dangerously small margin (although, in general terms, the final MDA for a 'stepped' procedure could well be below the actual elevation of obstacles earlier in the approach). The reason the aircraft did not level at or above 690 ft could not be determined but the probability is that it was due to human factors. The aircraft was correctly positioned laterally and was configured for the approach, so pilot workload would not have been excessive, particularly as the pilot was not attempting to follow the recommended profile. However, the observed flight path suggests that the pilot may not have been expecting the actual weather conditions to be as bad as they were. Penetration of low cloud relatively late in the approach would have increased stress and workload considerably and could therefore have been a contributory factor.

The pilot's call at 4.5 nm (rather than at 2 nm as requested) could have been an attempt to prompt an early landing clearance, as the aircraft was approaching the final MDA of 690 ft. The controller was not constrained in issuing a landing clearance, so the request to call again when the runway lights were in sight was unnecessary and created an additional uncertainty for the pilot. The pilot's response of "WILCO" indicates that he was not visual with the lights at this stage and, from the predicted flight path, was by then just reaching 690 ft. Following this last exchange, the pilot would naturally have started looking for the runway lights and could have inadvertently descended below the MDA. There was only 11 seconds between his transmission and contact with the trees.

Conclusions

The aircraft crashed during a non-precision approach at night and in poor weather, after descending below the MDA applicable to the initial part of the approach. The available evidence indicated that the aircraft made contact with the trees in a normal approach attitude and configuration, whilst under control and under power, and that the pilot then lost control as a result. Recorded data indicated that standard approach procedures had not been adhered to and the aircraft descended directly into contact with the trees. No evidence was found to suggest that a technical malfunction or defect had contributed to the accident, although this could not be ruled out. If a technical fault did play a part, it is likely that this was limited to a distraction at a critical stage of the approach. Had this occurred when the aircraft was below the applicable MDA, any transient loss of height would have been critical.