



ROYAL AIR FORCE

SERVICE INQUIRY INTO AN AIRCRAFT ACCIDENT OR INCIDENT

DATE	8 AUG 2007		LOCATION AND GRID REFERENCE	HUDSWELL GRANGE CATTERICK TRAINING AREA SE. 139 987		
AIRCRAFT TYPE(S)	MARK(S)		SERIAL NUMBER(S)	PARENT UNIT(S)		
PUMA	HCI		ZA 934	RAF BENSON		
NAME(S) OF PILOT(S)	Flt Lt SALE (Capt)		PARENT UNIT(S)	33 SQN RAF BENSON		
	Flt Lt HAMILTON (Co)					
NUMBER OF CASUALTIES						
KILLED			INJURED			
CREW	PASSENGERS	OTHERS	CREW	PASSENGERS	OTHERS	
2	1	-	1	8	-	



*Rear Admiral C A Johnstone-Burt OBE MA FRAeS FCIBD
Commander Joint Helicopter Command*

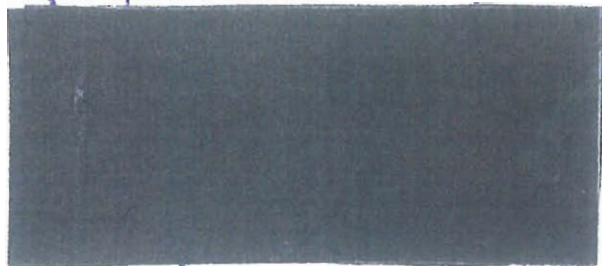


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SERVICE INQUIRY INTO THE ACCIDENT INVOLVING PUMA MK1 ZA934 ON 08 AUG 07

As Convening Authority for the Service Inquiry into the accident involving Puma Mk 1 ZA934 on 08 Aug 07 I have considered the provisional report and declare this report to be the final report.



27 Jan 11

RESTRICTED – SERVICE INQUIRY

**SERVICE INQUIRY REPORT INTO THE
RAF PUMA HELICOPTER ZA934 ACCIDENT
AT HUDSWELL GRANGE, CATTERICK TRAINING AREA
ON THE 8 AUGUST 2007**



RESTRICTED – SERVICE INQUIRY

Part 1

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By Air Commodore C W Dixon OBE RAF

(Located in Part 3.2 due to size of document)

PART 1.1 COVERING NOTE

RESTRICTED – SERVICE INQUIRY

JHC/SAFETY/SI-ZA934

Sep 2010

Cdr JHC

**SERVICE INQUIRY INVESTIGATING THE ACCIDENT TO PUMA HC1ZA934,
CATTERICK TRAINING AREA, 8 AUG 2007**

1. The Service Inquiry panel assembled at JHC on the 18 Dec 09 by order of Cdr JHC for the purpose of investigating the accident involving PUMA HC1 ZA934 as detailed in the convening order dated 18 Dec 09. The Panel has concluded its inquiries and submits the provisional report (including the record of proceedings and supporting paperwork) for the convening authority's consideration.

PRESIDENT

Signed Wg Cdr [REDACTED] RAF

MEMBERS

Signed Sqn Ldr [REDACTED] RAF (Specialist)

Signed Sqn Ldr [REDACTED] RAF (Engineer)

2. The following inquiry papers are enclosed:

Part 1 (The Report)

- Part 1.1 Covering Note
- Part 1.2 Convening Order & TORs
- Part 1.3 Narrative of Events
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Part 1

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PART 1.2

CONVENING ORDER & TORS

20091201-JHC-Puma-Catterick-SI

8 Dec 09

Action:

SI President
SI Members
Stn Cdr Benson
Stn Cdr Shawbury

Copy to:

Comd JHC

CONVENING ORDER FOR SERVICE INQUIRY INTO ACCIDENT INVOLVING PUMA ZA934 THAT OCCURRED ON 08 AUG 07

1. A Service Inquiry (SI) is to be held under section 343 of AFA 06.
2. The purpose of this SI is to investigate the circumstances into the accident involving **Puma HC1 ZA934 on 08 Aug 07** in order to prevent a reoccurrence.
3. The SI Panel is to assemble at HQ JHC, Erskine Barracks on 8 Dec 09 at 1100 hrs.
4. The SI Panel comprises:

President: **Wg Cdr** [REDACTED]
Members: **Sqn Ldr** [REDACTED]
Sqn Ldr [REDACTED]
5. The legal advisor to the SI is **Gp Capt** [REDACTED]
6. The SI is to investigate and report on the facts relating to the matters specified in its Terms of Reference (TOR) and otherwise to comply with those TOR (attached at Annex A). It is to record all evidence and express opinions as directed in the TOR.
7. The following advisors/observers may attend the SI subject to the following conditions:

Lt Col [REDACTED] (**Aviation Medecine**) – **unrestricted attendance.**

Sqn Ldr [REDACTED], **SI (Advisor)** – **unrestricted attendance.**

Dr [REDACTED], **RAFCAM HF Accident Investigator (Advisor)** - **unrestricted attendance.**
8. Stn Cdr RAF Shawbury is requested to provide facilities, equipment and assistance

suitable for the nature and duration of the SI.

9. Costs are to lie where they fall. Those within the JHC are to be charged to A1009A.

S O FALLA
Air Cdre
for Comd

Annex:

A. Terms of Reference for SI into accident involving Puma HC1 ZA934 -- 08 Aug 07.

ANNEX A TO
PUMA ACCIDENT
CONVENING ORDER
DATED 8 DEC 09

TERMS OF REFERENCE FOR SI INTO ACCIDENT INVOLVING PUMA HC1 ZA934 ON
08 AUG 07

As the nominated Inquiry Panel for the SI into the accident involving Puma HC1 ZA934 you are to:

- a. Conduct a review of all the evidence provided by North Yorkshire Police into the accident, including that evidence provided by Service SMEs.
- b. Review the circumstances of the accident involving Puma HC1 ZA934 on 08 Aug 07 in light of the available evidence, including reference to the evidence gathered by the North Yorkshire Police and such evidence provided at the Coroner's Inquest as is considered appropriate.
- c. Determine the cause or causes of the incident and examine contributory factors.
- d. Determine state of serviceability of relevant equipment, aircraft etc.
- e. Investigate and comment on relevant fatigue implications of an individual's activities prior to the matter under investigation.
- f. Review the level of injury sustained by crew and passengers and whether such injury (including stress related conditions) has been or will be the cause of later disability, as established from expert testimony.
- g. Ascertain if Service personnel involved were acting in the course of their duties.
- h. Examine what orders and instructions were issued and whether they were complied with.
- i. Review the engineering documentation provided and the RNFSaic Technical Report that was completed.
- j. Investigate the authorisation and qualifications of the air and ground crews and the authorisations for passengers carried on the flights.
- k. Establish the level of training, relevant competencies and qualifications of the individuals involved.
- l. Ascertain the extent and value of loss/damage to service and to civilian property, including any classified material.

- m. Ascertain if aircrew escape and survival facilities were fully utilized and functioned correctly.
- n. Identify if the levels of planning and preparation met the activities' objectives.
- o. Review the levels of authority and supervision covering the task during which the accident occurred.
- p. Confirm that the Post-Crash management procedures were carried out correctly and that they were adequate.
- q. Make appropriate recommendations in order to prevent a reoccurrence.
- r. Assess Health and Safety at Work and Environmental Protection implications in line with JSP 375 and JSP 418.

PART 1.3

NARRATIVE OF EVENTS

PART 1.3. - NARRATIVE OF EVENTS

(All times LOCAL [BST]).

1. Introduction.

a. ZA934, a Puma HC1 of 33 Squadron based at RAF Benson, was detached to RAF Leeming to complete an Army support task [1] on Catterick Training Area (CTA) on the 7 and 8 of August 2007. During that task, on the 8 August at 20:53L, with 12 persons on board, the aircraft crashed in a field at Hudswell Grange Farm (SE 13972-98743). The aircraft impacted the ground at a high forward speed and high Rate of Descent, then tumbled 200m across the field through a low Hawthorn tree-line. The Captain and Crewman died at the scene. An army passenger died of his injuries in hospital 48 hours later. The Co-pilot and remaining 8 army passengers were hospitalised, suffering varying degrees of injury. Crew and passenger names, ranks and pictures are detailed at Annex A.

b. A Board of Inquiry (BOI) was convened, but suspended 4 days later when Cockpit Voice Recorder (CVR) evidence then required the BOI President, at the direction of the Convening Authority, to pass the investigation to the North Yorkshire Police. Subsequent technical investigation [2] indicated that the aircraft was serviceable at the time of the crash and that weather was not a factor [3]. Following a 2½ year civilian Police investigation, aided by, Royal Navy and RAF specialist personnel [4] and a 4 week Coroner's Court hearing, a new Service Inquiry was convened in December 2009 to complete the aborted 2007 BOI. The North Yorkshire Police Evidence was not made available to the 2009 Service Inquiry Team until end of February 2010.

2. Personnel Background.

a. The Captain of Puma ZA934 was a newly qualified Combat Ready (CR) pilot [5] with 518 hours total flying (277 hours Puma), 64 hours captain (45 hours captain Puma) and a White Procedural Instrument Rating. He had not yet deployed on Out of Area Operations in Iraq and the Catterick task was his first Self Authorising, land-away, detachment as captain. [REDACTED]

[REDACTED] Details of the Captain's background, training and logbook are at Annex C-3.

b. Co-pilot 1 of ZA934 was a new Limited Combat Ready (LCR) pilot [6] with 290 hours total flying (112 hours Puma), 40 hours captain (19 hours captain Puma) and a White Procedural Instrument Rating. The task was his first overnight land-away task on 33 Squadron. On post crash inspection Co-pilot 1's logbook was found not to be endorsed Limited Combat Ready by 33 Squadron. Co-pilot 1 was single. Details of Co-pilot 1's background, training and logbook are at Annex C-4.

c. The Crewman (Weapon Systems Operator (WSOp)) of ZA934 was a former Airman Propulsion technician, having enlisted in July 1999 and served on the Tornado force at Marham before re-mustering as a WSOp in October 2004. In August 2007 he was a new Limited Combat Ready Crewman [7] with 382 hours total flying (270 hours Puma). The Crewman was single. Details of the Crewman's background, training and logbook are at Annex C-5.

[1] Task for the Infantry Training Company (ITC) Catterick Garrison. Recruit training exercise. Tasking Request (HELQUEST) at Exhibit 1.

[2] Royal Navy Flight Safety & Accident Investigation Centre (RN FSAIC, RNAS Yeovilton) Technical report for North Yorkshire Police. Full report at Annex B (placed in part 3 due to size of document).

[3] RAF Leeming Weather Report for 8 August 07 at Exhibit 2.

[4] North Yorkshire Police Crash Investigation titled "OPERATION HEATING". RAF Specialist Team initial summary report at Exhibit 3.

[5] Combat Ready Check - 25 June 2007.

[6] 33 Squadron Operational Conversion Flight, End of Course Check - 9 March 07. Annex C-4 (6)

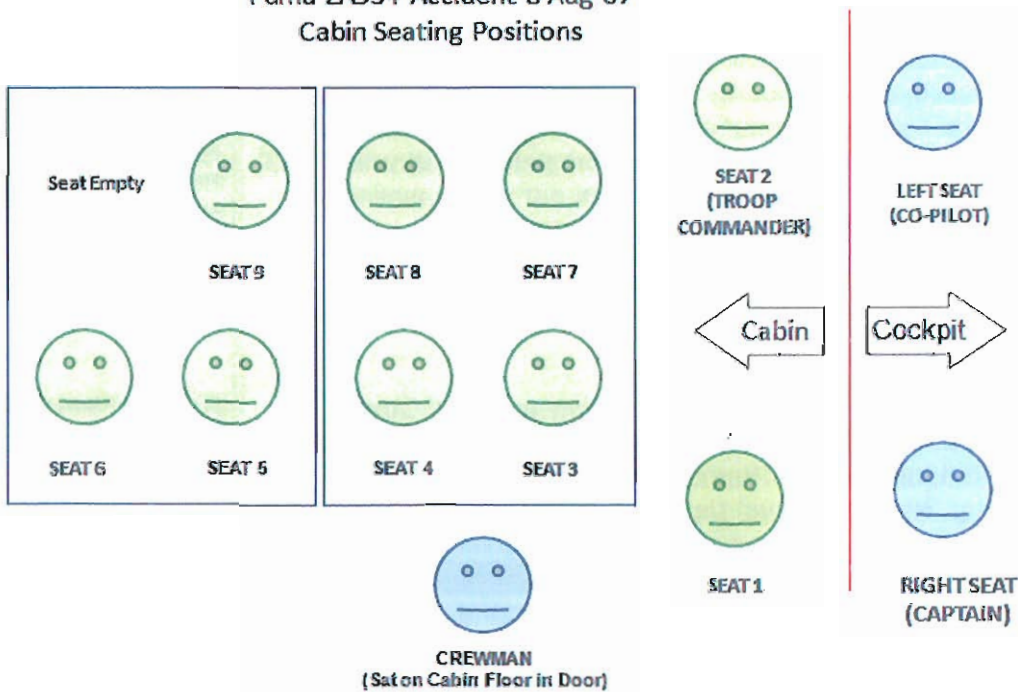
[7] 33 Squadron Operational Conversion Flight, End of Course Check - 10 April 07. Annex C-5 (4)

d. The fourth member of the crew was a second Co-pilot. Co-pilot 2 was a new Limited Combat Ready pilot [8] with 295 hours total flying (125 hours Puma), 35 hours captain (10 hours captain Puma) and a White Procedural Instrument Rating. The task was his first overnight land-away on 33 Squadron. Co-pilot 2 remained at Leeming, on the ground, on the afternoon of 8 August and was not involved in the accident. On subsequent inspection Co-pilot 2's Log Book was found not to be endorsed Limited Combat Ready by 33 Squadron.

[8] 33 Squadron
Operational Conversion
Flight, End of Course
Check - 8 March 07.

e. Nine Army passengers from the 1st Scots, Infantry Training Company (ITC) were onboard ZA934 at the time of the accident; a Troop Commander and 8 basic recruits. The recruits were on light duties, due to sickness or minor injury, as the support troop to the main exercise training effort being conducted that day. The Troop Commander was the 1st Scots ITC aviation liaison and interface with the crew of ZA934 for that days tasking. An overview of the seating positions at the time of the accident is shown at Fig 1 (Names & Pictures at Annex A).

Puma ZA934 Accident 8 Aug 07
Cabin Seating Positions



(Fig 1. Seating Positions on ZA934 on 8 August 2007)

3. **Aircraft Background.** ZA934 (Fig 2) Entered RAF service on the 28 May 1980. It had no history of significant incidents or accidents prior to 8 August 2007. The airframe had deployed to Iraq in June 2006 and May 2007. It had 'Desert Recovery' and 'Primary Star' engineering servicing work conducted after both Iraq Detachments. It went into AgustaWestland Helicopters (Yeovil) for Self Defence System (SDS) modifications and upgrades between October and November 2006 and then had a 'Penalty Primary Star' servicing in June 2007 due to airframe life and servicing extensions put in place because of Operational demands.

4. For its task at Catterick, ZA934's role fit was 12 seats fitted in the cabin with a Crashworthy Auxiliary Fuel Tank (CAFT) also fitted at the rear of the cabin. If required this would extend the aircraft's working endurance from 1hour 45min to 2hour 15min (see Fig 3).

