TRANSPORT ACCIDENT INVESTIGATION COMMISSION
TE KOMIHANA TIROTIRO AITUA WAKA

AIRCRAFT ACCIDENT REPORT

No. 92-013

Aerospatiale AS 350B

ZK-HST

Poolburn, Central Otago

7 July 1992

Transport Accident Investigation Commission
Wellington · New Zealand

Price $11.10 (including G.S.T.)

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Aircraft Type, Serial Number and Registration:	Aerospatiale AS 350B, 1625, ZK-HST
Number and Type of Engines:	1 Turbomeca Arriel 1B
Year of Manufacture:	1982
Date and Time:	7 July 1992, 0942 hours NZST
Location:	Poolburn, Central Otago Latitude: 45°08'S Longitude: 169°43'E
Type of Flight:	Aerial Work — Survey
Persons on Board:	Crew: 3
Injuries:	Crew: 1 Fatal, 2 Serious
Nature of Damage:	Destroyed
Pilot in Command's Licence:	Commercial Pilot Licence (Helicopter)
Pilot in Command's Age:	39
Pilot in Command's Total Flying Experience:	8930 hours 5001 on type
Information Sources:	Transport Accident Investigation Commission field investigation
Investigator in Charge:	Mr Alister Buckingham

1. NARRATIVE

1.1 ZK-HST was operated by Hele-Tranz Ltd, and was engaged in an Aeroplan NZ Ltd survey of Central Electric's distribution system. During the course of mapping a roadside 11 kV line, the helicopter collided with the Roxburgh-Islington A 220 kV line.

1.2 The airborne survey was being conducted by a crew of three — the pilot, a technician (who was also a commercial helicopter pilot) and a line surveyor from the electrical supply authority. The surveyor had an intimate knowledge of the local distribution network, and was acting as a guide and supplementary lookout.

1.3 The survey equipment consisted essentially of a GPS (Global Positioning System) satellite receiver linked to an onboard computer, which also interfaced with a video recording system. The forward-facing video camera was mounted on the underside of the helicopter, and was controllable in elevation and zoom through the technician's controls. This system produced a continuous recording from the beginning of the day's operation up to the moment of the collision with the powerline.

1.4 The video monitor was placed on the left front, or "co-pilot" seat, which had been turned to face rearwards, and secured by means of the seat belt and shoulder harness. The technician herself was seated in the left rear seat (position number 1 of four available on the full-width bench seat) where she had access to the video equipment and computer keyboard. The surveyor was seated in the inboard right rear or number 3 position, from where he had a generally adequate field of view for the task at hand, although a better view would have been available from the front seat. The bulk of the "hardware" was stowed beneath the rear seats.

1.5 ZK-HST was equipped with an intercom system, permitting direct voice communication between the crew members, all of whom were wearing headsets during the survey flight. The microphone for the video soundtrack had been sandwiched between the earphone cups of a spare headset, but the directional properties of the microphone resulted in a low quality recording of the intercom conversation. However, a useful side effect was the recording of the background noise in the cabin area.

1.6 Apart from the task of flying the helicopter exactly above the line being surveyed, at as constant a height as possible (generally about 10 feet above the line), the pilot was required to log positions by means of a push-button switch mounted on his cyclic control. This automatically recorded the GPS position in the computer, while a continuous position and time overlay was also recorded on the video. In this manner, the exact position of each individual pole in the network was to be recorded, together with the position at which the supply entered each consumer's premises.

1.7 The helicopter and crew arrived in Alexandra on Friday 3 July, and spent the weekend setting up the equipment and conferring with the customer as to the conduct of the survey. The first day's operations, planned for Monday 6 July, were curtailed by technical difficulties, and flying was limited to a number of short flights to test the equipment and practise the actual position-logging technique.

1.8 That evening, a comprehensive briefing on the next day's activities took place, which was attended by the pilot, the survey operators (including the technician) and the line surveyor. During this briefing it was agreed, after discussing the line surveyor's experience in helicopter operations, and in view of his comprehensive knowledge of the distribution network, that he would act as both "navigator" (i.e. in terms of ensuring complete network coverage) and as a supplementary lookout. During the trials, the pilot had found that the precise positioning of the helicopter above the line being surveyed and the position marking of the poles required his full attention. Essentially his visual scan was continuously restricted to the area immediately to the lower front of the helicopter.

