



A
STRATEGIC REVIEW OF THE
PUMA HELICOPTER FORCE

by

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GLOSSARY

Ser (a)	Abbreviation (b)	Meaning (c)
1	ACAS	Assistant Chief of the Air Staff (2 star).
2	ADR	Air Data Recorder.
3	AGRICOLA	Operations in Balkans (1999).
4	ALARP	At Lowest Acceptable Risk Possible.
5	AMCPG	Air Manoeuvre Capability Planning Group.
6	AOA	Aircraft Operating Authority.
7	AP	Airworthiness Plan.
8	AUM	All Up Mass – the total weight of helicopter, fuel, crew, pax and baggage. The Maximum permissible AUM (MAUM) will change with temperature and heights.
9	BH	Battlefield Helicopter.
10	BHD	Baghdad Helicopter Detachment – based at Baghdad International Airport (BIAP), [REDACTED]
11	BIAP	Baghdad International Airport.
12	BLOS	Beyond Line of Sight – normally referring to communications.
13	BMQ	Basic Mission Qualified.
14	BoI	Board of Inquiry.
15	Cdr or Comd	Commander.
16	CFI	Chief Flying Instructor.
17	CFS	Central Flying School.
18	CINC	Commander In Chief (4 star).
19	COS	Chief of Staff.
20	CPA	Collective Pitch Anticipator.
21	CR	Combat Ready – see LCR.
22	[REDACTED]	[REDACTED]
23	CRM	Crew Resource Management.
24	C2	Command & Control.
25	CVR	Cockpit Voice Recorder.
26	DA	Design Authority.
27	DARS	Directorate of Aviation Regulations and Safety (previously DASC).
28	DE&S	Directorate of Equipment and Sustainability (formerly Procurement Executive (PE)).
29	Det'	Detachment.
30	DG	Director General.
31	DLOD	Departmental Line(s) of Development.
32	DHFS	Defence Helicopter Training School at RAF Shawbury.
33	[REDACTED]	[REDACTED]
34	[REDACTED]	[REDACTED]
35	EHSAT	European Helicopter Safety Analysis Team.
36		
37	EP	Equipment Programme.
38	ET	Environmental Training: Desert, Jungle, Temperate or Arctic.
39	FADEC	Flight Automatic Direction an Engine Control.
40	F5200	A Flying Record Folder held for all RAF aircrew.
41	FC	Full Command.
42	FCO	Foreign and Commonwealth Office.
43	FDR	Flight Data Recorder.
44	FMQ	Full Mission Qualified.
45	GFA	Good Friday Agreement.
46	HERRICK	Operations in Afghanistan.

Ser (a)	Abbreviation (b)	Meaning (c)
47	HIGE	Hovering In Ground Effect.
48	High-End Aircrew	
49	HF	High Frequency.
50	HFACS	Human Factors Classification System.
51	HF(U)	Human factors (Unit).
52	HOGE	Hovering Out of Ground Effect.
53	HUMS	Health and Usage Monitoring System.
54	IMC	Instrument Metrological Conditions.
55	IPS	Intermediate Pitch Stop or Into Productive Service
56	IPT	Integrated Project Team.
57	IPTL	Integrated Project Team Leader.
58	ISD	Into Service Date.
59	JCG	Joint Command Group (chaired by VCDS).
60	JHC	Joint Helicopter Command – A 2 star Joint HQ embedded with HQ LAND Command at Wilton.
61	JHF(A)	Joint Helicopter Force (Afghanistan) – based at Kandahar and Camp Bastion in Helmand Province. An SO1 (OF4) level command.
62	JHF(I)	Joint Helicopter Force (Iraq) – forward based at Basra International Airport, with a rear support base in Kuwait. An SO1 (OF4) level command.
63	JHF(NI)	Joint Helicopter Force (Northern Ireland) – based at RAF Aldergrove. Commanded by an OF5, who is dual-hatted as Stn Comd RAF Aldergrove.
64		
65	LCR	Limited Combat Ready – requires more time on type and focused training to become CR.
66	MAR	Military Aircraft Release.
67	MAUM	Max AUM - See AUM.
68	MAWS	Missile Approach Warning System.
69	MFD	Multi-Functional Display.
70	M(R)GB	Main (Rotor) Gearbox
71	MSHATF	Multi-SH Aircrew Training Facility (an interconnected suite of helicopter simulators at RAF Benson).
72	MSH	Medium Support Helicopter eg Puma and Sea King (SK).
73	Nr	Speed of Rotor Blades (number of rotations).
74	NVD	Night Vision Devices.
75	NVG	Night Vision Goggles.
76	NYP	North Yorkshire Police.
77	OASC	Officer Aircrew Selection Centre.
78	OCF	Operational Conversion Flight.
79	ODM	Operating Data Manual (specific to aircraft type).
80	OGD	Other Government Departments.
81		
82	OSD	Out of Service Date.
83	PDT	Pre-Deployment Training; focused on a particular theatre and/or operation. See – ET.
84	PFI	Private Finance Initiative.
85	PLEP	Puma Life Extension Programme.
86	PMA	RAF Personnel and Manning Agency.
87	PU FOR	Shorthand for Puma Force, which is 33 Sqn at RAF Benson and 230 Sqn at RAF Aldergrove, under a single OF 5 (Stn Comd RAF Benson).
88	PVR	Premature Voluntary Release.