5. ZA934 received After Flight (AF) and Before Flight (BF) Servicing, by the crew, at Leeming VASS [9] commencing at 1200L on 8 August 2007. Following on from the afternoon's tasking, a further Continuous Operations Mandatory Maintenance (COMM) [10] servicing was conducted by the crew and signed off by the Captain at 1600L on 8 August 2007. The Captain signed for the aircraft at 1645L on 8 August 2007 and shortly thereafter departed for Catterick Training Area (CTA).

6. A full and comprehensive post accident technical investigation was conducted by RN FSAIC [2] with assistance from the AAIB [11], QinetiQ, RAFCAM [12], Eurocopter, Sagem Defence Systems [13] and Turbomeca [14].

7. Mechanical or technical failure were found not to have caused the accident. Aircraft and engine performance, fuel and fuel systems, flying controls, autopilot, associated avionics, Radar Altimeter and weight and balance were similarly discounted.

[9] VASS – Visiting Aircraft Support Section, RAF Leeming.

[10] COMM – Continuous Operations Mandatory Maintenance – A visual airframe inspection and fluids levels check, conducted by the crew, after no more than 5 hours continuous task flying.

[11] AAIB - The Air Accident Investigation Branch, Farnborough, Hampshire.

[12] RAFCAM – RAF Centre of Aviation Medicine, RAF Henlow.

[13] Sagem Defence Systems – Puma Autopilot manufacturer.

[14] Turbomeca – Puma Engine manufacturer.



(Fig 2. Puma ZA934)

[Fig 2] Puma HC1 ZA934 pictured at Shaiba Landing Site, CTA pictured at 19:50.34L, 8 August 07, approx one hour prior to the accident. Picture: ITC Trp Cdr.



(Fig 3. Puma Cabin in representative Role Fit)

[Fig 3] Puma HC1 Cabin viewed from the Crewmans centre seat looking aft. The CAFT (which holds 310kg of fuel) is seen at the very back of the cabin area.

Eight centre cabin seats are fitted (the fwd centre bank between the cabin doors) and a further 4 side seats mounted at the fwd end of the cabin, fwd of the cabin doors (partially obscured).

The Crewman's Harness is secured to the bottom of the Main Rotor Gearbox (top centre of Fig 3).

8. **The Previous Week.** The Catterick Infantry Training Company (ITC) Task was allocated with a crew at 33 Squadron's weekly planning meeting the week prior. This function was routinely held on a Thursday after the Station and Squadron Executives' meetings, and comprised the Squadron's Duty Executive [15], Training Staffs and Operations (Ops) Officer [16]. For this task the original crew allocated was the Captain, Co-pilot 2 and the Crewman.

9. In the days following the meeting, Co-pilot 2 was replaced on the crew allocation by Co-pilot 1. No evidence has been identified as to why these changes took place, however this may have been actioned by the Squadron's Ops Staff, due to Co-pilot 1's request, and also direction from the Sqn training staffs to fly Co-Pilot 1 as much as possible following on from a period grounded, sick with a [REDACTED] injury [17].

10. In the 3 days prior to the task the crew constitution changed again, at Co-pilot 2's request, for him to be restored to the crew, to share the Left Hand Seat flying and gain training benefit.

11. **Authorisation and Briefing.** On the day of departure, 7 August 2007, the Captain constructed his own flying authorisation for the transit up to Leeming and presented it to the Squadron's Duty Authoriser for inspection. The Squadron Duty Authoriser inspected and corrected the Captain's Authorisation [18], amending and raising his minimum height from 50' to 100' above ground level (agl) and 30' minimum separation clearance (msc) for all but limited and specified navigation objectives on 4 targets [19]. These 4 specific navigation targets were authorised down to 50'agl and 30'msc. The Duty Authoriser did not attend the Crew Brief, but took an Out-Brief from the Captain, due to his requirement to out-brief and supervise other Squadron flying activities.

[15] Squadron Duty Executive; also referred to as the Duty Flight Commander (DFC).

[16] No formal record exists of this 2007 planning meeting. Details established from SI Interview Pres/Squadron Executive Officer (2007 Sqn 2IC). Transcript at Part 2.3 - 2

[17] Telephone call 7 April 10, SI President/33 Squadron Operations Acting Senior NCO 2007 Note placed on Ops Officers Board to fly Co-pilot 1 on all available sorties.

[18] Exhibit 4 – Copy of Authorisation sheets for 7 & 8 August 2007. See also Duty Authorisers N'Yorks Police statement dated 8 April 08. Statement 2.3-1

[19] JHC FOB - J330.110.3 - Fit below 100'agl. See 1.4 – 12 Para 6(b).

12. The Captain then approached the Squadron Duty Executive (Duty Exec), and requested Detachment Temporary Powers of Authorisation (Auth) [20]. The Captain discussed his task and exercise requirements with the Duty Exec, however this process was compromised by the Duty Exec's requirement to host a Squadron visit party, as he was the only senior officer on the Squadron at that time [21]. The Duty Exec stated in his SI Interview (Part 2.3-2) that the discussion was of 'general' nature covering both the task & training and the temporary auth limits. The Duty Exec did not brief 'specific' minimum heights.

13. The Captain subsequently constructed his own flying authorisation for Self Authorisation powers which, due to the distraction of the requirement to host a visit party to 33 Squadron, the Duty Exec did not sign until 1830L, some period after the crew's departure (1328L). The Captain's transit authorisation had Co-pilot 2 incorrectly nominated as a passenger, rather than crew [22].

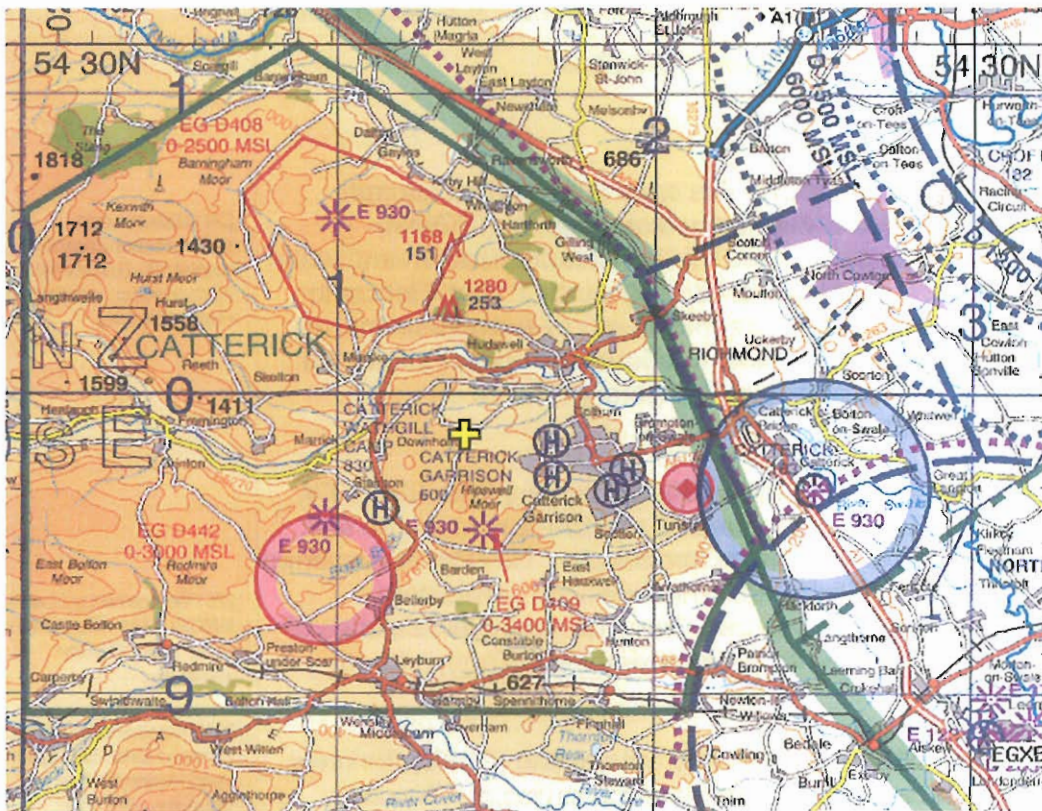
14. **Transit to Leeming.** The transit to Leeming was conducted with the Captain in the Right Hand Seat (RHS) (handling), Co-pilot 1 in the Left Hand Seat (LHS) (non handling), the Crewman in the Centre Seat and Co-pilot 2, observing from the cabin on a spare crewman's harness. Co-pilot 1 wished to practice his low-level navigation skills following on from a navigation related incident [23] on Salisbury Plain 4 days prior. The flight to Leeming went without incident, arriving at 1524L and parking at VASS [9].

[20] Powers granted iaw JHC Flying Order: J301.100.4 Temporary Powers of Authorisation.

[21] Sqn Execs situation 7/8 August 07: OC 33 Sqn and OC A Flt: Away on Adventurous Trg. OC B Flt: OOA Iraq. OC C Flt (OC Trg): position temporarily gapped. OC D Flt (OC OCF): Terminal Leave (PVR'd), Temporarily gapped. OC HQ Flt (2IC): Duty Exec.

[22] Low-level Flight with passengers - Flight JHC J340.140.1 applies.

[23] Formation Airprox with AAC Aircraft. F765B dated 3 August 07 (Not attached). Puma formation on Salisbury Plain Training Area became lost & came into very close proximity of an AAC aircraft.



(Fig 4 – 1:250'000 Map of CTA with Aviation Overprint)

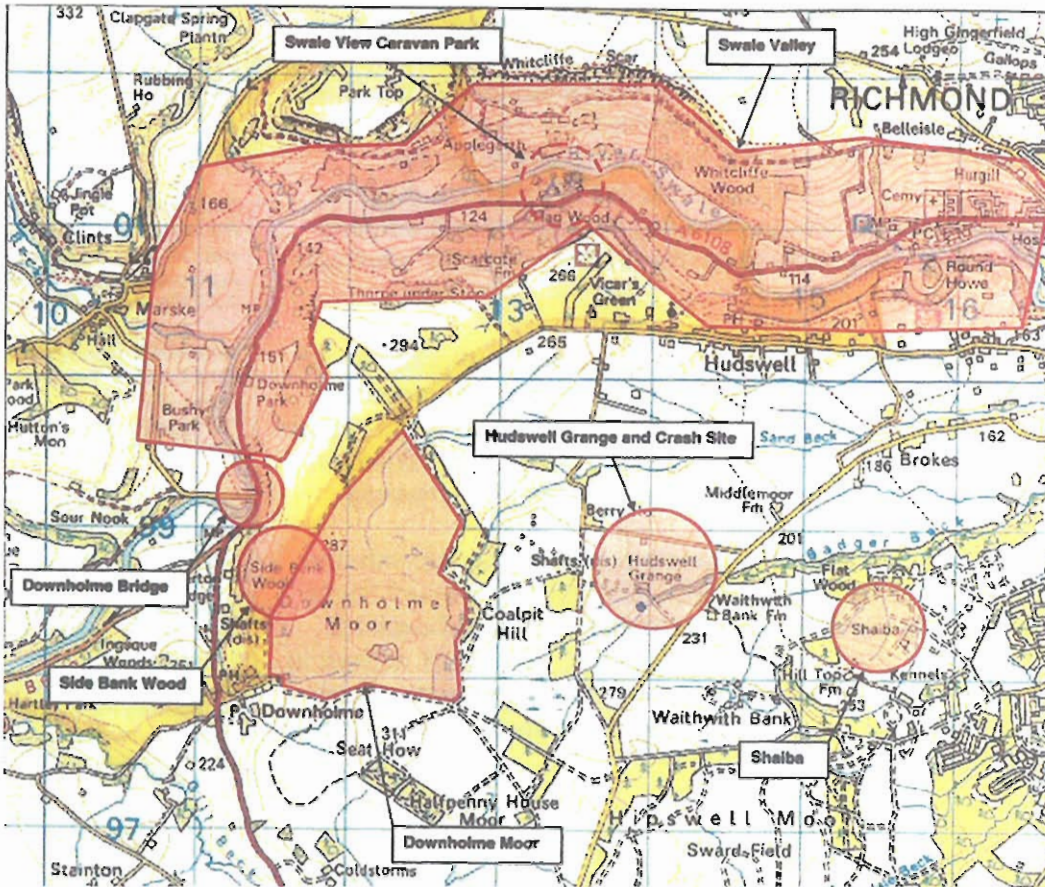
(Fig 4) 1:250'000 Map of Catterick Training Area & Ranges.

Hudswell Grange Farm (accident location) is marked by a yellow cross, centre of map.

The red bounded areas (i.e. EGD 408 & EGD 442) are live firing areas located within the wider Catterick Training Area.

Note that Weapons Ranges are not part of the UK Low Flying System (i.e. EGD 408 or EGD 442), & are normally controlled by a co-located Range Authority. However all other areas are part of the UK LFS, including in this case, the main area of Catterick Training Area and require Low Level booking permissions.

RAF Leeming (EGXE) is located bottom right of the map.



(Fig 5 – 1:50'000 Map of Catterick Training Area)

[Fig 5] 1:50'000 Map of Catterick Training Area (CTA) with key locations indicated [extracted from RN FSAIC Report – Annex B].

Areas highlighted in red/pink overlay & name tags relate directly to incident activity & ZA934s flight path.

CATTERICK TASKING

15. **Evening Tasking 7 August 2007.** The crew refuelled the aircraft, carried out a Continuous Operations Mandatory Maintenance (COMM) servicing and re-briefed. The Captain closed his transit authorisation and wrote a new authorisation for the evening task. It did not include a Joint Helicopter Command (JHC) Height Minima or any reference to a Low-Level booking [24]. Furthermore, and unbeknown to the Captain, the Squadron Exec had, at that time, not yet endorsed the Captain's original Temporary Powers of Authorisation sheet at RAF Benson.

[24] Detachment Authorisation Sheet - 7 August 07 (Exhibit 4). Authorisation missing JHC Height Minima.

16. ZA934 lifted at 1714L and departed to Shaiba Landing Site (LS), CTA, with the Captain in the RHS, Co-pilot 2 in the LHS and the Crewman, to task with the ITC under the direction of the Troop Commander. Co-Pilot 1 remained at Leeming. The crew landed at Shaiba LS, shut down and conducted Trooping and Safety briefings with ITC troops. The crew then flew a series of troop familiarisation flights at very low-level (approximately 50'agl), prior to returning to Leeming at 2110L.

[25] Witnessed by Leeming SNCO's Mess Bar Staff - North Yorks Police interview.

17. **Post-Task 7 August 2007.** After landing at Leeming (2110L) the crew refuelled ZA934, but did not carry out any engineering servicing. The crew then retired to their relevant Messes where they had made arrangements for late meals to be provided. The crewman ate his meal and drank 1 pint of lager before retiring to bed at 2240L [25]. The officers ate their late meals and drank 2 or 3 pints of beer each [26], before retiring to Co-pilot 1's room, with a bottle of wine, to talk further. At approximately midnight Co-pilot 2 retired to his own room to sleep [27].

[26] Witnessed by Leeming Officers Mess Bar Staff - North Yorks Police interview. JSP 550 R305.115.1 Alcohol & Flying applies.

[27] Interview SI Pres/Co-pilot 2, dated 23 March 07, RAF Benson. Transcript at Part 2.3-3.

18. **Pre Task 8 August 2007.** The crew had agreed to rendezvous at 1145L, near their accommodation, with an intended take-off time of 1300L. The officers booked out of the Mess at reception and were observed to be fit and well by the staff [28].