1.9 The area to be surveyed was defined at the briefing, and was constrained by the coverage of the GPS telemetry link which had been sited at Alexandra Aerodrome. A number of these sets had been deployed around the district, and to ensure thorough coverage, had been placed on Central Electric's VHF radio-telephone repeater sites. However, as it was found that the VHF equipment caused interference to the GPS signals, the sets were removed pending more satisfactory siting. The set at Alexandra Aerodrome was an interim arrangement, so its performance was to be monitored as the task progressed.

1.10 The initial part of the survey was thus restricted to the Manuherikia Valley area, as without the telemetry link, the required degree of precision would not be obtainable. The intention was to proceed with the survey until the helicopter required refuelling, which would be performed back at Alexandra Aerodrome. At this time the survey crew was to decide whether or not the ground station was to be moved; relocation would have also required further briefing of the flight crew.

1.11 The video recording showed the operation commencing on the outskirts of Alexandra at 0819 hours, shortly before sunrise. The weather was fine, calm and clear, with a heavy frost evident. The operation proceeded as planned, initially following the 33 kV line from Alexandra to Omakau. This line is crossed by the Roxburgh-Islington A line about one nautical mile north of Alexandra, and the video recording showed the aircraft safely crossing above this line at 0823 hours.

1.12 There is no doubt that the crew was aware of the presence of the 220 kV transmission line, and that it was a significant consideration in the task ahead. The surveyor carried a set of line network maps, with the lines to be surveyed highlighted in yellow, and the 220 kV line in orange. Apart from the crossing described in paragraph 1.11 above, there were no further crossings in the planned task segment; however there were nine crossings in the Ida Valley area, which would have been surveyed later that day. Both the Manuherikia and Ida Valley areas were depicted on the same map. At intervals on the video soundtrack, the rustling of paper can be heard, and it is assumed that this is the surveyor checking his maps, which were the only sizable paper items found at the accident scene.

1.13 The 33 kV line was followed without incident as far as Ophir, from where a series of branch lines to the north-east was mapped. As these lines were generally short in length, the amount of manoeuvring required increased substantially in this area. The mapping in the Ophir area occupied 27 minutes, after which the helicopter set off along the Omakau-Poolburn line across the

Raggedy Range. There is no indication from the video sound track as to why this course was chosen, when it was not part of the initial plan. In fact, when the ground party learned later of a helicopter accident in the Poolburn area, they initially discounted the possibility of ZK-HST's involvement, as Poolburn was outside the briefed area.

1.14 The helicopter arrived in the Poolburn area at 0916 hours, and several lines in the area were successfully surveyed. At 0926 hours, a call was received from Central Electric's Chief Engineer, who passed a message from a deer farmer offering advice on overflying deer herds. Shortly after this, the technician was obliged to call the survey ground party, to resolve an anomaly in the data displays. During these calls, the pilot climbed to and held at an altitude estimated between 500 and 1000 feet agl, for 10 minutes.

1.15 The survey resumed at 0936 hours, and at 0940 hours the helicopter arrived at a road junction about 500 m west of the accident site. The lines leading to the two residences on the corner were mapped, this involving several quite rapid turns with heading changes totalling some 900° in 55 seconds. As this represents an average turn rate of 16° per second, the potential existed for temporary disorientation of the non-flying crew members.

1.16 While the aircraft was in this vicinity, it was observed by several witnesses. The children at one of the houses waved to the helicopter as it flew over, and one of them stated that "the man in the back waved". It was established from the video recording that at this point the helicopter was being aligned with the roadside line again, having completed logging the residential lines. From this position it continued in an easterly direction, following the roadside 11 kV line. On the videotape soundtrack, the rustling of paper could be heard for some seconds, starting part-way round the final turn and lasting until the helicopter was well established on the roadside line again.

1.17 Some 20 seconds after leaving the last residence, the helicopter collided with the three conductors of the 220 kV transmission line which crossed 24 feet above the roadside line. The first conductor was severed by the main rotor blades, and the other two were substantially damaged. Each conductor comprised a seven 3.71 mm strand steel core, surrounded by thirty 3.71 mm aluminium strands, with an overall diameter of 26 mm. Situated immediately beneath the span of the 220 kV conductors was a 26 foot high pole, supporting the roadside line. The pilot's attention would necessarily have been focussed on this pole in preparation for marking its position. From the navigation data available, the groundspeed at the collision point was calculated as approximately 45 knots.

1.18 The reactive forces of the rotorstrike were sufficient to tear the transmission and engine bodily from the airframe, which then fell to the ground through the 2-wire 11 kV line, striking the adjacent boundary fence in an approximately level attitude some 45 m past the collision point. One concrete fencepost was snapped at its base, and several metres of the fence were flattened. The fuselage section came to rest inverted on the remains of the fence.

