Department of Trade

ACCIDENTS INVESTIGATION BRANCH

Westland Sea King MK41 89-61

Report on the accident at Yeovil Airfield, Somerset on 16 January 1974

LONDON: HER MAJESTY'S STATIONERY OFFICE
1975

List of Aircraft Accident Reports issued by AIB in 1975

No	*Short title*	*Date of publication*
1/75	Beechcraft 95 – B55 (BARON) G-AZZJ at Cholesbury cum St Leonards, Bucks., January 1974	May 1975

ISBN O 11 511419 X

Department of Trade
Accidents Investigation Branch
Shell Mex House
Strand
London WC2R 0DP

16 January 1975

The Rt Honourable Peter Shore MP
Secretary of State for Trade

Sir,

I have the honour to submit the report by Mr G C Wilkinson, an Inspector of Accidents, on the circumstances of the accident to Westland Sea King MK41 89-61 which occurred at Yeovil Airfield, Somerset on 16 January 1974.

I have the honour to be
Sir
Your obedient Servant

W H Tench
Chief Inspector of Accidents

Accidents Investigation Branch
Aircraft Accident Report No 2/75
(EW/C476)

Aircraft:	Westland Sea King MK41 89-61
Engine:	Two Rolls Royce H.1400 Gnome
Registered Owner and Operator:	Westland Helicopters Ltd Yeovil, Somerset
Crew:	Commander: – Uninjured Flight Test Observers: 4 – Uninjured
Place of Accident:	Yeovil Airfield, Somerset
Date and Time:	16 January 1974 at 1218 hrs All times in this report are GMT

Summary

The helicopter was undergoing a test flight in strong, gusty wind conditions. Whilst carrying out a low level circuit on Yeovil airfield, airspeed fell off markedly and a high rate of descent developed with the helicopter heading down wind. The pilot applied maximum power but unintentionally raised the collective pitch lever too far and an overpitched condition was reached at too low a height to permit a safe recovery. The helicopter touched down in a field adjacent to the airfield boundary, still heading down wind, struck a building and crashed. The crew of five escaped unhurt.

1. Investigation

1.1 History of the flight

The aircraft had been manufactured by Westland Helicopters Ltd for the Federal German Navy and was scheduled to make a pre-delivery test flight on the morning of 16 January to establish the consistency of the torque matching of the two engines.

The flight was made with the auto-stabilisation equipment (ASE) engaged throughout. The aircraft called for take-off clearance at 1201 hrs and was informed that the wind was southwesterly 20 knots gusting to 40 knots by Yeovil Air Traffic Control (ATC). The aircraft then took off and flew to the northwest corner of the airfield to carry out the test programme. The flight pattern on each test consisted of a take-off, pausing at 30 feet, and a vertical climb to 200 to 300 feet. A transition to forward flight was then made and followed by a descending left hand circuit to return for a landing. Three such brief circuits were carried out without mishap. During the first, at 1204½ hrs ATC informed the pilot that the wind was then gusting up to 50 knots. The pilot stated that the fourth circuit was flown at a bank angle of 15 to 20° and an airspeed of 60 knots. The flight proceeded normally until the helicopter, still in a turn, was heading approximately downwind. At this time the pilot believed the helicopter was still banked 15 to 20° to the left, 150 to 200 feet above ground level (AGL), with an airspeed of about 60 knots. However, he was not sure of the preciseness of any of those figures as they representated a general impression rather than noted flight instrument readings. The pilot considers that at this point he became aware that he was instinctively applying an increasing amount of power to maintain his intended descent flight path and that immediately after this he realised that despite the application of the maximum attainable power of 120 per cent torque he was unable to arrest the rapid rate of descent. At about this time he was heard to exclaim over the intercom 'Christ I've overpitched' and he recalls observing a rotor speed of 90 per cent, although he could not say whether the latter figure was the minimum reached or for how long a low rotor speed had pertained.

He immediately levelled the aircraft laterally and lowered the collective pitch lever to regain the loss in rotor speed and the aircraft then made a downwind touch down in a field adjoining the north west corner of Yeovil airfield. It ran for about 170 feet on a slightly curved path to the right before striking the steel frame of a building under construction. At this point the main rotor was severely damaged and the tail section broke off, whilst the rest of the fuselage travelled a further 100 feet before coming to rest on its left side. There was no fire and the crew escaped without injury.