[28] Witnessed by Leeming Officers' Mess Reception Staff - North Yorks' Police interview.

19. The crew moved to the aircraft and carried out an After Flight and Before Flight Servicing, signed off at 1220L. The crew had a short pre-flight brief [27]. The Captain wrote an authorisation, signed the aircraft engineering log at 1245L and lifted from Leeming at 1309L with himself in the right hand seat, Co-pilot 2 in the left hand seat, Co-pilot 1 observing from the centre cockpit seat and the Crewman operating in the cabin. The Captain's task authorisation did not include a JHC minimum height [29] and also had Co-pilot 1 as passenger rather than crew [22].

[29] Detachment Authorisation Sheet – 8 August 07 (Exhibit 4 a & b).

20. The crew of ZA934 did not contact the Leeming Met Office at any time over the 7/8 August 2007, however electronic weather information facilities were readily available in Leeming Flight Planning, next to the Visiting Aircraft Support Section. The weather forecast for the afternoon and evening period of 8 August were good, with excellent visibility, high cloud and light winds [3].

[3] Leeming Meteorological Actual and Forecast reports at Exhibit 2.

21. **Afternoon Tasking – 8 August 2007.** ZA934 Lifted at 1309L and flew to Hudswell Grange Farm to carry out troop briefings and familiarisation flights for the Officer Commanding (OC) the ITC Parachute Regiment Troops. During this tasking period ZA934 was routinely flown down to 50' agl both on and off the range area. The crew also flew ZA934 to West Grange Farm, approximately 6 miles NW of CTA, at the request of OC ITC Paratroops Company to view a friend's property from the air. Camera clips recorded onboard ZA934 during this period indicate troops incorrectly briefed and seated for familiarisation flights [30], and inappropriate low-level flight conducted over populated areas (The Swaledale Caravan Park [31]) for which a sequence of anxious and concerned flying complaints was later logged with the Civil Aviation Authority, Civilian Police and RAF Leeming [32] (See also Fig 6 & 7).

[30] JSP 550 - R340.130.7&9, Captains responsibilities & Safety Restraint. D340.140.1, Hazardous Flight Regimes. Puma Standard Operating Procedures (SOPs) 1.

[31] See MP4 Clip, at Exhibit 10 - Flight over, Swaledale Caravan Park. Grid Ref NZ 133 013. Fig 5.

[32] Low Flying calls to MOD, Police & RAF - Exhibit 5a, b & c;

- a. MOD Low Fly Call.
- b. Police 999 Low Fly call.
- c. RAF Leeming Ops Complaint statement. Received after ZA934 had refuelled & departed on its final task window at 1700L.



(Fig 6 – Troop & Crewman sat on doorsill at Low-Level.)

[Fig 6] Image taken by troops onboard ZA934 during tasking on 8 August 07. Picture shows ITC Troop and Crewman sat on the aircraft doorsill during low-level flight. Note the troops dress; short sleeves and no head or apparent hearing protection. Regulation J.130.105.1 Refers.



(Fig 7 – ZA934 Shadow at Low-level Flight)

[Fig 7] Image taken by troops onboard ZA934 during tasking on 8 August 07.

Picture shows Puma shadow crossing a single vehicle track road on Catterick Training Area. The left cabin door sill is visible bottom left of picture.

Note the outline shadow of legs & feet on the RH aircraft step.

QinetiQ calculations based on sun angle, lens type & other factors estimated the aircraft at 110 knots at between 46 & 62 feet (+/- 10 feet).

22. ZA934 Returned to Leeming at 1536L. The crew refuelled the aircraft and carried out a COMM Servicing, signed off at 1600L, during which the Crewman topped up the Main Rotor Gearbox with 0.5 litre of transmission oil.

23. **Evening Tasking – 8 August 2007.** The aircraft lifted from Leeming at 1700L en-route to Catterick Training Area (CTA), with the Captain in the RHS, Co-pilot 1 in the LHS and the Crewman. Co-pilot 2 remained on the ground at Leeming. The crew landed at Shaiba LS and shut down for further troop familiarisation serials, under the direction of the Troop Commander, 1st Scots ITC. Throughout the tasking window the Captain and Co-pilot 1 carried out inappropriate handling with and without passengers on board [33]. These actions were not defined in the Captains temporary powers of authorisation or otherwise briefed by his Squadron Executive (Duty Flight Commander) as legitimate tasking or training activity.

[33] Low level and Advanced handling at high All Up Weights. Note that the Captain was not a Qualified Training Captain & was not formally trained to intervene if the Co-Pilots actions were wrong or misjudged. See CVR Transcript 0:50.30. Exhibit 6-2 (C).

See also: 1.4 -12 Note 48.

24. At some stage in that evening tasking frame, the Crewman opened the gearbox sliding cowling and inspected the Main Rotor Gearbox oil levels, which were found to be normal.

[34] 8 August 2007, Sunset at 20:54L, Evening Civil Twilight at 20:37L.

25. Towards the end of the tasking period, at approx 2040L [34], the crew elected to fly a final troop familiarisation sortie with the 'Light Duties' troops, accompanied by Troop Commander, 1st Scots ITC, prior to recovering to Leeming. The crew discussed a low-level profile, captured on the CVR Cockpit Area Microphone [35] that would take them over the ITC Paras, at Hudswell Grange Farm; the troop they had been tasking with earlier in the day.

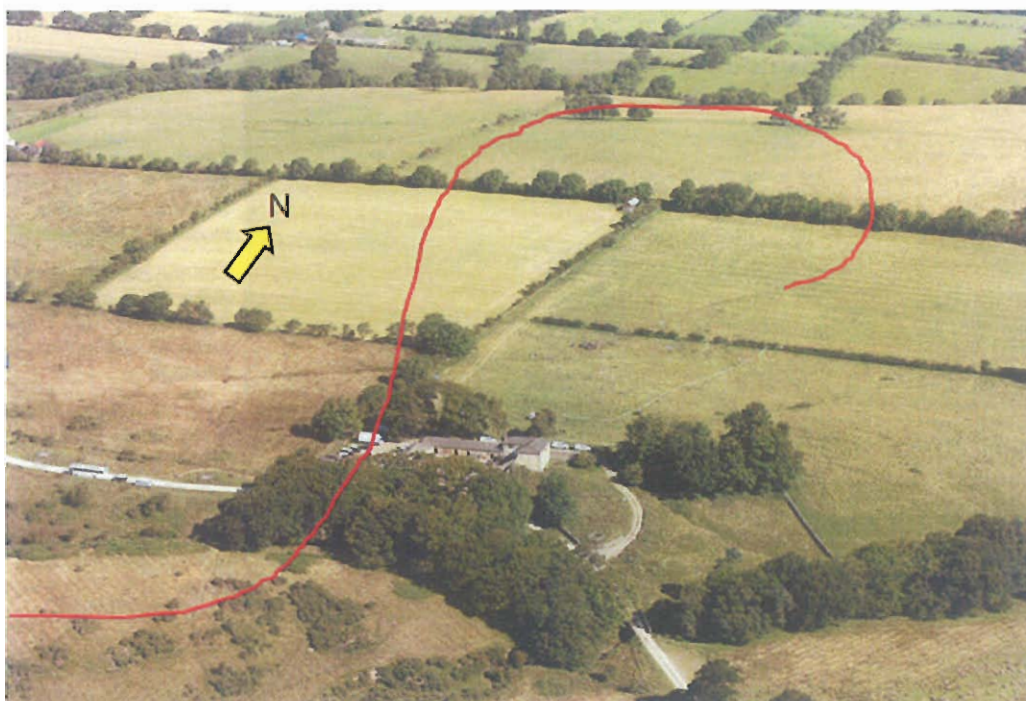
[35] CVR. Cockpit Area Microphone 1:50.52, Captain/Co-pilot 1 discuss final, unplanned, serial with 'Light Duties' party. CVR Transcript Exhibit 6-2 (b).

26. ZA934 Lifted at approx 2047L, with 3 crew and 9 pax, routing initially North to join the Swaledale Valley and then onward following an anti-clockwise route around the main training area (see Fig 5). Two minutes after lift, the Captain carried out a 'Wing-Over' style manoeuvre from which the aircraft appears to have recovered below its separation minima, triggering the RADALT (Radar Altimeter) audio warning. The crew briefly discussed the incident and the Captain directed the crew not to discuss it again [36]. On post crash inspection the

[36] CVR Transcript 1:57.45, Exhibit 6-2 (b).

damaged Co-Pilots RADALT warning setting was found indicating 35ft , ten feet below the correct setting (45') for flight at 50'agl. The Captains RAD ALT, which was similarly damaged, was found with the warning bug set at 50'agl.

27. The crew continued West, then South along the Swaledale Valley, conducting TAC CLIMB and 'bunting' manoeuvres [37], turning East to run in towards Hudswell Grange Farm at low-level. The Captain and Co-pilot 1 discussed the route into the Farm and the Captain elected to overfly the ITC Paratroops from the South, executing a 'Repositioning Turn' so as to overfly the troops a second time on departure back to Shaiba (See Fig 8 and Note [38]).



(Fig 8 – Accident site, Hudswell Grange Farm)

ACCIDENT SEQUENCE

28. **The Final Manoeuvre** [38]. Having discussed the approach and area of manoeuvre during the final run in to Hudswell Grange with Co-pilot 1 [39], the Captain overflew the ITC Paratroops position [40] on the western edge of the Farm complex on a NNW track (see Red Line within Fig 8). Having directly over-flown the troops at low-level (approx 50'agl) the Captain carried out a short, but smooth, 15-20° nose-up attitude climb to approx 350' agl. The Captain then flew a tight right turn, at a very high Angle of Bank (at, or greater than 60°), reversing the aircraft's track through approx 220° to face back towards Hudswell Grange Farm. The aircraft rolled wings level on completion of the right turn, below 100'agl, onto a track of 213°, still with a high Rate of Descent and forward speed. Cockpit Voice Recorder (CVR) and witness evidence indicates that the aircraft flared just prior to impact, striking the ground, in a slight nose-up, wings level attitude, with the tail rotor guard ('hockey-stick') impacting first [41].

29. RN FSAIC Investigation of the CVR trace utilising AAIB computer audio software ('Sonogram') and comparison sampling of data from live aircraft flight and simulator trials indicate that ZA934's engines were above 80% NG and developing the required power levels throughout the final manoeuvre. Additionally, Rotor Speed (NR) was within expected parameters [42].

[37] TAC CLIMB – Tactical Climb; a rapid climb to height to avoid enemy fire. 'Bunting' Manoeuvre; A climb followed by a rapid descent causing negative 'G' to the crew.

[Fig 8] The Accident location at Hudswell Grange Farm. Final flight path shown in Red, entering from the SW (bottom left).

The Farm buildings (lower centre of picture) were exclusively used for MOD purposes, routinely as an HQ or Company exercise location.

The track running from the farm SE is the main access route to the main road (bottom centre-right of fig 8).

[38] See Annex B, RN FSAIC Report, 2. Analysis, 1.14 The Flight, Page 84.

[39] CVR Transcript 1:59.44. Exhibit 6-2 (b).

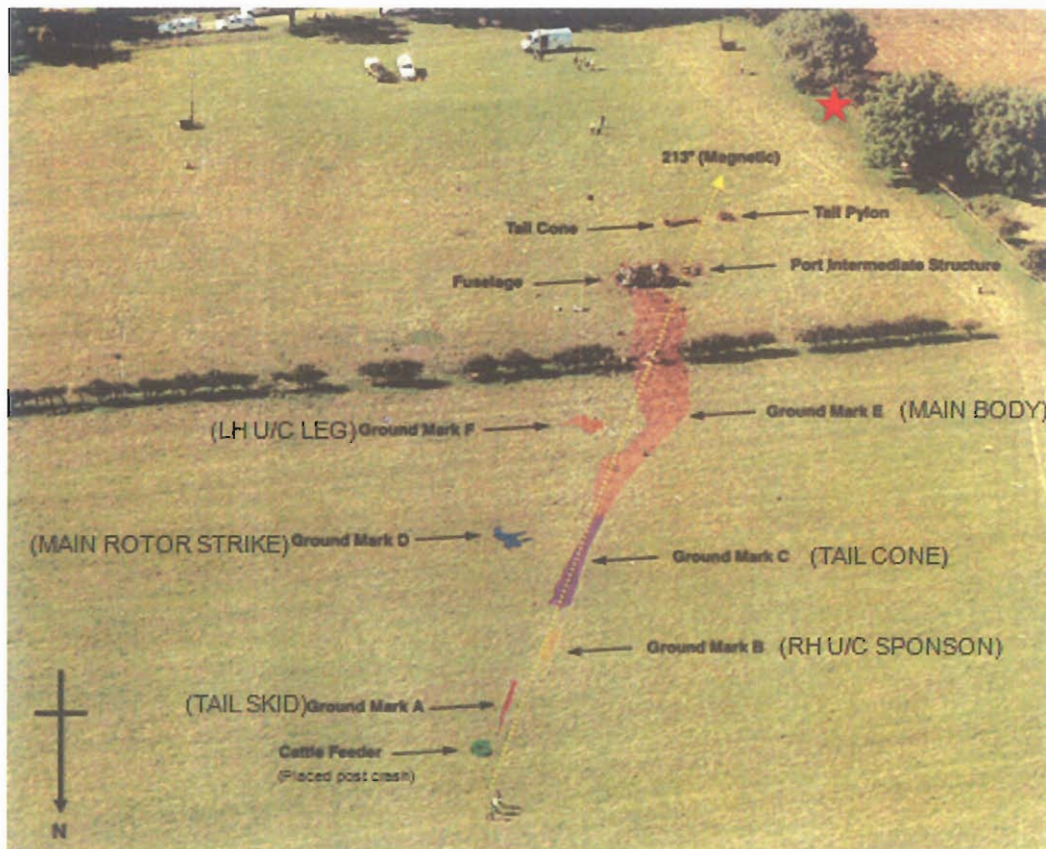
[40] Final Manoeuvre conducted with the under carriage retracted (UP).

[41] See QinetiQ Emulation Puma HC1 ZA934 Presentation 3, 5, 6, 7 and 8, dated 27 November 08, Exhibit 10-[1-5].

[42] See Annex B, RN FSAIC Report, Fig 14 page 132.

30. **Impact Sequence** Witness accounts and analysis by the Materials Integrity Group, utilising ground marks, airframe and other physical evidence indicated that ZA934 struck the ground tail first, then tumbled across the field, through a low Hawthorn tree-line before coming to rest on its left side (See Fig 9 and [43]).

[43] See RN FSAIC Emulation ZA934 Impact Sequence, Exhibit 10-[6].



[Fig 9] The Point of Impact, ground markings and wreckage trail at Hudswell Grange.

The red star (top right of picture) indicates where the Crewman was found, some 65 metres from the fuselage.

Note the round steel cattle feeder at the start of the ground wreckage marks. This was placed by the civilian police, post crash, to assist in the formation of a perimeter cordon.

(Fig 9 – Point of Impact, ground Markings and wreckage trail, Hudswell Grange)

31. Fig 9, shows the initial markings (A) made by the tail rotor guard ('hockey stick') and the lower tip of the tail boom, then marks made by the R/H undercarriage sponson (B). At this point the tail boom broke under stress and its forward, open end dug into the ground (C). The aircraft then rolled to its left (left) causing the main rotor blades to strike the ground (D) causing the aircraft to rotate horizontally and face aft. At this point the tail boom was thrown forward of the main fuselage. At some stage the centre cabin seat bank was ejected from the fuselage, with 3 passengers still secured to it. The fuselage continued backwards (E), impaling its starboard (right) undercarriage leg into the ground (F) and rotated vertically, so as to face along the direction of the crash axis, but fully inverted. At this point the fuselage impacted a low, but significant, Hawthorn tree-line (see Fig 11, page 1.3-10), striking the centre and right cockpit area with significant force. This destroyed the cockpit area, tearing both pilots' positions from the fuselage, leaving the main cabin area badly deformed but intact.