1.19 At least two witnesses saw the impact. Their description of the flight path was confirmed by the video evidence, in that the helicopter appeared to take no evasive action prior to the collision; neither was there any prior warning audible on the soundtrack. The witnesses immediately alerted the local emergency services. The first person on the scene was the farmer on whose property the accident occurred, and he was joined soon after by two of his neighbours. They found that the surveyor had already died, but the pilot was still alive, suspended upside down in his combined lapbelt and shoulder harness. Together, they were able to extricate the injured pilot and carry him on one of the cabin doors to the opposite side of the road.

1.20 The seriously injured technician was not noticed for some time after the emergency services arrived at the scene. A fireman, trying to account for a single boot he had found on the roadway, searched under the wreckage and located her. She was on the ground beneath the helicopter, hidden beneath some loose items from the baggage lockers. The pilot had been saying repeatedly to his rescuers "two", meaning that there were two others on board, but evidently this was interpreted as meaning a total of two on board.

1.21 The pilot was taken by ambulance to Dunstan Hospital and transferred to Dunedin later the same day; he was discharged after four days. The technician was flown by helicopter directly to Dunedin, from where she was transferred to Auckland some weeks later.

1.22 The forward part of the cabin roof was destroyed by the fence as the aircraft rolled onto it; however, the fence also limited the degree of rollover sufficiently to keep the pilot's seat clear of the ground, averting more serious injury to its occupant. The two rear seat crew members, seated with their backs to the rear cabin bulkhead, were restrained by lap belts only. Despite there being less damage to this area than the front portion of the cabin, both received severe injuries consistent with lack of upper body restraint. Additionally, none of the three occupants of the helicopter had been wearing a protective helmet. It was subsequently recommended that protective helmets and suitable protective clothing be worn on this type of operation, and that the availability of shoulder harness kits for the rear positions be investigated.

1.23 The survey method described in this report had been developed by Aeroplan NZ Ltd and had generated considerable interest in several electrical distribution authorities. The Central Otago survey was the first of its type to be conducted in New Zealand. Although the operation was planned carefully, this accident has revealed a number of potential problems.

1.24 One was the sustained high level of concentration required of the pilot. The length of the planned sortie during which the accident occurred was dictated by the helicopter's fuel endurance, and would thus have been about three hours. Although the accident occurred less than $1^1/_2$ hours after departure, this was probably approaching the upper limit of a pilot's sustained attention span for the given task. A safety recommendation was made to the effect that a short break be planned at hourly intervals on this type of operation.

1.25 A second potential problem was the provision of a lookout who was familiar with both the network and helicopter operations. The line surveyor had previously operated with and flown in helicopters in the course of his work, but it was not established to what extent. His role on the flight was primarily to ensure network coverage, and at the task briefing, it was decided to use him in the additional role of supplementary lookout in light of his extensive knowledge of the network and his previous helicopter experience. The pilot was not familiar with the Central Otago area, and it is clear from parts of the intercom conversation on the video soundtrack, that the surveyor was keeping the pilot progressively briefed on the route to be followed.

1.26 However, as some customers may be unable to supply an observer with sufficient experience, it was recommended that a second pilot be utilised on these operations. The use of an additional pilot would have a secondary benefit if adopted together with the recommendation for hourly breaks, in that flying and lookout duties could be alternated. It was also recommended that if using a non-pilot observer, that person be seated in the second pilot position.

1.27 The pilot in command and the survey company were satisfied with the lookout arrangement on this task, and the flight to the Ophir area proceeded as planned. The pilot could not remember why the flight then proceeded to the Poolburn area, and despite laboratory analysis no indication was able to be gleaned from the videotape soundtrack. The earlier crossing of the 220 kV line just north of Alexandra was the only one anticipated on the first sortie, and may have induced a "mind-set" in the crew that the overhead lines were no longer a hazard. Changing the planned task may have caused the crew to proceed into an area containing known hazards, with the "mind-set" appropriate to the previous plan. Accordingly, it was recommended that any diversion from the planned task be preceded by a re-briefing.

1.28 Since the accident, the survey company has devised a software modification, whereby the coordinates of known hazards, such as the 220 kV transmission line towers, can be inserted in the computer before commencing the task. If the surveying aircraft approaches within a preset distance of the hazard, the computer produces an on-screen and audio warning.