The pilot has stated that during the entire flight there was no sign of any technical failure or malfunction and that he had full control of the helicopter apart from being unable to arrest the loss of height experienced. But he and the flight test observers, who were concerned solely with engine behaviour during the flight, were certain that there had been no engine malfunction, surge, or loss of power.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Others*
Fatal	–	–	–
Non-fatal	–	–	–
None	5	–	

1.3 Damage to aircraft

The aircraft was damaged beyond economic repair.

1.4 Other damage

Damage was caused to the steel frame of a building under construction in a field adjacent to the airfield.

1.5 Crew information

1.5.1 *Pilot*

Age:	49 years.
Licence:	Commercial Pilots Licence (Helicopters) – valid until 29 March 1976.
Last medical examination:	9 October 1973 – valid until 30 April 1974.
Total hours as pilot:	5,778.
Total hours on helicopters:	4,027.
Total hours on Sea King:	850.
Total hours last 28 days:	11.50 (all on the Sea King type) .

1.5.2. *Flight Test Observers – 4, all uninjured*

1.6 Aircraft information

Sea King MK41 markings 89-61 had been manufactured by Westland Helicopters for the Federal German Navy (FGN) and at the time of the accident was owned and being operated as a civil aircraft by Westland Helicopters in accordance with the 'B' Conditions laid down in the Air Navigation Order 1972 (ANO) Para 3(c)(ii). The identification markings were those of the FGN.

It first flew on 10 January 1974, but as an engine had to be changed after the first flight the original certificate of fitness for flight was rendered invalid. However, subsequent to the inspection of the newly installed engine and a re-inspection of the aircraft a new certificate of fitness for flight was issued on 11 January. From 11 January until 15 January, the aircraft completed 4 test flights but during the last flight on 15 January a 7 per cent difference in the indicated torque of the two engines was noted.

The following day (16 January) the aircraft was refuelled with Avtur and on the accident flight took off with 4,891 lb of fuel at the maximum total weight authorised of 20,500 lb, and centre of gravity 8.578 inches aft of datum, which was within the specified limits, in order to re-check the engine torque figures.

Up to the time of the accident the aircraft had carried out 6 flights of the test programme and no unusual or serious defects had been experienced or recorded throughout its total flying time of 3 hours 5 minutes.

The engines were type H1400, number 1 MK 3010 and number 2 MK 3011 Gnome engines manufactured by Rolls Royce in September and December 1973 respectively. Both engines had operated satisfactorily throughout the test programme and although a torque mismatch of 7 per cent between the two engines had been observed on the last flight of the day prior to the accident it was considered that this was probably due to an instrument error or a slight alteration in the mechanical control to one or both engines. Further test flights were thus scheduled in order to make an accurate assessment of this minor mismatch which did not amount to an unserviceability. No unusual or serious defects had been experienced or recorded throughout the total running time of each engine since new of 3 hours 5 minutes.

1.7 Meteorological information

1.7.1. Before the flight the pilot saw a meteorological forecast for the period 0830 to 1700 hrs on 16 January issued by the meteorological office of the Royal Naval Air Station Yeovilton at 0815 hrs. The relevant sections of this were as follows:

Inference. A deepening depression centered 100 nautical miles west of Ireland is moving ENE at 45 knots. The associated cold front is moving east at 45 knots and is expected to clear the area late this morning. The area will lie in a moist strong/gale force SSW air stream which after the cold front will become unstable and WSW.

Surface Wind 210-230°/30-35 knots
gusting 45-50 knots, veering to 250-270°.

Weather Overcast. Moderate rain, heavy rain at times; later becoming cloudy with moderate/heavy showers.

Warnings Low stratus/Hill fog.

Risk of hail/thunder later gale force winds. Severe low level turbulence.

1.7.2 On start-up the aircraft was passed a wind of 210°/20 knots gusting 40 knots by Yeovil ATC, and at 1204½ hrs the aircraft was warned that the wind was then gusting up to 50 knots. A crash observation made by Yeovil ATC at 1230 hrs was as follows:

Wind:	210° 32 knots, gusting.
Visibility:	4 kilometres.
Weather:	Continuous moderate rain.
Cloud:	5/8 stratus 800 feet, 8/8 stratus 1,000 feet.
Temperature:	+ 8 °C.
QFE:	988.4 millibars.