[44] See Annex B, RN FSAIC Report, Annex B, CVR Analysis and Survivability, 2.3.16, page 98

See also

Strategic Review of the Puma Helicopter Force, 15 May 08 - 'Dixon Report' – Annex E to Puma Review Minutes of DG Heli Meeting – 9 Apr 08, Page E3 – CVR Crashworthiness. Annex H.

32. As a result of the force of the impact and the damage to the cockpit area, the power supply to the CVR was disrupted immediately on first impact [44]. Notwithstanding the low fuel state of ZA934, fuel from the forward under-floor tanks leaked onto the forward cabin seat occupants. The CAFT remained

[45] CAFT. Crash-worthy Auxiliary Fuel Tank. Empty at the time of accident.

in-place with no fuel leaks [45].



(Fig 10 – Hawthorn tree-line, Hudswell Grange)

[Fig 10] Remains of the Hawthorn tree-line at Hudswell Grange that ZA934 passed (inverted) through. Note centre cockpit window impaled on tree stump.



(Fig 11 – ZA934 Cockpit area – see note)

[Fig 11] – ZA934 post crash at Hudswell Grange. The picture shows the front of the aircraft and the remains of the cockpit area.

The fuselage is resting on its Left Side. The cockpit roof switch-panel and throttles quadrant (yellow and red handles) can be seen on the right side of the picture.

The CVR was found amongst the wreckage (remains of Left Hand Seat cockpit floor) at centre bottom of the photo (indicated by red arrow).

INJURIES and SURVIVABILITY

33. A full report on the crew and passenger crash injuries and survival aspects was conducted by RNFSAIC [46] and RAFCAM [47]. Post-crash rescue was affected by ITC Paratroops within moments of the accident.

34. Further assistance was rapidly affected by the Swaledale Mountain Rescue Team who attended the accident site, with an army reservist doctor and nurse, from a crash exercise being held 2 kilometres to the West, on Downholme Moor (See Fig 5).

35. See Fig 1 and 3, and Annex A, for crew positions. A summary of the survival detail is detailed below:

a. **Captain and Co-Pilot.** The cockpit of ZA934 was destroyed in the post impact 'tumble', most likely on impact with the low but dense Hawthorn tree line (See Fig 9, 10 and 11).

(1) The right cockpit seat was torn from the cockpit floor and was found beside the wreckage by ITC troops with the Captain still secured in it. He had suffered traumatic head injuries and was declared dead at the scene.

(2) The left cockpit seat was torn from its mounting rails and was found beside the wreckage by ITC troops with Co-Pilot 1 still secured in it. He was found semi-conscious and removed from his seat, by ITC troops, away from the wreckage. He had suffered [REDACTED] injuries.

b. **Crewman.** (See Fig 1 and 3). The Crewman was positioned in the right hand cabin door, wearing a standard helicopter crewman's harness, over his LCJ [48], around his upper chest area. He was not secured in a cabin seat. At some stage during the post impact 'tumble', the Crewman's harness was severed [49] and he was thrown from the aircraft. He was found by ITC troops some 25 min after the accident, 65 metres from the fuselage (see red star in Fig 9). Paramedic teams attempted resuscitation, however he was declared dead at the scene. The Crewman's left hand was cleanly and completely severed just above the knuckles.

c. **Cabin Occupants.** (See Fig 1 and 3) The main centre fuselage section, forming the cabin, remained largely intact. The force of the impact and the high vertical and lateral 'g' loadings exceeded the designed safety tolerances of the seat units by a significant margin. The 2 centre cabin seat units failed in varying degrees. The rear cabin seat bank broke from its floor mounts, but remained within the cabin confines with its occupants.

d. The forward centre seat bank structure failed in a number of places. The main body of that seat, with 3 troops still secured to it, was ejected from the aircraft and was found upside down on the grass near the main body of wreckage by ITC troops. The forward left hand seat corner and 4th occupant of that seat bank (Fig 1, Passenger 7) broke from the main seat section (at the frame). Still attached to the seat-belt section, he was found semi-conscious in the rear cabin, under the rear seat occupants. Passenger 7 subsequently died of head injuries on the 10 August at 10:45L, at the James Cook Hospital, Middlesbrough.

e. Both forward cabin side seat banks remained intact retaining their occupants (Fig 1, Passenger 1 and 2).

[46] See Annex B, RN FSAIC Report, page 55-57, 1.15, Survivability & Safety Equipment.

[47] See Annex D. RAFCAM AIHF Report 06/07 2010 SI Update.

[48] LCJ: Load Carrying Jerkin. Vest worn over flying clothing designed to carry Survival Aids (Emergency Beacon, First Aid Kit etc) and accommodate armour plate when req.

[49] RN FSAIC Forensic findings proved that the Crewman's harness was pulled apart under severe strain and not cut. See Annex B, RN FSAIC Report Page 126-130, Figs 159-170.

36. It is noteworthy that a number of injuries to troops seated in the cabin, despite being correctly secured and wearing combat helmets, were aggravated by loose cabin equipment such as the aircraft parking chock and the under-slung load strop (See Fig 12 Notes).



(Fig 12 – ZA934 Cabin area)

[Fig 12] ZA934 Cabin viewed from the right cabin door. The Airframe is resting on its left hand side. The forward left side mounted cabin seat can be seen at the top left corner of the picture.

The remains of the centre forward seat bank legs can be seen at the top centre of the picture, framed in the left door.

The centre aft seat bank can be seen at the centre right of the picture.

Note the end of the crewman's harness still attached to the main rotor gearbox, bottom centre.

Also note the excess of loose equipment (both troops and role equipment) in the picture – aircraft chock (with white numbers '934') and Under slung load strop.

RESCUE & EVACUATION

37. The survival of crew and troops on ZA934 is largely due to the courageous and prompt actions of the ITC Paratroops Exercise Staff and men, under the control of OC ITC Paratroops, who effected immediate rescue and first aid from the wreckage and called for civilian emergency services (2055L).

38. ITC Paratroops entered the upturned fuselage and lifted a number of injured troops from the cabin, despite the risk of post crash fire. The troops utilized the aircraft's cabin door as a stretcher to move the most injured personnel from the immediate vicinity.

39. OC ITC Paratroops phoned RAF Leeming, on his mobile phone, and was connected to Air Traffic Control [50]. He enquired as to the number of aircrew on ZA934 and the names, in order to account for all personnel. This was the first notification of a crash received by RAF Leeming who immediately started Post Crash Management actions.

40. Two WPCs attended the accident site in a panda car (2110L) followed shortly by a Army Reservist Doctor and civilian Nurse, who had just left the Swaledale Mountain Rescue Team (MRT), on exercise on Downholme Moor, and chose to follow the passing police car which was displaying blue lights.

41. The MRT Army reservist doctor immediately summoned the civilian MRT to his location, carried out an assessment (triage) and called for specific medical assets including SAR helicopter support (2115L) [51]. The most serious casualties were evacuated by RAF SAR Seaking helicopter, others moved by ambulance. The Captain and Crewman's bodies were protected and left in

[50] North Yorks Police Statement Leeming ATC Staff dated 22 Oct 07. 2.3-4.

[51] Extract from North Yorks Police Statement MRT Doctor recollections & MRT details at 2.3-5.

place until first light. The Swaledale MRTs prompt and critical actions undoubtedly prevented further loss of life.

42. By approx 2130L ambulance and paramedics, Fire and Rescue, 2 RAF SAR Seaking helicopters and additional troops from Catterick Garrison had arrived. RAF Leeming military MRT attended with further medical support, heavy equipment and manpower (2230L) and thereafter Leeming deployed a full Guard Force of 100+ personnel and assumed control of the site (2300L).

PIDAT [52]

43. No formal Bloods or Alcohol testing took place during the immediate post crash process, however subsequent North Yorkshire Police investigation, based on A&E hospital blood samples, found no significant traces of alcohol or drugs amongst the crew. None of the Army ITC troops were tested.

POST CRASH MANAGMENT

44. RAF Leeming’s swift and comprehensive response to the accident was assisted by the lessons learnt from an autumn 2006 Crash Exercise “MERLIN RESPONSE”. All critical actions on 8 August 2007 were methodically executed, including fuel spillage plans and press handling at Hudswell Grange.

45. RAF Benson moved quickly to conduct KINFORM [53] action before the press gave out any details on TV and radio. However some critical 33 Squadron documents (Crew Signature Cards and Training Records) were temporarily misplaced or accidentally wiped clean [54].

46. **Cockpit Voice Recorder.** ZA934’s CVR was recovered intact (See Para 1.3-10 Para 32 and Note 44) and was flown to Farnborough QinetiQ by RAF Hawk. With the BOI suspended and the North Yorkshire Police investigation convened, control of the CVR Contents passed to the North Yorkshire Police. Under Crown Regulation [55], Civilian CVRs are retained and controlled exclusively by the AAIB, whilst Military CVRs are afforded no such protection.

DAMAGE TO AIRCRAFT, EQUIPMENT and PROPERTY

47. **Aircraft and Equipment.** ZA934 suffered catastrophic damage and was declared Category 5 damage (scrap).

- a. The cost of recovering the airframe [56] was estimated at: £5900.
- b. The cost of the airframe and its equipment, including Operational Airframe Modifications, Safety and Role Equipment was estimated at: £709,239. [57].

48. **Property.** The accident occurred on Crown Land (Catterick Range). Damage to Property was light, with no damage to civilian effects or property. In summary:

- a. RN Environmental Health Team surveyed and co-ordinated accident site recovery actions [58].
- b. RAF Leeming Fuels Team prevented fuel and oils contamination of the local water source. Subsequent tests showed no evidence of contamination.
- c. The Environment Agency, with Catterick Range Authorities, removed contaminated soil and grass and, with assistance from RAF Leeming and monitored the area up until 2009.

[52] Post Incident Drug and Alcohol Testing (Iaw DIN 2006DIN02-030).

[53] Informing Next of Kin of crew injuries & fatalities.

[54] North Yorkshire Police Statement OC 33 Squadron dated 28 Jan 2008 and 2IC 33 Squadron dated 22 May 2008. Statement 10 & 11.

[55] Statutory Instrument 1996 No. 2798 The Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996, Para 18.

See Annex I (1), (2) & (3). AAIB Statutory Instrument, DARs CVR Study (DRAFT) & JHC Response.

[56] Joint Aircraft Recovery and Transportation Squadron (JARTS) report. Annex E-1.

[57] Based on Puma Project Team 'On-book' Airframe value figures, not replacement costs.

[58] RN Environmental Report Overview. Enclosure Annex E-2.

The total cost of these actions to protect and restore Crown Property has been estimated at £37,500.

49. **Total Loss Costs.** The total value for the damage to the Aircraft, equipment and property is estimated at £752,639.

LOSS OF CLASSIFIED MATERIAL

50. No documentary material classified above restricted was carried in the aircraft and all items or equipment of a higher security grading (elements of Self Defence Fit [59]) were accounted for during the recovery phase.

[59] ZA934 had only partial embodiment of the latest Out of Area Self Defence Fit. Critically sensitive items were not routinely fitted to UK based aircraft.

CONCLUSIONS

51. The Service Inquiry Panel concluded that:

- a. The crew were on duty.
- b. The weather was suitable for the task [60].
- c. The aircraft was declared serviceable for the task [61].
- d. The crew conducted a brief [62].
- e. The crew were competent to undertake the core task, in its simplest form, with the Captain acting as the handling pilot [63].
- f. The flight was incorrectly authorised [64].

[60] Leeming Meteorological Actual and Forecast reports at Exhibit 2.

[61] RN FSAIC (RNAS Yeovilton) Investigation for North Yorkshire Police. Full report at Annex B.

[62] SI Team Interview, Co-Pilot 2 statement at Part 2.3 - 3.

[63] Review of Crew Training Profiles Annex C-1.

[64] 1.3 – 4 and 5, Para 11 to 13.

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PART 1.4 FINDINGS

PART 1.4 – FINDINGS

INTRODUCTION

1. The Service Inquiry Panel's task was greatly complicated by the timeline of the civilian police and Coroners Court investigations (Part 1.3-1 Para 1b) stretching to over 2½ years beyond the accident. The Panel therefore began by reviewing the existing Board of Inquiry (BOI), civilian police, AAIB, RNFSIAIC, RAF CAM and other agency evidence. The Panel then went onto re-investigate a number of areas and make fresh enquiries into other factors and data not covered by those agencies.

2. A considerable amount of North Yorkshire Police, AAIB and other evidence was available, or subsequently requested, by the Panel, which enabled it to reconstruct a reasonably accurate account of the accident. Further investigation by the Panel was required to fully expose the wider chain of events leading up to the accident. Evidence included statements from the surviving Co-Pilot, passengers, Infantry Training Company (ITC) Troops and eyewitnesses, evidence from the crash site and from the Cockpit Voice Recorder (CVR) fitted to ZA934.

3. The Puma's 3 channel CVR [1] is a voice recorder only. It does not record rotor RPM, engine performance, control positions or height and airspeed data. Furthermore ZA934's GPS memory was damaged during removal giving no useful data. This lack of performance data somewhat hindered the 2007 investigation. Notwithstanding this, due to the location, containment and preservation of the aircraft and the accident site, the 2007 BOI's belief after receiving the CVR recording was that ZA934 had not suffered any performance, technical or mechanical failure, a fact ratified by the subsequent police/military investigation. The 2009 Service Inquiry Panel, therefore, concentrated its investigation in the following areas: Human Factors, Crew Training, Organisational Factors, and Supervision.

[1] Basic 3 Channel Voice Recorder. Capt, Co-Pilot and Cockpit Area Microphone. Tape on 2 hour 'loop'. See Annex B, RN FSAIC Report 3-1-6-2, Page 109.

AVAILABLE EVIDENCE

4. To assist the Panel in its deliberations the following evidence was available:

- a. Statements from the surviving Co-Pilot and the cabin occupants (Infantry Training Company Troop passengers).
- b. Cockpit Voice Recorder data from ZA934.
- c. Eyewitness statements.
- d. The wreckage of ZA934.
- e. Engineering documentation of ZA934.
- f. Orders and documentation.
- g. ATC transcripts and radar traces from National Air Traffic (NATS) and RAF Leeming.

- h. North Yorkshire Police ('OPERATION HEATING' [2]) evidence and statements.
- i. The RAF Centre for Aviation Medicine (RAFCAM) - medical and post mortem reports.
- j. Expert analysis and reports.

[2] OPERATION HEATING. North Yorks Police title for ZA934 Investigation.

SERVICES

5. To assist the Panel in its deliberations the following services were available:

- a. Royal Navy Flight Safety and Accident Investigation Centre, RNAS Yeovilton.
- b. Air Accident Investigation Branch (AAIB).
- c. The RAF Centre for Aviation Medicine (RAFCAM) Accident Investigation Unit.
- d. QinetiQ, Farnborough.
- e. Eurocopter, associated supporting contractors and agencies [3].
- f. RAF Leeming Meteorological Office.
- g. Puma Integrated Project Team (IPT).
- h. Joint Aircraft Recovery and Transportation Squadron (JARTS).
- i. RAF Benson – PUFOR[4] and MSHATF[5].
- j. Defence Helicopter Flying School (DHFS), RAF Shawbury.
- k. RAF Air Staff Service Inquiry Advisors.