Ser (a)	Abbreviation (b)	Meaning (c)
89	QHI	Qualified Helicopter Instructor.
90	RADALT	Radar Altimeter.
91	RTS	Release to Service.
92	RTSA	Release to Service Authority.
93	RTU	Return to Unit.
94	RW	Rotary Wing.
95	SAR	Search and Rescue.
96	█	█
97	SD	Spatial Disorientation or Service Deviation.
98	SDR	Strategic Defence Review.
99	█	█
100	█	█
101	SH	Support Helicopter.
102	SK	RN Sea King Helicopter (Mk 4).
103	SPTA	Salisbury Plain Training Area.
104	Sqn	Squadron (in the RAF this is a Wg Cdr's (OF4) level comd).
105	STANEVAL	Standards and Evaluation Unit. Presently based at RAF Benson.
106	SNCO	Senior Non-Commissioned Officer.
107	SVS	Synthetic Vision System.
108	TELIC	Operations in Iraq.
109	TOR	Terms of Reference.
110	UAV	Unmanned Aerial Vehicle.
111	UI	Unit Inquiry.
112	VCDS	Vice Chief of the Defence Staff.
113	WSOp	Weapons Systems Operator.

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EXECUTIVE SUMMARY

HISTORY AND TECHNICAL ASPECTS

E1. Now the MOD's oldest medium support helicopter, the Puma continues to offer an important capability. With about half its airframe life remaining the fleet is airworthy and planned to be upgraded and extended in service until 2022. The existing Puma has certain design features which require particular aircrew focus. The lack of an anticipator device in the engines can result in slow response and the loss of rotor speed if the aircraft is mishandled, particularly when heavy. A high centre of gravity makes the aircraft prone to roll over during a forced landing. The IPT is working to improve aircraft operating data in high ambient conditions, and new engines including an anticipator are included in the planned upgrade. **Paras 2.1 and 2.2**

ANALYSIS OF RECENT ACCIDENTS

E2. Analysis of recent Puma BsOI shows that Human Factors (Aircrew) issues predominate, but there is no major single causal theme linking the most recent accidents. Slow engine response has been cited as a secondary cause in a number of cases. In Iraq, contributory factors appear to include a combination of operating the aircraft towards the limits of its capability and the distractions of a busy operational mission. As with other military fleets, analysis of Puma incidents underscores the need for crews to keep on top of their aircraft, to fly to SOPs and within the bounds of their training, experience and authorisation. **Paras 3.1 to 3.3**

PUMA FORCE CULTURE, FLYING AND TRAINING

E3. Culture. Puma Force ethos has evolved from its early single-pilot/crewman mode of operation and a long history of self-deployed training across Europe, long spells in RAF Germany and in Northern Ireland and several major expeditionary operations overseas. The culture of the force is slightly introspective but 'can-do', with a very strong will to get the job done. The age of the aircraft and a sense of being marginalised by newer helicopters may have prompted a competitive spirit and a desire in some Puma crews to prove themselves in front of their peers. **Para 4.1**

E4. Crew 'Dynamics' and Synthetic Training. The Puma crew dynamic, with just one crewman to monitor and influence 2 pilots, is probably less effective than in other larger SH in moderating poor decision making, particularly when people are inexperienced. The simulator complex at RAF Benson is a good vehicle for building an effective crew dynamic and crewman confidence and moral authority. The facility is not operating to its fully funded capacity and the scope exists for a 'return to unit' training package to reorient returning crews to the more regulatory complex environment at home. **Paras 4.2 to 4.7**

E5. Quality of Aircrew and Basic Helicopter Training. Like other SH, the outlook of Puma crews is shaped initially during basic and advanced helicopter training at the DHFS at RAF Shawbury. Overseen by a mixed community of experienced civilian and service instructors, this training is well structured and effective. While individuals' social outlook reflects the times, the quality of basic recruits arriving at DHFS Shawbury is no less than at any time in the past. Encouraged by the Commandant, instructors work hard to instil and reinforce a sound military ethos in their students. Role selection to Puma, like other aircraft, is carefully administered. Each student is matched carefully to the most suitable slot available on front

line sqns, resulting in good balance of characters and individuals across the helicopter force. **Paras 4.8 to 4.11**