1.7.3. As gusts of significiantly higher strengths were experienced at RNAS Yeovilton during the relevant period the Meterological Office Bracknell were asked to prepare an aftercast of the weather in the Yeovil area covering the period 1200 to 1240 hrs. It was as follows:

At 1200 hrs GMT on 17 January 1974 a deepening depression near Rosslare was moving quickly ENE whilst a trough of low pressure from the centre to near the Isle of Scilly was moving rapidly east.

Surface wind:	210° 35 to 50 knots, gusting 55 to 75 knots.
Visibility:	3,000 to 5,000 metres.
Weather:	Rain showers.
Cloud:	5 oktas to 8 oktas. Base 800 to 1,500 feet above aerodrome level.

Barometer falling rapidly.

1.7.4 The Yeovil ATC anemometer and wind vane were examined and found to be reading satisfactorily. They were sited on a pole on top of the Control Tower which is itself on the roof of a three story building. The head is 70 feet AGL and 8 feet 6 inches above the ATC roof, and buildings with a height up to about 55 feet border the tower from southwest through south to east. The anemometer was not over-sheltered, being 15 feet above all obstructions, but would have been affected by eddies, especially from the tower itself. This would not affect the mean wind registered by the anemometer but would have reduced the ratio of the maximum gust to the mean speed somewhat. The airfield lies in a slight saucer and this probably explains why the anemometer tends to under read compared with RNAS Yeovilton, which is very much more exposed.

1.7.5 The best estimate of the atmospheric conditions over Yeovil airfield at the time of the accident was as follows:

Showery, but with no precipitation at the time of the accident. Wind 210°/32 knots gusting to about 50 knots at 70 feet AGL, and 210°/47 to 52 knots gusting to 60 to 66 knots at 200 feet. In the unstable conditions pertaining marked up and down draughts associated with the shower activity might have occurred from time to time.

1.8 Aids to navigation

Not relevant.

1.9 Communication

UHF communications on 281.6 MHz were maintained between Yeovil ATC and the aircraft throughout the flight. The recording of these communications indicated that 38.5 seconds elapsed between the time the helicopter was cleared to start its last vertical climb and circuit and the time the crash was first reported on the radio.

1.10 Aerodrome and ground facilities

Not relevant.

1.11 Flight recorder

Not required or fitted.

1.12 Wreckage

1.12.1 *On site examination*

Examination of the touch down and impact marks indicated that the aircraft was travelling on a heading of 050° (M) at moderate speed when the twin tyres of its extended right main landing gear came into contact with an area of wet grass some 150 feet to the northeast of the 7 feet 6 inches airfield boundary fence. From the marks subsequently made by the aircraft's main and tail wheels it was evident that the right main wheels were braked and the tail wheel castoring as the aircraft continued to turn further to the right.

After travelling some 170 feet after touchdown the aircraft slewed fairly rapidly to the right. This movement brought the tail pylon and the outer portion of the rotating main rotor blades into contact with a vertical steel girder forming the corner of a building under construction. The force of the impact wrapped the tail pylon around the girder, broke the drive to the tail rotor, disrupted its blades, and caused the tail pylon to become detached. As the aircraft travelled closer to the girder the outer portions of the rotating main blades continued to strike the girder thus progressively reducing their length.

Consequent upon the separation of the tail pylon the forward fuselage rotated to the right and then started to travel in a progressively tail first direction for about 100 feet before rolling over to the left, causing the already shortened but still rotating main blades to strike the ground, bend upwards and break off. Detachment of the blades then allowed the helicopter to roll further to the left causing the left sponson and strut to collapse as the aircraft finally came to rest on its left side but facing in the reverse direction of its approach. No fire occurred but the aircraft was damaged beyond economic repair.

1.12.2 *Subsequent examination*

After the wreckage was removed to the manufacturers premises the airframe, engines, and all systems were further examined. The extent of the damage precluded a functional check of the systems but the examination revealed no sign of any pre-crash damage, mechanical failure, or malfunction in the airframe, engines, or systems.

Examination of the engines led to the conclusions that both engines were alight with their gas generators running at not less than 22,500 RPM (58 per cent Ng) when the main rotor blades struck the building. It was also established that the engine and rotor tachometers and the torquemeter instruments were still serviceable. Tests of the two engine fuel computers and flow control units showed that both were operating in accordance with the requirements of the test schedule.

After temporary repairs had been made to the crash damaged airspeed indicating system the aircraft pitot and static lines were subjected to the standard pressure test and this showed that both the captain's and the co-pilot's systems were unobstructed and free from leaks. The duplicate airspeed and vertical speed indicators and the altimeters were found to be still serviceable.