[3] Engine, Autopilot and Avionics manufacturers.

[4] Puma Force RAF Benson.

[5] Medium Support Helicopter Aircrew Training Facility – CAE Simulator.

FACTORS CONSIDERED BY THE PANEL

6. At an early stage the Panel was able to discount mechanical and technical systems failure, structural damage, engineering maintenance, pilot incapacitation and weather as factors in the accident. Whilst not discounting other factors, the Panel concentrated on the following:

- a. Organisational Factors:
 - (1) Squadron manning and experience levels.
 - (2) Squadron task load.
- b. Training.

- c. Supervision.
- d. Human Factors:
 - (1) Crew Resource Management (CRM).
 - (2) Deviation from correct procedures.
 - (3) Visual Illusion.
- e. Relevant Orders and Instructions.
- f. Flying handling.

DISCUSSION OF FACTORS

7. Organisational Factors.

a. Squadron Manning and Experience Levels.

(1) A number of factors led to a gradual reduction of aircrew experience (dilution levels) from the Puma Force (PUFOR), out to other areas, from 2003 onward. Key amongst these was a requirement to grow an expanded Chinook Force and a new Merlin Squadron (78 Squadron) [6].

(2) Additionally, the Puma Force's critical role and robust performance in a number of high tempo operations [7] had also resulted in the promotion of a significant number of experienced aircrew out of the force.

(3) Furthermore, the demand of operations had reduced the availability of aircrew to release to QHI courses [8] creating an increased demand on those remaining instructional staff.

(4) The cumulative effect of this draw on Puma experience to other forces can be seen by 2007 (Fig 11 & notes a - c). Note the high dilution levels (Yellow and Red) of junior pilots flying experience.

•ALL Aircrew (Main Sqn, Operational Conversion Flight & Other) – 76 {83}

Pilot 42 {53 Nav & Pilot}	Nav 7	Crewman 27 {30}
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•PILOTS (Main Sqn) – 31 TOTAL Hours (ALL Types)

>1000 Flying Hours -14 pilots	>500 Flying Hours - 13 pilots	<500 -4
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•PILOTS (Main Sqn) – 31 Puma Hours

>1000 Puma Hours -12 pilots	>500 - 5	< 500 Puma Hours -14 pilots
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(Fig 11 – 33 Squadron Manning and Experience Levels Aug 2007)

[6] Strategic Review of the Puma Helicopter Force, 15 May 08 – 'Dixon Report' – 4.13 Current Aircrew Manning and 5.8 Experience Levels in the Puma Force, Annex H.

[7] [REDACTED] and the Baghdad Foreign and Commonwealth Organisation (FCO) Airbridge and [REDACTED]

[8] QHI. Qualified Helicopter Instructor. Central Flying School, RAF Shawbury.

[Fig 11] 33 Squadron Manning and Experience Levels, Aug 2007. Data drawn from 33 Excel Spreadsheet – Annex F.

a. ALL Aircrew – Manning Target 83, actual manning 76, of which the Squadron Cdr, 2IC and OC A Flt where Navigators.

b. PILOTS (Main Squadron) TOTAL Hours. Pilots allocated to the core Sqn (excluding the Operational Conversion Flight and S&D Flight). Note that greater than half the Squadron has below 1000 hours flying experience (all types).

c. PILOTS (Main Squadron) Total PUMA Hours. Note that 14 of the Squadron's Pilots have less than 500 hours experience on Puma. A further 5 have less than 1000 hours on Puma.

See also

Strategic Review of the Puma Helicopter Force, 15 May 08 – 'Dixon Report' – 4.12 Dilution, Annex H.

(5) It is noteworthy that 3 of 5 Squadron executives were navigators (OC, 2IC and OC A Flight) and unable to assist in training new pilots in handling skills. The Squadron Commander had elected to PVR [9] and was leaving the service imminently. [REDACTED]

[REDACTED] OC C Flight's (OC Training) post was gapped due to a posting and the OC Training Flights responsibilities were being covered by a new Junior Officer (JO) B2 [10] QHI. The Operational Conversion Flight (OCF) Flight Cdr had elected to PVR and was absent on terminal leave, his responsibilities being covered by a substitute QHI.

b. **Squadron Task Load** [11].

(1) From 2003 onward the Puma Force found itself reacting to growing operational demands in Iraq (Op TELIC). Initially at Basra, with 4 crews, supporting the Multi National Division (South East) (MND(SE)), it was then further tasked to provide support to the Foreign and Commonwealth Office (FCO) in Baghdad [12].

[REDACTED]

(3) Whilst the commitment at Basra ceased in Apr 05, the wider Iraq task grew ([REDACTED]) to become a significant burden on the both 33 and 230 Squadron in manpower, training and engineering terms.

(4) Additionally, 33 Squadron carried other tasks having to support the ongoing throughput of student Puma aircrew on the OCF [16] and provide an experienced crew to support [REDACTED] [17]. These tasks added to the already significant training burden being carried across 33 Squadron as a whole.

(5) Critical to this heavy burden [Note 12, 15, 16 and 17] was the draw on the most qualified aircrew, much of the experienced Squadron training staff, [REDACTED] creating a shortfall of UK based training staff. Those instructors that were available were prioritised into training the next tranche of Out of Area crews, leaving new arrivals and low hours pilots (mostly Limited Combat Ready) as the lowest priority.

[9] PVR. Premature Voluntary Release (Resign from the Service).

[10] B2 QHI - A newly qualified and inexperienced instructor.

B1 QHI - An established and experienced instructor.

A2 QHI - An above average and advanced instructor

[11] Data drawn from RAF Historical Branch, Northolt, Restricted and SECRET F540 (Squadron History) Records, Not included as Annex or Exhibit.

[12] FCO Airbridge, also known as the BHD - Baghdad Heli Det. [REDACTED]

[13] [REDACTED]

[14] [REDACTED]

[15] [REDACTED]

[16] Operational Conversion Flight. Responsible for converting new crews onto type running 5, overlapping courses a year.

[17] [REDACTED]

(6) These facts had been clearly articulated by Support Helicopter Standards & Evaluation Unit (STANEVAL) in its March 2006 and March 2007 reports [18], and by the Squadron Cdr to the Puma Force (PUFOR) HQ and Joint Helicopter Command (JHC) in document and email traffic [19] and encapsulated in the PUFOR Cdrs “Long War” Paper [20] in which the PUFOR Cdr gave JHC a clear list of options regarding the effect of Operational demands on Out of Area Capabilities and UK based tasking and training activity.

(7) This “Long War” paper [20] was written against the significant real and perceived pressure at all levels to meet recognised demands on helicopter lift capability in both theatres and a background of Strategic direction from Senior Defence Staffs directing that “nothing was to undermine support to current ops”. Other changes discussed were Harmony rates down to 1:2.5 [21], reduction of OCF Into Productive Service (IPS), utilisation of R&S [22] Wing personnel on Ops and consideration of return of newly qualified QHIs direct back to Front Line Squadrons bypassing any Defence Helicopter Flying School (DHFS) instructional consolidation.

8. Pressures driven by Out of Area priorities placed the Puma Force under considerable strain. The Panel considers that the cumulative effect of the outflow of experienced aircrew, OOA task priorities and commitments on UK based training and airframe availability for crews, placing the newest crews as the lowest priority, was a factor in reducing the flying rates, training quality and opportunities on 33 Squadron based aircrew [23].

[18] Exhibit 7.
STANEVAL Squadron
Visit Reports:

(a) 2006 - 33 Squadron

(b) 2006 - 230 Squadron.
Included for comparison &
completeness.

(c) 2007 - 33 Squadron.

[19] Exhibit 8 a to f

(a) Puma Force Manning
Letter OC 33 Squadron –
JHC HQ SO2 J7 Trg SH
(Copy to RAF Personnel
Manning Agency). 18 Apr
2007.

(b & c) Email trail OC 33
Squadron – FHQ. 25 &
26 Jul 2007; RE: PU and
ME FORCE IMPACT
STATEMANT

[d to f] JHC Monthly
Aviation Report – May, Jul
& Aug 07

[20] Briefing paper to
DACOS J3/J7 JHC HQ 29
Sep 06 from Puma Force
Cdr. Extracts at Exhibit 9.

[21] Harmony Rates –
Time away verses time
UK based. Already in
reality routinely 1:2 or
less. 33 Squadron F540
(SECRET) RAF Historical
Branch, Northolt.

[22] R&S Wing.
RWOE&TU (Rotary Wing
Operational Evaluation
and Trial Unit) +
STANEVAL (Standards
and Evaluation Unit).
Units not normally
supporting Ops with
personnel. Primary task
normally training.

[23] Strategic Review of
the Puma Helicopter
Force, 15 May 08 – ‘Dixon
Report’ - 5.11 Training,
5.12 Squadron
Administration and 5.13
Managing Concerns about
Overtasking. Annex H.

See also,

SI Interview OC 33
Squadron and OC B Fit,
33 Squadron, Part 2.3 – 6
& 10.

9. **Training.**

a. The scale and style of operations being supported by the Puma Force by 2007 ([REDACTED]) demanded a significant and constant training and supervision burden in maintaining specialised skill sets to support up to [REDACTED]

ongoing UK based tasking and training [16].

b. The requirement for both Operational Conversion Flight (OCF) day training and main squadron Night-Assault training meant that 33 Squadron was running flying operations from 0800L through to 0200L daily in the summer months, with the associated requirement for engineering and flying supervision cover. Additionally, in the absence of a Station Airtest Pilot (post gapped), 33 Squadron was providing an Airtest Crew [24] for the 2nd Line Puma deep servicing facility [25] for post engineering rectification test flights, for which there was a significant daily burden.

c. With the OCF fully tasked training new Puma aircrew [26], the main Squadron was responsible for its own Limited Combat Ready to Combat Ready (LCR to CR) and OOA training, of which Iraq Ops training was the highest priority.

d. The main 33 Squadron OC Training position was gapped due to manning shortfalls and demands for experience crews to feed Out of Area Operations. The task was being carried by a Junior Officer (JO) B2 QHI [Page 1.4 – 4, Para 7a (5) and Note 10]. The former OC Training [27] was transferred to take over B Flt and deploy in support of Out Of Area Ops commitments [REDACTED]

due to the shortage of suitably experienced and qualified aircrew.

e. The cumulative effect of this focus on 'high-end' Ops was to direct all remaining available assets on Pre-Deployment training (almost exclusively night based) and as a result, restrict the routine opportunities and quality of training for lower priority aircrew, ie new arrivals and follow-up Limited Combat Ready (LCR) to Combat Ready (CR) training.

f. An analysis of the Captain's flying hours and profile [Annex C] shows that he flew a total of 209:50hrs and 139 sorties in 12 months prior to the accident. He flew less than the Squadron average (13:40hrs) for 5 months and less than NATO Minimums (15:00hrs) for 7 months. 38 of 139 sorties were on engineering maintenance test flight [28] sorties. He flew 21 sorties with Squadron Training staff over the period. Only 45:35hrs was logged as Puma Captain. The Squadron Commander remarked on his low flying rate in his Logbook Annual Flying Summary [29]. The Captain passed his Combat Ready (CR) check on 25 June 2007; the sortie being assessed as 'Low Average'.

g. No evidence can be found to prove that the Captain was formally taught the full 'Wing-Over' exercise on the Puma OCF. Due to Griffin (Bell 412) 'Release to Service' issues (manoeuvre limits) at the Defence Helicopter Flying School (DHFS) he was not taught the 'Wing-Over' exercise on Sixty Squadron. A brief mention of being demonstrated a 'Wing-Over' exercise on a revision sortie on 705 Squadron DHFS (Squirrel) was recorded on 6 October 2004.

[24] A CR Qualified Pilot, capable of flying post maintenance airtest flights. Qualification requires specialist training.

[25] Puma Servicing Flt. Station Engineering Wing run facility conducting deep servicing of airframes requiring scheduled maintenance or returning from Out Of Area Operations.

[26] Due to a critical lack of experienced aircrew, OCF instructors were also 'flexed' to support Main Squadron Out Of Area Operations. Strategic Review of the Puma Helicopter Force, 15 May 08 – 'Dixon Report' – 7.3.2 Provision of QHIs/QCIs, Annex H.

[27] Former OC Training Flt. Qualified as a Training Captain. This is a lesser, Squadron based qualification and less capable than formal CFS QHI status.

[28] The Captain was not Full Airtest qualified, however he was able to crew 'Rotor Tune' sorties. This involved repetitive medium-level, straight & level, cruise flights at varying speeds whilst vibration data was gathered by a qualified technician.

[29] ZA 934 Captain Pilots Flying Logbook, Sect 7, Annual Summary dated 3 Jun 07. Annex C-3-(5).

h. Notwithstanding these facts, the Captain of ZA934 had completed the 'Quick-Stops' sortie on the Puma OCF, report dated 1 March 2006, and should have therefore been demonstrated, and flown for himself, a 'Repositioning Turn' manoeuvre [30].

i. ZA934's Co-Pilot 1 training record indicates that [REDACTED] [REDACTED] Having successfully completed an End of Course check on the OCF all graduates move to the main Squadron as "Recommended LCR". On arrival on the main 33 Squadron, Co-Pilot 1 received a Day and Night Out-of-Phase check [32] and was subsequently placed on the flying roster. His Flying Log Book was not endorsed "LCR" by 33 Squadron staffs. Co-Pilot 1 received little further formal follow-on training in his first month on 33 Squadron before he injured his [REDACTED] and was temporarily grounded in early June.

j. On return to flying status on the 24 July, Co-Pilot 1 was given a further Day and Night Out-of-Phase check. He flew 5:50hrs in the remainder of July, and 10:45hrs in August, most of which was on the August Catterick Task, none of which was with Squadron Training Staff. No record exists of him having completed a supervised 'live' trooping exercise in a Puma prior to the August 2007 accident. He had flown a total of 19:45hrs as Puma Captain over his OCF Course and on the main 33 Squadron at the time of the accident.

k. The Crewman's flying rate both on the OCF and on arrival on the main Squadron was significantly higher due to a manning shortage of RAF rear crew and Out Of Area demands. Notwithstanding these factors he experienced a closer level of supervision by the crewman training staff than that applied to the pilots.

10. All 3 members of the accident crew had omissions (documented or otherwise) in their training requirements:

a. The Captain had no record of having completed a full formal 'Wing-Over' Exercise since 2004. No subsequent record exists of this omission being formally corrected or taught.

b. The Co-Pilot had no record of experiencing a supervised live trooping exercise, although he had flown a Maximum-All-Up-Mass (MAUM) Profile [33]. Critically, his Flying Log Book was not endorsed 'Limited Combat Ready' (LCR) by 33 Squadron. This in itself is not an indication of having not completed the required training, but reflects on the scrutiny of his training activity by the Training Staff and supervisors [34].

c. The Crewman had no formal report on having seen or being briefed on Tactical Climb and Descent profiles, a manoeuvre that has similar judgement and energy management aspects to that of a 'Wing-Over', or 'Repositioning Turn'.

11. Notwithstanding these facts, the Panel noted that the accident crew members had all successfully been examined and graduated from the Puma OCF and were capable of conducting the core trooping familiarisation task in its basic format, with the Captain acting as handling pilot.