2. FINDINGS

2.1 The pilot was appropriately licensed and experienced for the task.

2.2 The helicopter was functioning normally until it collided with the 220 kV conductors.

2.3 The pilot was fully occupied with positioning the helicopter accurately and recording spot positions.

2.4 The pilot had delegated the function of supplementary lookout to the surveyor.

2.5 The surveyor would have been able to perform this function better had he been seated in the second pilot position.

2.6 The accident occurred outside the survey area for which the crew had been briefed.

2.7 The reason for the departure from the planned area could not be established.

2.8 The 220 kV conductors were not sighted prior to the collision.

2.9 The surveyor may have been temporarily disoriented by the manoeuvres immediately preceding the accident. He may also have been distracted by the need to refer to his map at a critical moment.

2.10 The injuries to the crew would have been less severe had protective helmets been worn, and had shoulder harness been available to and worn by the rear seat occupants.

2.11 The causes of this accident included a decision to fly beyond the area for which the crew had been briefed, the continuous high degree of precision flying at low level which effectively restricted the pilot's attention to the immediate front of the helicopter, and possible disorientation of the crew by manoeuvring prior to the accident. The extended period of demanding flying without a rest period was a probable contributing factor.

3. SAFETY RECOMMENDATIONS

As a result of this accident, it was recommended to Hele-Tranz Ltd that:

They consider the use of protective helmets and suitable protective clothing for all personnel on board, when conducting operations of this type.

They investigate the availability of shoulder harness kits which can be retrofitted to the rear passenger positions of the AS 350B.

They consider the carriage of a second pilot to act as lookout on these operations.

If using a suitable observer instead of a second pilot, seat the observer in the second pilot position.

During preflight briefings for these operations, they stress the importance of not departing from the planned task without a re-briefing.

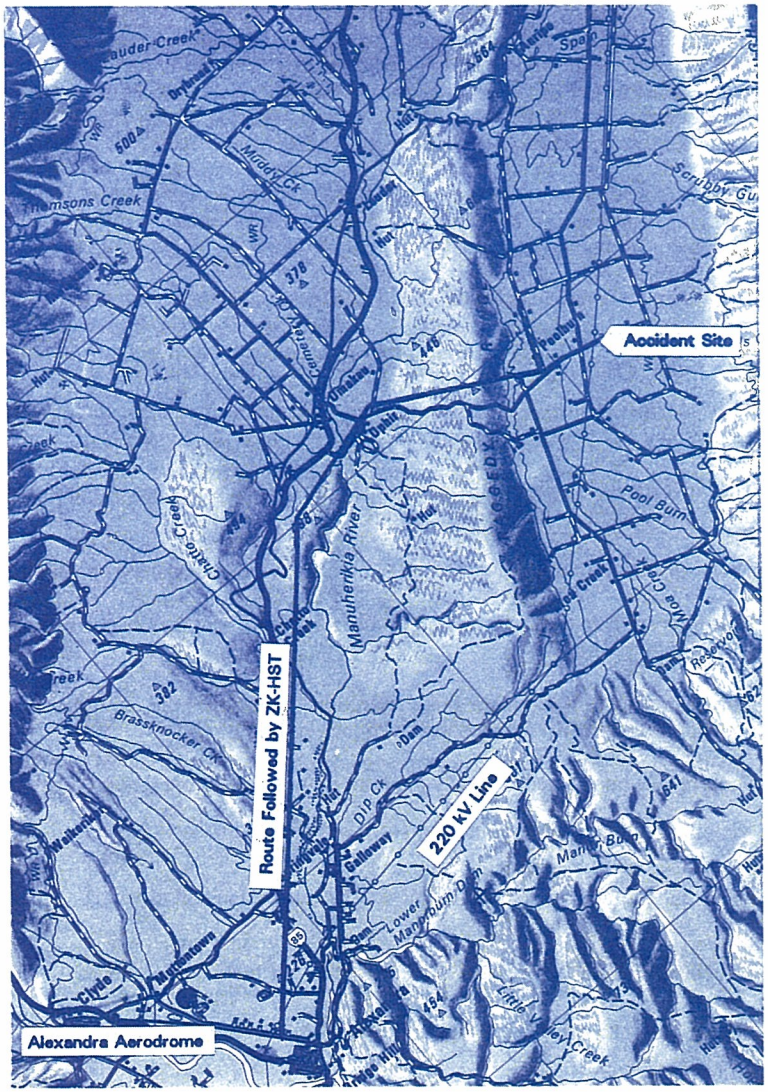
Short breaks be planned at hourly intervals on this type of operation.

11 February 1993

M F DUNPHY
Chief Commissioner

AREA OF OPERATIONS: ZK-HST

(Localised Manoeuvring not depicted)



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