1.13 Medical and pathological information

Not applicable.

1.14 Fire

There was no fire.

1.15 Survival aspects

The aircraft came to rest on its left side and workers near the scene reached it within seconds. They found that the cockpit right-hand roof window was broken so they attacked it with tools and completed the removal of the glass. The crew escaped through this aperture instead of the emergency exits, under the supervision of the pilot who made his exit last of all.

One of the fire section landrovers ('Crash 4') was in the northwest corner of the airfield at the time of the accident and saw the helicopter crash but could not reach the site, which was 100 yards from the northwest airfield gate, as the vehicle did not carry a key to unlock the gate. The fire crew therefore scaled the fence and arrived at the aircraft as the crew climbed out.

The accident was seen by ATC who sounded the crash alarm at 1218 hrs. The airfield fire section responded at once and a Carmichael Redwing long wheel base Landrover crash tender ('Crash 1') and a Nubian appliance ('Crash 2') were despatched. Yeovil is a grass airfield without a perimeter road and the surface is soft for about five months a year. 'Crash 1' was able to traverse it and go straight to the accident site via the north-west gate (for which the vehicle carried a key as part of its standard equipment) and arrived at about 1222 hrs. The Nubian was also driven onto the airfield but nearly became bogged down after some fifty yards travel and was then reversed onto the air-field dispersal area and driven to the scene on public roads, arriving at about 1228 hrs. However the driver (the Chief Fire Officer) did not possess a heavy goods vehicles licence and so could have refused to take this vehicle onto the public highway.

The fire section ambulance could not turn out as there was no driver available because two firemen, one of whom was nominated as the ambulance driver, were in 'Crash 4' when the alarm sounded. The Westland works ambulance responded to the emergency call but became bogged down on the airfield. Since the fire section ambulance was a similar model, the Chief Fire Officer considered that the same fate would have befallen it had it been used.

1.16 Other information

Examination of the possible flight path from the take-off point to the first ground impact marks show the diameter of the 180° turn downwind to have been about 310 feet, whereas a co-ordinated turn with 20° of bank would have a diameter of approximately 1,700 feet, notwithstanding the wind.

2. Analysis and Conclusions

2.1 Analysis

2.1.1 The evidence is that the helicopter was fully serviceable at the start of the flight. The crew were aware of no technical failure or malfunction, nor was any sign of one found in the examination of the wreckage. Thus it is considered that the accident was not caused by a technical failure or malfunction.

2.1.2 At the time of the accident the weather was showery, with no precipitation. The wind was 210°/32 knots gusting to about 50 knots at 70 feet AGL, and 210°/47 to 52 knots gusting to 60 to 66 knots at 200 feet.

2.1.3 While the pilot believes that the 180° turn after the transition was made at a bank angle of 15 to 20° and an airspeed of 60 knots the diameter actually achieved was about 310 feet, whereas a co-ordinated turn at 20° bank would have had a diameter of approximately 1,700 feet. Assuming that the turn was properly co-ordinated this indicates that either the bank angle was significantly in excess of 20° or a large part of the turn was made at an air speed much lower than 60 knots or, most likely, a combination of both. A turn involving 30° of bank and 30 knots IAS or 40° of bank and 40 knots IAS would achieve a diameter of turn of about 310 feet.

2.1.4 The pilot was, in the course of his tests, carrying out ground orientated tight low level circuits in severe wind conditions and he had flown three such circuits without incident. If the same technique was used for the fourth circuit, and there is no evidence that the technique was markedly different, then either there was a significant reduction in airspeed compared with previous circuits or an exceptionally strong gust was encountered or more probably a combination of the two. The effect was that towards the end of the downwind turn the helicopter was at a low level, about 150 to 200 feet AGL, at an airspeed well below 60 knots when the pilot first became aware of an excessive rate of descent. It is significant that the pilot did not report a sudden event of any description but became 'aware' that he was instinctively applying power to maintain his intended descending flight path. Since he is certain that he saw matched torques of 120 per cent and the crew was also sure that there was no sign of engine rundown or surge, a loss of engine power, even temporarily, can be discounted as a cause of this loss of height.