[30] Repositioning Turn - Turning manoeuvre using both a horizontal and vertical element to quickly and efficiently achieve the reverse track. Similar in some aspects to a full 'Wing -Over' manoeuvre but utilizing less of a vertical component (height).

[31] Air Warning: Formal reporting action taken to detail a student's failings and provide a structured package of additional flying training. See Annex C-4-(5).

[32] Out-of-Phase (OOP) Check. A flight or task supervised by a Training Capt or QHI where specific essential skill sets are practiced. Carried out after a calendar period of non-flying by all aircrew.

[33] MAUM. Maximum All Up Mass – Flying handling instruction with the aircraft loaded to its maximum weight limits.

[34] Strategic Review of the Puma Helicopter Force, 15 May 08 – 'Dixon Report' – 5.12, 33 Squadron Administration, Annex H.

12. The Panel considers that the reduced opportunities for supervised consolidation and reinforcement training, combined with the low flying rates of junior aircrew, reduced the levels of Airmanship and Experience across elements of the Squadron, contributing to the judgement and handling decisions made by the crew of ZA934 on the 7/8 August 2007.

13. **Supervision.** Supervision on 33 Squadron was initially affected through a weekly planning meeting; routinely on a Thursday after the Station Executives Meeting. The planning meeting was attended by the Duty Flight Commander (DFC), OC Training (or his deputy), the Squadron's Operations Officer (or deputy) and an Engineering Officer or SNCO. During this meeting, the forthcoming week's tasking and training would be prioritised against assets and crews available.

14. On a daily basis, the Squadron Duty Flight Commander (also referred to as Duty Exec) would command overall flying operations, delegating the minute by minute supervision to an experienced Junior Officer pilot or navigator, titled the 'Duty Authoriser' (DA).

15. The specific Authorisation process of ZA934's Crew and Task on the 7 August 2007 is detailed at Page 1.3-4 Para 8–13.

16. The Panel made the following observations:

a. The constitution of ZA934's crew, in both its original and subsequent formats was capable of executing the core task (basic day troop familiarisation) with ZA934's Captain acting as handling pilot for the tasking element.

b. The combined experience level of the crew was very low, with both the Co-pilots (1 and 2) and the Crewman being new Limited Combat Ready aircrew. The Captain had only graduated to Combat Ready status the previous month and had no broader 'operational' experience or training/supervising qualification.

c. The Catterick Task was the Captain's first Self Authorising mission as Aircraft Commander.

d. The Catterick Task was Co-Pilot 1 and 2's first overnight land-away mission on 33 Squadron.

e. ZA934's Captain was not a Training Captain [35] and so was not authorised to teach or coach new or Limited Combat Ready aircrew.

f. The initial departure authorisation process [36] between the Duty Flight Commander and the Captain had been compromised by a requirement for the Duty Flight Commander, as the only senior officer available [37], to host a Squadron Visit. The Captain wrote his own Temporary Powers of Authorisation entry which the Duty Flight Commander signed later, at the prompting of the Duty Authoriser, although not until after the crew had departed to Leeming.

g. Whilst the Squadron Duty Authoriser corrected the Captain's departure Authorisation and informed the Duty Flight Commander of his requirement to sign the Temporary Powers of Auth section, all of the Captain's subsequent self-authorized entries at Leeming, were incorrectly constructed, lacking minimum heights and/or low-level booking references in addition to other factors [38].

[35] Training Captain. An experienced Squadron Pilot who is selected to act as 'Mentor' to other Squadron Aircrew. He is trained by a QHI in Coaching and Intervention skills such that he is able to supervise and consolidate skills already taught by QHI and prevent a new pilot getting into a hazardous situation.

[36] The granting of Temporary/Detachment Powers of Authorisation. JHC Flying Order: J301.100.4

[37] OC 33 Squadron and OC A Flt away on Adventure Trg Sailing Cse, OC B OOA Iraq, OC C Position gapped, OC D PVRd/Position gapped.

[38] See 1.3-6 (15) & Exhibit 3 a & b – OP HEATING, RAF Specialist Team Report.

17. The Panel considers that the Squadron Duty Authoriser's actions were reasonable, given the already constituted crew presented to him & the very simple nature of the task. The Panel believes that the wider supervision of the task; in crew allocation, DFC briefing and oversight and Captains actions, was not suitably robust.

18. Given the level of experience of the Co-pilots and Crewman, the Panel consider that it would have been more suitable for:

- a. The Captain of the Catterick Task to have been a Qualified Training Captain.
- b. The Crewman to have been a more experienced Combat Ready WSOp.
- c. Cancel the Task.

19. **Human Factors.** A full CRM and Human Factors Report (Serial No 14/09), produced by the Aviation Human Factors Psychologist from the Crash Investigation Unit, RAFCAM, RAF Henlow, is attached at Annex G. In summary:

a. **CRM.**

(1) The 'Dynamic' of the accident crew points to a 'flat' cockpit gradient. Whilst the aircraft Captain was technically the more experienced pilot, he had been noted, throughout his training, [REDACTED]

[39]. Co-Pilot 1 was considered to be a confident and outward going character but was also noted, at stages through his flying training, [REDACTED] [40].

(2) Additionally:

(i) The Captain and Co-Pilot 1 were close friends. They had passed through Officer and Flying Training in very close proximity and both lived in the Officers' Mess.

[REDACTED]

(iii) This was the first 'real' task that the entire crew had undertaken without higher supervision present and was perceived as an 'easy' and 'fun' task [42].

(iv) Co-Pilot 1 considered the Captain to be an 'experienced' pilot having recently returned from an exercise in Belize and having gained Combat Ready.

(v) The Crewman, whilst a more mature airman and ex-technician, was inexperienced in aviation and tasking terms and possibly reluctant to question 2 closely knit pilots with regard to operating procedures [43], particularly when the task was considered simple and benign.

[39] Captain Training Profile – Annex C-1 Review of Training Records (page marked Annex G, page numbered 410, para 3d) & C-3 (Sixty Sqn DHFS End of Cse Report).

[40] Co-Pilot 1 Training Profile – Annex C-1 & 4.

[41] North Yorks Police Interview – OC 33 Squadron, 8 Nov 2007. 2.3 - 8.

[42] SI Interview – Co-Pilot 1. 2.3 – 7.

[43] Strategic Review of the Puma Helicopter Force, 15 May 08 – 'Dixon Report' – 4.4 Roles of Crewmen. Annex H.

(3) The 'sum' of these dynamics potentially leads to a Captain who could be 'capacity' limited and may not fully 'command' a situation, a co-pilot who may not fully monitor or appreciate the Captain's actions and a crewman who may not question the front crew's course of action. The Panel feels that this was an unfortunate and untimely mix of human factors which contributed to the chain of events on the 8 August 2007.

b. Deviation from Correct Procedures.

(1) Cockpit Voice Recorder and camera footage evidence details a number of deviations from correct procedure. An example of some, but not all occurrences are:

- (i) Moving the under-carriage (up & down) outside of safe single engine operating parameters.
- (ii) Abbreviating or missing essential (Green Banded) checks [44].
- (iii) Flying below the minimum authorised height [See 1.3-4 Note 19].
- (iv) Playing music over the aircraft intercom from a Portable Electronic Device [1.4-12 Para 7].
- (v) Carrying out unauthorised 'advanced' manoeuvres inappropriate to the given task [45], by both the Captain and Co-pilot 1.

(2) These and other actions demonstrate a general relaxation of formal cockpit routines and protocols that contributed to an acceptance of the breaking of regulations, procedures and limits.

c. Visual Illusion.

(1) Study of the topography of the accident site and its immediate surrounds, in relation to the final manoeuvre path, demonstrate some potential to have given the handling pilot misleading clues as to his height above the ground, considering his lack of formal training regarding the style of manoeuvre chosen.

(2) RAFCAM Human Factors Psychologist analysis (Annex G) shows that the crew looked out over falling ground during the final, outbound, climb to height, potentially giving the impression of a greater elevation achieved. It is believed that the Captain's focus was then to look back at the troops location, hard over his right shoulder, during the >60° AOB turn, in order to achieve the desired return track. This action reduced the likelihood of him looking back inside at his own flight instruments. The orientation of the return track sight picture, relative to the Captain, and the sloping angle of the far horizon may have led him to believe he had greater separation than actually achieved until recovery action was too late to be effective [46].

[44] Mandatory crew monitored checks.

[45] See 1.4-12 Para 6c. JHC FOB – J340.140.9 Para a & b. Low Flying – Familiarisation Sorties refers (up to 1 November 2007).

See also
1.3 – 7 Note 30.

[46] Extensive and independent profiles were flown, on the Puma Simulator at RAF Benson, by:

a. CAE/Serco Simulator Instructor Staffs (former A2 Army Air Corps and later, RAF QH1) for the North Yorkshire Police, 2007. See statement 2.3-9, dated 14 Jan 2009

b. Central Flying School (Helicopters) - External Standards Examiner (A1 QH1), 2008.

c. 2009 Service Inquiry Panel President (A2 QH1), 2009.

All 3 teams' assessments independently drew very similar aircraft handling conclusions.

(3) Cockpit Voice Recorder Analysis leads the President and Specialist Member to believe that Co-Pilot 1 may have been looking back into the cabin during the critical turn of that final manoeuvre and may not have been monitoring the flight instruments or cockpit sight picture. No adverse or cautionary comment was heard from the Co-pilot or Crewman throughout the final manoeuvre.

d. The Panel considers that the 'Dynamic' of this crew's combined inexperience, style of interaction, attitude to the given task, procedures and regulation were key to the poor choices and actions carried out on the 8 August 2007.

20. **Escape System Function.** RAFCAM carried out a detailed analysis of the Escape Systems and the crew's Aircrew Equipment Assemblies (AEA) [47]. These are further detailed in the RN FSAIC Report. Due to the catastrophic nature of the impact and aircraft 'tumble', none of the designed escape facilities were used by the crew or passengers other than to exit through the damaged fuselage or open cabin doors.

[47] AEA. See:

a. Annex B, RN FSAIC Report, page 55-57, 1.15, Survivability & Safety Equipment. &

b. Annex D, RAFCAM AIHF Report 06/07 2010 SI Update.

21. **Relevant Orders and Instructions.** The Panel noted that the relevant orders and instructions were complied with apart from the following (extracts):

a. **JHC and JSP 550 Orders:**

(1) **J110.101.1 General.** All aircrew, whether operating as Aircraft Commander or as a crewmember, have a primary responsibility to ensure that the mission, sortie or task, for which they have been authorised, is executed in a manner that minimizes the risks and hazards to the aircraft, its occupants, ground crew, other airspace users or general public over which such aircraft are flown. If at any time a crewmember considers that a circumstance may jeopardize the safety of the aircraft and its crew, he is to advise the aircraft commander accordingly and, if necessary, offer specific guidance to avoid the hazardous situation.

(2) **J115.100.1 General.** Captaincy is the generic term used for the judgement and asset management skills of aircrew when performing their primary duties as Aircraft Commander. Before being given the qualification of Aircraft Commander, a pilot must satisfy the supervisory chain that he is capable of carrying out all duties that may be required of him, including captaincy.

(3) **J115.100.2 Non-Operational Flying.** The Aircraft Commander/formation leader is to carry out the mission or alternate mission as briefed within the constraints of his orders or any other applicable orders. In addition, the formation leader, or if a single aircraft the Aircraft Commander, is to ensure that the mission is executed in a manner that minimizes the hazards to the aircraft, its occupants and equipment.

(4) **P115.000.1** Only competent aircrew are deemed qualified to act as the Aircraft Commander or crew in UK Military Aircraft. Except for personnel authorised under the relaxations to the regulations promulgated in Section 100, all aircrew must be in possession of a valid Certificate of Competence (CofC) or a Certificate of Qualification on Type (CQT) in their logbook showing them to be qualified to carry out the duties to be authorised.

(5) **J330.105.1 Authorisation** The authoriser must ensure that within the UK, the requirements of the UK Mil AIP Vol 3 Part 1 are observed. The authorisation is to include details of Low Flying Areas through which the flight is to be conducted and MSD/AGL/MSL figures as detailed in Order J330.110.3 and 4

(6) **J330.110 MINIMUM HEIGHTS/MSL/MSD**

(a) **J330.110.1 Tactical Flying.** For the purpose of this Order, tactical flying is defined as flight conducted to achieve attack, observation, reconnaissance and/or artillery support missions, Joint Personnel Recovery missions or a Confined Approach & Departure (CAD) [48].

(b) **J330.110.3 Minimum Heights for Helicopters.** Normally, the minimum height for JHC helicopters when low flying is 100 ft AGL; however, low flying may be authorised to 50 ft AGL to meet specific operational training requirements. However, authorising officers are to ensure that this is kept to the minimum necessary to meet the training task and that the training requirement meets the necessity for flying below 100ft AGL. Tactical flying may be authorised down to ground level. Tactical flying training is subject to the following limitations:

i. Flight below 50 ft AGL is to take place within the UKLFS or on military training areas and is to comply with specific regulations in the UK Mil AIP Vol 3. Flight below 50 ft AGL in overseas theatres is only permitted where the relevant national procedures allow.

ii. In peacetime, in any operations involving flight below 50 ft AGL, 2 pilots, pilot and nav, or a pilot and a fully briefed crewmember are to man the helicopter cockpit. This condition may only be waived if the pilot is considered by the authoriser to be fully familiar with the area of operation.

(c) **J340.140.9 Familiarisation Sorties** [45]. Approving officers and authorisers are to use the following guidelines when passengers and troops are flown on familiarisation sorties:

i. **Basic Familiarisation Flying.** Basic Familiarization Flying. The sortie profile would consist of straight and level flight with simple manoeuvres only and no low flying. This would be suitable for all categories of civilians.

[48] The crew of ZA934 were conducting Troop Familiarisation Training and not Tactical Flying (See J330.110.1), therefore 100' agl should have been the crews minimum height (J330.11.3 applies).

See also:

See 1.4-12 Para 6c. JHC FOB – J340.140.9 Para a & b. Low Flying – Familiarisation Sorties refers.

Note Exhibit 1 – HELQUEST wording "Familiarisation Flights".

ii. **Advanced Familiarisation Flying.** This sortie profile would be as a basic familiarization sortie but would include a short low-level leg in a previously recced area. This would be suitable for troops.

(7) J203.110 CARRIAGE AND OPERATION OF PORTABLE ELECTRONIC DEVICES (PEDs)

J203.110.1 General.

a. The term PED is used to describe items such as laptop/palmtop computers, calculators, mobile telephones, radios, cameras and electronic medical support equipment.

b. The carriage and operation of PED in JHC aircraft is permitted without the need for a Service Deviation (with the exception of the Puma HC Mk1 [49]) provided that the criteria in Order J203.110.2 and Order J203.110.3 are fulfilled.

[49] The Puma HC1 has 2 TV style displays in the cockpit, which can be



(8) J130.105 AIRCREW EQUIPMENT ASSEMBLIES (AEA) AND SURVIVAL EQUIPMENT (SE)

J130.105.1 General.

a. All operating aircrew of JHC aircraft are to wear aircrew flying helmets:

b. Passengers in the rear seats (external to the cockpit) are to wear either a firm fitting Mk 15 Passenger Helmet, a flight deck headset that offers cranial protection or a correctly fitted aircrew flying helmet, except where operational requirements make this impractical; as a minimum, they must wear an appropriate form of hearing protection. Troops are to wear a service issued combat helmet, [50] except where operational requirements make this impractical; as a minimum, they must wear an appropriate form of hearing protection. The Aircraft Commander is responsible for ensuring that the protective equipment is worn correctly and securely at all times.

[50] MP4 Camera footage taken by ITC troops in ZA934 during tasking prior to the crash shows that troops flew incorrectly dressed (no combat helmets) and seated (riding on the aircraft door sill).

(9) R305.105 DANGEROUS OR NEGLIGENT FLYING

R305.105.1 Dangerous, negligent or unauthorised low flying or flying such as to cause unnecessary annoyance is not only in breach of these Regulations, but is a specific offence under the Service Discipline Acts. Specifically, the following are Service offences:

a. Being guilty of any act of neglect in relation to flying or in the use of any aircraft or aircraft material which causes or is likely to cause loss of life or injury to any person.

b. Whilst acting as a pilot, low flying (i.e. flying at a height less than such height as may be provided for by any regulations), except when taking off or landing or in other authorised circumstances.

(10) R305.115 ALCOHOL AND FLYING [51]

R305.115.1 Aircrew, including those with supervisory duties, are to ensure that they are not suffering from the effects, or after effects, of alcohol when reporting for duty. No alcohol is to be consumed during the 10 hours immediately prior to being liable for flying duties. Additionally, aircrew are to minimise their intake of alcohol during the 24-hour period before flying (as a guide no more than 5 units of alcohol).

[51] Whilst the crews post crash blood levels were found to be 'insignificant' (North Yorks Police Op HEATING Report – i.e. below UK Drink-Drive Limits), the Capt & Co-Pilot appear to have not fully regarded JHC Regulation R305.115.1.

b. The Panel considers that, notwithstanding their overall combined low experience levels, the knowledge of these orders was centre place to their passage through basic, advanced and operational flying training and they would reasonably have been expected to have clear understanding of the safety related aspects of these regulations and their responsibilities as a crew.

22. Flying Handling. In considering the flying handling aspects of ZA934's final manoeuvre the SI President, Specialist [52] and Human Factors Psychologist Members all visited the accident site and, with the SI Engineering Member, flew over 3 hours in the Puma simulator at RAF Benson in order to analyse and replicate the final flight profile [See 1.4 – 10 Note 46]. The following analysis is given based upon multiple witness statements [53], Cockpit Voice Recorder (CVR), Sonogram data [54] and simulator trials:

[52] Note that the SI Pres and the SI Specialist are qualified QHIs (A2 and A1 respectively) with a combined experience of approx 6000 hrs on Operations and Instructional Flying on the Puma.

a. ZA934 came off high ground, from the SW and overflew the Infantry Training Company (ITC) troops at Hudswell Grange Farm on a NNE track, at low level (estimated at 50'agl), at cruise speed (approx 125 knots) [See 1.3-9 Fig 8].

[53] North Yorks Police statements by Sgt [redacted] and Cpl [redacted] (ITC Para).

b. The Captain executed a gentle climb, at fixed pitch and power, estimated to be at 15° nose-up, for 5-6 seconds gaining approximately 350' - 400' feet above his start elevation. As the climb progressed, the ground forward of the aircraft track fell away compared with that immediately below the aircraft. With the instrument panel coaming obscuring the near forward ground, only the very distant high ground would be seen, if the crew's full focus was forward, potentially giving the impression of more height gained, and *only* if the crew were to ignore their flight instruments (Barometric Altimeter and Radar Altimeter).

[54] CVR Data analysed by RN FSAIC, the AAIB and QinetiQ, modelled against 'live' aircraft flight trials to match aerodynamic, engine and rotor blade sound parameters.

c. The Captain then rolled to the right, using greater than 60° angle of bank (AOB) [55], through 220° of track, so as to achieve a return track that overflew the ITC troops at Hudswell Grange Farm [56].

[55] QinetiQ and Simulator trials show that approx 80-90° AOB was necessary to achieve the return track from the given height and ground track/position.

d. With the aircraft's rotor disc now at greater than 60° from the vertical component, the helicopter's Lift Vector [57] was reduced, allowing a 'sink rate' or 'Rate of Descent' (ROD) to rapidly build up.

[56] This intention was pre-briefed by the Captain to Co-Pilot 1, recorded on the Cockpit Area Microphone (CVR Transcript 1:51.15). Exhibit 6.

[57] Lift Vector. The thrust component produced by the Rotor Disc, aligned with the Rotor Mast, usually directed near vertically skyward in opposition to gravity.

e. Simulator trials [Note 46 & Statement 9] and CVR analysis suggest that:

(1) During the final turn, it is highly likely that the Captain would have been looking hard over his right shoulder in order to direct the aircraft back to its intended target. This may have reduced the Captain's likelihood of referring to his cockpit flight instruments and noticing his instrumented height and building Rate of Descent [58].

(2) Study of the Cockpit Voice Recorder indicates that the Co-Pilot may have directed his attention back into the cabin on a number of previous turning manoeuvres to watch or comment on the crewman's and passenger reactions [59]. During this final manoeuvre no advice, performance or instrument data, or warnings were passed by the Co-Pilot to the Captain. Laughter is heard on the intercom during the final moments of the turn indicating that the crew were probably content with the progress of the manoeuvre.

[58] Rate of Descent on Impact estimated by RN FSAIC/QinetiQ to have been between 2400' and 2700' feet per minute depending upon RAD ALT Audio Warning bug settings of either 30' or 50' agl.

[59] Example at CVR Transcript 1:59:20. Exhibit 6. Co-Pilot 1 observes & comments on Crewman's actions in cabin during Zero-G manoeuvre.

CONCLUSIONS

1. **Cause.** The cause of the accident to ZA934 was an incorrectly executed Repositioning Turn manoeuvre from which the aircraft did not recover, impacting the ground in a wings level, high speed and high Rate of Descent configuration.

2. **Contributory factors.** The Panel identified the following contributory factors that did not directly cause the accident but made it more likely to happen:

- a. The Crew's combined level of experience.
- b. The Crew's quantity and quality [60] of training.
- c. The crew constitution [61].
- d. Crew Resource Management (CRM).
- e. Supervision; both by the
 - (1) Duty Flight Commander (Duty Exec).
 - (2) Aircraft Captain.
- f. The operational task load placed upon 33 Squadron.
- g. The manning shortfalls on 33 Squadron.

[60] Repetitive Out of Phase checks and lack of QHI staffed training.

[61] 

3. **Aggravating Factors.** The Panel considered that the following factors increased the severity of the incident:

- a. The Crew's lack of adherence to checks and operating procedures.
 - (1) Flight below authorised minimums.
 - (2) The Crewman's security and seating position.
 - (3) Stowage and security of cabin Role Equipment.

4. **Other Factors**

- a. The administration and completion of essential aircrew flying and training documentation.

OBSERVATIONS

5. The Panel made the following observations:

a. **Aircraft Servicing.** The crew of ZA934 utilised the 'Continuous Operations Mandatory Maintenance' (COMM) servicing procedure [62] for a benign non-operational task when a more comprehensive 'Turn-Around' servicing may have been more appropriate.

- (1) The use of this 'abbreviated' style of servicing (COMM), originally indented for time critical operational situations (first introduced in Northern Ireland), appeared to have become the normal 'default' Puma servicing method between full 'After Flight' (AF) and 'Before Flight' (BF) servicing operations, even at Main Operating Bases in 2007, due to its reduced time and effort requirements.
- (2) This practice appears to continue on Puma units to present day, renamed as the 'Continuous Flight Mandatory Maintenance' (CFMM) servicing.
- (3) The Panel believe that this practice is worthy of review, in order to clarify its use in preference of the 'Turn-Around' servicing.

b. **Flying Complaints.** No single central 'Flying Complaint' reporting telephone number or receiving authority exists. Complaints are passed by commercial phone operators, in a random fashion, to any authority deemed appropriate (Police, CAA, Military base etc).

- (1) Had the multiple flying complaints directed at ZA934s activity on the 7 and 8 August 2007 [63] been actioned in a more timely and coordinated fashion the crew may have been prevented from the style and course of events that led to the accident later in the period.

[62] See 1.3 – 6 para15 & 1.3 – 7 Para 21.

[63] Mr [REDACTED] Low Flying calls to MOD, Police & RAF - Exhibit 5a ,b & c;

- a. MOD Low Fly Call.
- b. Police 999 Low Fly Call.
- c. RAF Leeming Ops Complaint statement.

PART 1.5 RECOMMENDATIONS

PART 1.5 – RECOMMENDATIONS

CAUSAL and CONTRIBUTORY FACTORS LEADING TO THE ACCIDENT.

1. **Causal Factors.** The accident was caused by ZA934 conducting an incorrectly executed ‘Repositioning Turn’ manoeuvre from which parameters and flight path it did not recover. The Panel recommends that:

1.4 – 14 Para 22

a. The full formal ‘Wing-Over’ and ‘Repositioning Turn’ manoeuvre, including mishandled flight parameters, are taught to all Puma Operational Conversion Flight (OCF) students, primarily in the aircraft [1], at the later stages of the OCF Course.

1.4 – 6 Para 9 (g)

[1] In preference to the Simulator - To ensure ‘real’ site picture and closure rates are demonstrated.

b. Advanced handling and ‘energy management’ (high speed handling and high rate of descent regimes) are formally briefed and taught, as a dedicated lesson, on the Puma OCF [2].

[2] Achieved through the re-introduction of the teaching of ‘live’ (not synthetic) Practice Force Landings to the Flare Recovery on the Puma (taught by a QHI).

2. **Contributory Factors.** The following factors contributed to the accident:

a. **Squadron Manning and Experience Levels.** 33 Squadron’s manning situation and dilution levels, with respect to its task burden, were not fully and correctly supported. The SI Team recommends that:

1.4 – 3 Para 7 (a)

(1) If a squadron cannot be properly & fully manned to sustain a task, then the task should be reduced.

(2) Squadron aircrew experience levels must realistically reflect and fully support the nature and skills demands of its given tasks.

(3) A Unit Airtest task should be established and fully manned by dedicated, Airtest qualified aircrew.

1.4 – 6 Para 9 (b)

b. **Training.** The operational demands and training priorities reduced and limited the squadron’s ability to provide training staff and assets for LCR to CR training. The SI Team recommends that:

(1) Squadrons must have a fully established Squadron Leader grade (SO2) OC Training Flight who must be a B1 QHI (or higher) and that that Flight Commander should not be absent from his primary Squadron training duties without a deputy of similar qualification being present on the Squadron.

1.4 – 6 Para 9 (d)

(2) When home Squadron based, Limited Combat Ready (LCR) Aircrew must achieve NATO minimum monthly flying hours (15 hours) and that these hours should:

1.4 – 6 Para 9 (f)

(i) Include a suitable level of handling as P1 (not in a simulator).

(ii) Not include hours captured on Airtest or Engineering maintenance (Rotor Tune Flights) as P1 or P2.

1.4 – 6 Para 9 (f)

- (iii) Include regular, supervised, continuation training with a QHI or Training Captain. 1.4 – 7 Para 9 (i & j).
- i. Out of Phase checks should not be considered as ‘regular’ or ‘continuation’ training.

c. **Supervision.** The constitution and overall supervision of the crew of ZA934 was a key factor in the subsequent CRM and related observation of Regulation and Aircraft Limits that followed. The SI Team recommends that: 1.4 – 8 Para 16

(1) Unless the aircraft Captain is a QHI or Training Captain, only 1 member of a 3 man crew may be LCR for Self Authorised Land-away tasks. 1.4 – 8 Para 16 (b)

(2) All OCF Students should receive formal instruction on the composition, meaning, construction and use of: 1.4 – 8 Para 16 (f and g).

(i) Flying Authorisations (both electronic (STARs) and hand written).

(i) Temporary Powers of Authorisation regulations, limitations and procedures.

3. Other Recommendations:

a. **Cockpit Voice Recorder (CVR).** ZA934s CVR gave critical data to the investigating authorities. However the Panel recommends that:

- (1) The location of the Puma CVR is reviewed to improve post impact survivability and data collection. 1.3 – 10 Para 32. (See 1.3-11 Fig 11)
- (2) JHC/Military CVR Handling should fall in line with UK AAIB (civil) procedures and regulation. 1.3 – 14 Para 46 and [Note 55].

b. **Crewman’s Security.** ZA934s Crewman suffered fatal injuries as a result of seating position and restraint. The SI Team recommends that: 1.3 – 12 Para 35 (b) and [Note 49].

(1) The fitment and use of the Crewman’s harness systems on the Puma is reviewed and clarified.

(2) A practical Crewman’s harness facility allowing for security and working access, whilst retaining him/her within the Puma cabin, is trialled and procured.

c. **Stowage of Role Equipment.** RAFCAM Investigations indicated that injuries were caused by loose equipment in the cabin after impact. The Panel recommends that:

(1) Squadrons review the security and requirement to carry all but essential role equipment.

(2) Squadrons re-brief the necessity to secure equipment and freight in the aircraft cabin.

1.3 – 13 Para 36 and [Fig 12].

d. **Low Flying Complaints Co-ordination.** Inquiry evidence indicates that no single official point of contact was available to the public to report low-flying activity in 2007. Telephone calls were, and continue to be, randomly passed, by commercial operators, to Police, CAA, the MOD Operator and MOD Units (of all services). The Panel recommends that:

(1) The provision of a single, national, telephone number is investigated to process low-flying complaints, available to assist both the public, military aircrew and squadron operations and supervising staffs.

(2) The phone number is manned during the opening hours of the low-flying system, by trained, aviation aware, staffs.

1.3 – 7 Para 21 and [Note 32].

e. **Conduct of Rescuers.** The Panel believe that the conduct and actions of the key rescuers at the accident site on 8 Aug 2007 is worthy of formal recognition:

(1) OC ITC Paratroops and training staff.

(2) Swaledale Mountain Rescue Team – Lead Doctor & Nurse.

1.3-13 Para 37, 38, 40 and 41.

4. **RN FSAIC Recommendations.** The Panel draw the Convening Authorities attention to the technical recommendations made by the RN FSAIC Team in their AR 2/07 (Field) report.

Annex B, Part 1, Page 118, Para 4.0 to 4.11

5. **RAF CAM Recommendations.** The Panel draw the Convening Authorities attention to the human factors recommendations made by the RAFCAM Accident Investigation Team in their Aircraft Accident Human Factors Report No 14/09.

Annex G, Page 37, Para 108 – 112.

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PART 1.6
CONVENING AUTHORITY
COMMENTS

Part 1.6 Comments by Commander Joint Helicopter Command (Convening Authority)

INTRODUCTION

1. This accident has been fully investigated by both the North Yorkshire police and at the Coroner's Inquest¹, yet it is of utmost importance that the aviation-specific issues are clearly identified, understood and acted upon where necessary.
2. I thank the Panel for their hard work which, in addition to articulating the handling errors and lack of adherence to procedures by the crew, has exposed weak points in the wider aspects of supervision and training that were apparent at the time of the accident. The analysis of the accident sequence, from the moment that the aircraft took off on its final flight until the moment of impact, has been comprehensive and conclusive. The uncovering of the wider context in which the accident occurred is vital to preventing a similar situation developing in the future. The Strategic Review of the Puma Helicopter Force (Puma Review), carried out in early 2008, described the wider context and made many recommendations to address identified shortcomings, which I will refer to throughout my comments. It is unlikely that the influence of the wider aspects of supervision could ever be established conclusively but any failings in the lead up to the accident must be uncovered and addressed in order to prevent a recurrence.