It is therefore considered that the initial loss of height was the result of a gust or gusts causing a change of flow relative to the rotor when the helicopter's airspeed had already fallen and that this caused a further large loss of airspeed and an increased rate of descent. The pilot then applied a very large collective pitch demand in an attempt to arrest the descent before the helicopter could strike the ground. The engines achieved their maximum attainable power output of 120 per cent matched torque but the collective pitch lever was unintentionally raised further and the helicopter reached an overpitched condition with a rotor speed dropping to 90 per cent. When the pilot took action to increase rotor speed by lowering the collective pitch lever the rate of descent increased considerably. The helicopter's height was such that contact with the ground was inevitable.

2.1.5 During the evacuation the pilot acted commendably in staying in the helicopter until he had assisted all the crew to make their escape.

2.1.6 There was no evidence to suggest that the helicopter could not have been safely operated under the severe wind conditions experienced provided that sufficient allowance was made for these conditions.

2.1.7 Aircraft manufacturers regularly fly aircraft for test purposes under the 'B' conditions specified in the second schedule of the ANO. These conditions read in part 'If it is not registered in the United Kingdom or under the law of any country referred to in Article 3 of this Order, the aircraft shall be marked in a manner approved by the Authority for the purposes of these Conditions .....'.

This particular aircraft was not marked 'in a manner approved by the Authority' and did not therefore comply with the provisions of the ANO. It is left to individual manufacturers to mark specific aircraft as detailed in the letter of approval for operating under 'B' conditions and in the subject instance this was not done.

The Sea King, although produced to a military specification, was not classified as a military aircraft as defined by Article 89 of the ANO 1972. The relevant portion of this Article reads:

> 'Military aircraft' includes the naval, military or air force aircraft of any country and –
>
> (a) any aircraft being constructed for the naval, military or air force of any country under a contract entered into by the Secretary of State; and
>
> (b) any aircraft in respect of which there is in force a certificate issued by the Secretary of State that the aircraft is to be treated for the purposes of this Order as a military aircraft.

It can be seen that aircraft which are the subject of a contract, not entered into by the Secretary of State, between the manufacturer and a Foreign customer, as in this case, are not included.

The Airworthiness Division of the Civil Aviation Authority are at present responsible for aircraft not classified as military aircraft flying under 'B' Conditions. In certain instances, as was the case in the subject accident, where the aircraft has been manufactured to a military specification they are required to assume responsibility for aircraft which do not comply with British Airworthiness Requirements. In effect, they have to undertake a task for which they are neither qualified nor experienced.

2.2 Conclusions

(a) *Findings*

(i) The pilot was properly licensed and adequately experienced to conduct the flight.

(ii) The aircraft was operating under Air Navigation Order 1972 Schedule 2 'B' Conditions but was not 'marked in a manner approved by the Authority for the purposes of these Conditions'.

(iii) The aircraft's maintenance documents were in order and it had been serviced in accordance with an approved schedule.

(iv) The aircraft was servicable at the beginning of the flight.

(v) There was no evidence of any pre-crash technical failure or malfunction of the helipcopter, its engines or equipment.

(vi) Whilst the pilot was executing a tight decending turn at low level in very strong and gusty wind conditions airspeed fell off markedly without being noticed. A large reduction of lift was experienced and this resulted in a high rate of descent developing.

(vii) The pilot applied maximum power but mistakenly raised the collective pitch lever too far and an overpitched condition developed with the helicopter flying downwind at a very low airspeed.

(viii) When the pilot lowered the collective pitch lever to increase rotor speed the rate of descent increased further and the helicopter touched down in a field adjacent to the airfield and crashed into a building.

(ix) The primary crash/rescue vehicle and the ambulance were not able to operate on the airfield because of the soft surface.

(b) *Cause*

The accident was caused by the pilot's failure to maintain adequate height and airspeed during a downwind turn made in very severe wind conditions and then by his overpitching when attempting to correct the high sink rate which developed.

3. Recommendations

3.1 It is recommended that the definition of a military aircraft in the ANO should include aircraft manufactured in the UK and intended for the naval, military or air forces of any country which are the subject of a contract between the manufacturer and that country.

3.2 It is recommended that the production and testing of military aircraft should be the responsibility of the Ministry of Defence and not the Civil Aviation Authority.

3.3 It is recommended that manufacturers be reminded of their obligations and responsibilities when operating aircraft under 'B' conditions and that a register of such aircraft be kept.

G C Wilkinson
Inspector of Accidents

Accidents Investigation Branch
Department of Trade

January 1975.

Produced in England by Her Majesty's Stationery Office, Reprographic Centre, Basildon

R 81761/R92 K6 4/75 C