CAUSE AND CONTRIBUTORY FACTORS

3. I agree with the conclusion of the Panel that the cause of this accident was an incorrectly executed Repositioning Turn manoeuvre from which the aircraft did not recover. **However, within the SI's Conclusion (1.4-15) the Panel identified a number of Contributory, Aggravating and Other Factors and their influence over the accident, and I consider that the crew's lack of adherence to checks and operating procedures, combined with their flight below authorised minima, contributed significantly to the accident and its severity.** Consequently, whilst these factors did not cause the accident per se, I consider that they were Contributory Factors that made the accident more likely to happen, rather than Aggravating Factors as recommended by the Panel.
4. Notwithstanding the crew's handling errors, lack of adherence to checks and operating procedures and their flight below authorised minima, weak points in supervision undoubtedly were factors in aggravating this accident. A lack of appropriate supervision has been noted in several Boards of Inquiry and Service Inquiries (SI) during my tenure; therefore, I intend to explore fully the supervisory issues that relate to this accident.
5. **Squadron Supervision.** It is clear that the manning, experience levels and tasking of 33 Sqn at the time of the accident undoubtedly put an

¹ Coroners Inquest Sale, Burfoot and Tait, Harrogate Magistrates Court, 5-27 Oct 09.

enormous amount of pressure on the executives of the Sqn. I believe that the higher command chain did not take a broad enough approach to the wider manning issue of growing the Support Helicopter Force and operations so quickly, and did not appreciate fully the impact of the loss of experienced aircrew from the home unit. The Panel have explored the significant tasking load on the Sqn at the time of the accident which has also been articulated in detail in the Puma Review.² The extensive recommendations to address the high level tasking priority issues was acted upon, completed and closed in 2009.³ Further, the Panel's recommendations regarding Squadron Manning and Experience Levels need to be specific and measurable, and therefore the recommendations 2a(1) and (2) are rejected as I believe that those recommendations would be difficult to assess and achieve in practical terms. I replace them with two further recommendations below (14a and 14b); this more holistic approach to managing change in Force levels and/or operational tasking, relative to aircrew experience, will increase the likelihood of identifying significant areas of risk that can then be assessed and managed effectively. The JHC has recently established a new process for managing Risks to Life which may be able to be adapted to provide visibility of dilution rates within each Force. I recommend that **JHC Safety identifies a method, applicable to all aviation units, that readily identifies dilution rates to the chain of command (Recommendation 14a)**. I also recommend that **JHC HQ and Force Commanders use this method as a clear demonstration of the relationship between aircrew experience and operational tasking requirements when making tasking decisions and elevating risks (Recommendation 14b)**. This new process is, I believe, in keeping with the intent of the original recommendations, but provides a measureable output upon which aviation unit commanders can articulate clearly a unit's manning position and provide a better management tool with which commanders can manage change and articulate risk.

6. **Training.** The Panel identified that a number of factors led to the gradual dilution of experience on the Sqn and in particular, a surplus of inexperienced pilots who required more training and mentoring. The dilution of experience in the junior, newly qualified pilots was also reflected in the experience of those in significant training positions on the squadron. Whilst the issue of the required number of QHIs in the Puma Force was addressed by the Support Helicopter Manning Paper dated 9 April 2009, the overall supervision of training within a squadron was not addressed. The Panel's Recommendations 2b(1) and 2b(2)(iii) will improve the overall supervision of training but I **further recommend that the spread of QHIs, Training Captains and junior pilots borne on the Puma Force is reviewed by the Puma Force Commander in order to establish, and then implement, the appropriate balance of QHI posts on Puma Squadrons (Recommendation 14m)**. Following the findings of SIs into two further recent accidents, I have recommended a review of the training and use of Training Captains which will further enhance overall training supervision. The subject

² The Strategic Review of the Puma Helicopter Force Para 5.13 – Managing concerns about over-tasking.

³ The Puma Force – A Review of Contemporary Operating Issues, Annex C, Recommendation 2.

of Out of Phase checks warrants further investigation therefore I reject recommendation 2b(2)(iii)(i) but **recommend that SO2 J7 in conjunction with SH STANEVAL reviews the use of Out of Phase checks for continuation training (Recommendation 14e)**. The panel also made recommendations to enhance the requirements for LCR pilots regarding the quality of the flying (Recommendations 2b(2)(i) and (ii)). Whilst flying rates are low, the quality of the hours flown is crucial, particularly for junior aircrew. The overall supervision of junior aircrew training would be enhanced by readily available evidence of aircraft handling experience. In order to make the Recommendations 2b(2)(i) and (ii) more achievable I reject them, but recommend that **JHC J7 investigates the feasibility of formally recording ‘quality handling’ hours⁴, in addition to P1 and P2 hours, which will be used by supervisors, in conjunction with the method outlined at para 5 above, to provide a more explicit measure of experience levels (Recommendation 14c)**.

7. **Planning.** The Panel identified that the crew allocation for this task – which was an excellent training opportunity – via a weekly planning meeting, was altered twice between the original allocation and the aircraft departure without Sqn executive knowledge. The lack of a robust system for crew allocation, particularly whilst operating with recognised manning and experience limitations, reduces the supervision of the task. I agree with the Panel’s finding that the wider supervision aspect of crew allocation was not suitably robust. In light of the fact that all JHC aviation units may be manpower and experience limited at various times, **I recommend that JHC J7 make an addition to the JHC FOB regarding the requirement for Force commanders to ensure that a robust process for crew allocation is in place (Recommendation 14n)**.

8. **Cockpit Gradient.** It is difficult to predict that a crew will not operate within the rules, but the dangers of a combination of an inexperienced crew and a flat cockpit gradient must be recognised, understood and anticipated, both at the time of crew composition and during authorisation. A flat cockpit gradient has been identified as a factor in other recent accidents within this Command, therefore in addition to the recommendations made by the panel, I further recommend that **JHC J7 examine the training of supervisors and authorisers in order to ensure that sufficient emphasis is placed on the dangers of a flat cockpit gradient when combined with an inexperienced crew (Recommendation 14o)**. It is acknowledged that the criteria that supervisors use to judge the suitability of a crew for a task are necessarily predicated on the expectation that the crew operate within the rules and regulations. Sadly in this case this did not happen.

9. **Crew Resource Management (CRM).** At the heart of the supervisory process, the aircraft commander is a supervisor in his own right. Both the handling and supervisory styles of the aircraft commander of ZA 934 contributed significantly to the relaxed nature within the aircraft as evidenced

⁴ The exact definition of Quality Handling Hours needs to be considered in this review, but could include handling other than Airtests, Engineering maintenance flights and long transits.

by the CVR. The relaxation of formal cockpit routines and protocols that contributed to an acceptance of the non-adherence to regulations, procedures and limits could not necessarily have been predicted. The Puma Review also revealed examples of violations of regulations and SOPs in separate accidents in 2007.⁵ A subsequent recommendation of the SI into the accident involving Puma ZA 938 on 20 Nov 07 addressed the issue of non-adherence to SOPs within the Puma Reset.⁶ JHC aircrew are mandated⁷ to carry out Human Factors training on a 2-yearly basis, following recommendations from accidents in 2004 and 2006, which will remind crews regularly of what healthy CRM should look like. It is clear that there was a flawed dynamic within the cockpit of ZA 934 that was a result of a number of Human Factors, including a flat cockpit gradient, the close friendship between the aircraft commander and co-pilot, and the shared perception that the task was almost recreational rather than professional. This flawed dynamic was not alterable by anyone else once the aircraft had departed.

10. **Authorisation.** The sortie during which the accident occurred was self-authorised. The Panel have highlighted how the process of self-authorisation can be improved and I welcome their recommendations at para 2.c.(2). Whilst I acknowledge that the supervisors did not specifically authorise the accident sortie, their actions on the day before the accident are worthy of further consideration.

a. Ahead of the departure of the crew from RAF Benson to the Catterick training area on the day before the accident, the DA questioned the authorisation minima regarding Minimum Height and Minimum Separation Clearance that the aircraft commander had entered into the authorisation sheets and changed them to safer minima. The DA essentially directed the aircraft commander to operate within rules.

b. The DFC did not discuss the minima when granting temporary powers of self-authorisation. The crew's subsequent behaviour could not have been wholly prevented, but could have been influenced at this point by a more vigorous briefing to the aircraft commander. I concur with the Panel's conclusion that the DFC briefing and oversight was not suitably robust. I believe that Recommendation 14o below will provide appropriate focus during Human Factors training, improving an authoriser's awareness of the potential dangers of a flat cockpit gradient when combined with an inexperienced crew.

11. **Training Documentation.** Despite the fact that this is not a particularly high-end skill, neither the DA nor the DFC questioned the constitution of the crew and its ability to carry out the task, although it is likely that they were content that the co-pilot was capable of carrying out trooping. Indeed, the Panel concluded that the crew were capable of conducting the task with the

⁵ A Strategic Review of the Puma Helicopter Force 15 May 2008, Air Cdre C W Dixon & Col N J Moss, para 3.2.3 Violations.

⁶ The Puma Force – A Review of Contemporary Operating Issues, Annex B, Recommendation 3.

⁷ JHC FOB Order 360.000.6.

captain acting as the handling pilot.⁸ It also identified omissions within the training documentation, including the absence of the recording of wing-over instruction and trooping drills and the endorsement of LCR. Subsequently, the Puma Review addressed the issue of Sqn administration⁹ and found that following the Chatwin Study¹⁰ and follow-up checks by SH STANEVAL, 33 Sqn administration was assessed as good.¹¹

12. **Post Crash Management (PCM).** The overall excellent PCM was marred by the accidental wiping of Crew Signature Cards. I recommend that **JHC Safety Branch writes to all JHC aviation unit commanders regarding the required impounding actions in the event of an accident (Recommendation 14p).**

RECOMMENDATIONS

13. The Panel have produced a comprehensive package of recommendations and I accept Recommendations 1a and 1b. Recommendations 2a (1 to 3) are rejected as they are not practically achievable. I have replaced them with my Recommendations 14a, 14b and 14c below, which address the issue of Squadron Manning and Experience Levels in practical terms. I accept Recommendations 2b(1) but reject 2b(2) as it is now better achieved through my Recommendations 14c and 14d below. I accept Recommendation 2b(2)(iii) but replace part (i) with Recommendation 14e below as it will confirm the validity of Out of Phase checks. Whilst I accept the aim of Recommendation 2c, I would like the feasibility and benefit of this recommendation to be examined first and thus I have replaced this recommendation with para 14f below. I accept Recommendation 3 in its entirety.

14. The Panel's Recommendations 4 and 5 regarding the RNFSAIC Report AR 2/07 (Field) and the RAFCAM Air Accident Human Factors Report No 14/09 have been considered. I recommend that **Director (Helicopters), AES PT and PG PT respond to RNFSAIC Technical Recommendations (TR) 4.1 to 4.7 and 4.9 of Report AR 2/07 (Field) (Recommendation 14g).** In addition, I accept Recommendations 4.8 to 4.11 of the Report as they are directed at the Operating Authority and I therefore respond to these at 14h to 14k below. In response to the Human Factors (HF) Recommendations made within RAFCAM Air Accident Human Factors Report No 14/09, I reject HF Recommendation 108a as the issue of supervision of crew allocation will be addressed by 14n below. I accept HF Recommendations 109a, 111c and 112a but reject HF Recommendations 108b, 109b, 110a, 110b, 111a and 111b as they are not specific or practically achievable. In order to address these I make a further Recommendation 14l below. As articulated earlier in

⁸ Service Inquiry, Part 1.4-7, para 7.

⁹ A Strategic Review of the Puma Helicopter Force 15 May 08, Air Cdre C W Dixon & Col N J Moss, para 5.12, 33 Sqn Administration.

¹⁰ Review of Aviation Procedures – 33 Sqn RAF Benson, 27 Feb 08 (JHC/421).

¹¹ STANEVAL Inspections, 33 Sqn, 21 Jul 09 and 6 Jul 10.

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these comments, I make further Recommendations (14m to 14p) regarding wider supervision and PCM. My recommendations are as follows:

- a. JHC Safety identifies a method, applicable to all aviation units, that readily identifies dilution rates to the chain of command;
- b. JHC HQ and Force Commanders are to use the output of 13a above as a clear demonstration of the relationship between aircrew experience and operational tasking requirements when making tasking decisions and elevating risks;
- c. JHC J7 investigates a method of formally recording 'quality handling' hours¹², in addition to P1 and P2 hours which will be used by supervisors, in conjunction with the output from 13a above, to provide a more explicit measure of experience levels;
- d. When home squadron based, Limited Combat ready (LCR) Aircrew must achieve NATO minimum monthly flying hours (15 hours);
- e. JHC J7, in conjunction with SH STANEVAL, reviews the use of Out of Phase checks for continuation training;
- f. JHC J7 investigates the feasibility and benefit of directing the following: Unless the Aircraft Captain is a QHI or Training Captain, only one member of the Crew may hold LCR status for Self-Authorised Landaway tasks, unless the aircraft commander is a QHI or Training captain.
- g. Director (Helicopters), AES PT and PG PT are to respond to RNFAIC Technical Recommendations 4.1 to 4.7 and 4.9 of Report AR 2/07 (Field);
- h. JHC Safety issues policy guidance to aviation units regarding the carriage of multi-role equipment in the cabin when it is not mission essential;
- i. JHC J4 reviews, in conjunction with the PG PT, the requirement to provide dedicated stowages for role essential equipment that, when unrestrained, could prove hazardous in the event of an accident;
- j. JHC Safety carries out a safety review of the current practice of stowing the 8ft load lifting strop around the Puma HC Mk1 double centre seat assembly;
- k. JHC Safety considers a review at random across the JHC of post mission CVR recordings.

¹² The exact definition of Quality Handling Hours needs to be considered in this review, but could include handling other than Airtests, Engineering maintenance flights and long transits.

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- l. RAFCAM is requested to consider Recommendations 108b, 109b, 110a, 110b, 111a and 111b in order to make them specific and achievable.
- m. The spread of QHIs, Training Captains and junior pilots borne on the Puma Force is reviewed by the Puma Force Commander in order to establish and then implement the appropriate balance of QHI posts on Puma Squadrons;
- n. JHC J7 makes an addition to the JHC FOB regarding the requirement for Force Commanders to ensure that a robust process for crew allocation is in place;
- o. JHC J7 examines the training of supervisors and authorisers in order to ensure that sufficient emphasis is placed on the dangers of a flat cockpit gradient when combined with an inexperienced crew;
- p. JHC Safety is to write to all JHC aviation unit commanders regarding the required impounding actions in the event of an accident.

SUMMARY

15. The Panel has in my view correctly identified the cause of this accident together with contributory and other factors albeit I have concluded the crews non-adherence to checks, operating procedures and authorised minima were contributing factors to the ultimate tragic outcome rather than aggravating ones. However, what happened on that day cannot be changed, nor could the actions of the crew necessarily have been predicted by the those involved in the wider supervision of the crew. All personnel involved in the supervision and authorisation of flying within this Command must be in no doubt regarding the influence of their actions, and what should be done in order to operate aircraft in a safer environment. My comments are therefore focused specifically on supervision and authorisation, and I have made further recommendations to support those already made by the Panel within their thoroughly researched report. As discussed earlier, since this accident, the Puma Review has addressed many of these issues and it is my sincere hope that the findings and recommendations of this Service Inquiry will supplement this work, and will ensure that events of the sort that gave rise to this tragic accident are never repeated.

C A JOHNSTONE-BURT
RAdm
Comd JHC

27 Jan 11