E6. Dilution and Manning. Like other units, managing Puma sqn dilution is a balancing act between retaining experienced people and drawing in new blood. The RAF PMA has in the last 5 years boosted Puma aircrew experience levels by accepting transfers from the other Services. Building on existing experience and on specific training in Northern Ireland, this equipped the Puma Force well to join high-end operations [REDACTED] that peak experience levels have declined since as individuals have been drawn away into other high priority roles including Merlin [REDACTED] **to 4.13**

E7. OCF Training. Conversion training is conducted for the Puma Force by 33 Sqn at RAF Benson. The course includes comprehensive training in aircraft handling and engine and rotor management. The OCF has been a focus of a number of concerns over recent years, including a shortage of instructors, weak leadership at times, and key personnel PVR'ing. The extent of the instructor shortfall is in dispute, and will require resolution if the Force is to deliver the intended 'Fight by Flight' solution to overstretch. **Para 4.15**

LEADERSHIP AND MANAGEMENT

E8. [REDACTED]

E9. Baghdad Helicopter Detachment. The [REDACTED] BHD [REDACTED] is a relatively simple bus-run task, but has been used by the Force as a theatre familiarisation and training opportunity to graduate crews to the higher-end requirements [REDACTED]

[REDACTED] BHD requires strong leadership to prevent crews overplaying their hand. [REDACTED]

Para 5.2

E10. C2 in Theatre [REDACTED] C2 arrangements in theatre differ in some important aspects from those that have applied in operations elsewhere. [REDACTED]

[REDACTED]

[REDACTED] For the BHD, there is a need to ensure that crews do not make more of the task than is necessary and by doing so push themselves and their aircraft beyond their limits. Taken together these pitfalls warrant enhanced supervisory arrangements. The most effective steps would be to mandate a helicopter aircrew officer as the senior detachment cdr in theatre [REDACTED] [REDACTED] Selection and monitoring of this senior officer should be the responsibility of the JHCHQ. **Paras 5.3 and 5.4**

E11. [REDACTED]

E12. Force Planning and Preparation for Roulement. The picture of Puma Force preparations for current operations in Iraq is mixed. On the flying side, pre-deployment training has been well done [REDACTED] [REDACTED] However planning, particularly for the longer term sustainability of crews, has been inadequate. Problems have been compounded by the lack, 2 years ago, of a proper estimate and plan and by the failure by JHC HQ and the Puma Force HQ to agree on the manpower and CR calculus to be used to assess the overall capacity of the Force to generate capability. This situation was exacerbated by a patchy relationship between key individuals. [REDACTED] [REDACTED] felt able to agree to the increased commitment, but why elements of the Puma Force (notably 33 Sqn [REDACTED] [REDACTED] felt overstretched. Earlier and more incisive command action at all levels to iron out these differences and to present a united picture to MOD may have helped reduce stress at a difficult period. **Paras 5.9 to 5.11**

E13. Puma Force Administration. Set against a strong record of professionally flown Puma missions in theatre, there has been a loss of focus at home on routine administration, most notably on 33 Sqn. Stronger leadership at RAF Benson over this period would have ensured better processes to supervise administration and to inculcate pride in individual aircrew in the completeness of their own training records. Executives should have taken as a cue from the various investigations into particular accidents, the need for rigorous self-audit. Failure to do this has resulted in the need to 'inspect in', rather than to 'check on' standards. Executive awareness of the problems, already low, was not helped by the uncritical nature of visits and reporting by SH STANEVAL, which has failed to be the wake-up call that it might have been. However, Puma administrative processes have now been transformed and the lessons of recent intense scrutiny have percolated through to other forces. **Para 5.12**

E14. Managing Concerns about Overtasking. The evidence shows that by mid-2006 the strain of delivering the rising task in Iraq was causing serious strain. Each increase in commitment was billed by MOD as a short term 'surge'. This, and a prevalent 'can-do' attitude by everyone led to a 'Yes, but' culture where important concerns were subordinated in the effort to comply with the demand. The structure of Puma C2, which includes [REDACTED], PJHQ and MOD allowed no clear ownership of the 'Buts'. **Para 5.13**

E15. Delivering the Puma Reset. Looking to the future, the JHC is restructuring the Puma Force to avoid the need to have most experienced people in theatre at any one time. The new model, being delivered under the JHCHQ's Puma Reset and known as 'Fight by Flight', offers the potential for better long-term planning and stability. However, a corollary to the 'Fight by Flight' posture will be the presence in future, and in some numbers, of relatively inexperienced aircrews in theatre. [REDACTED]

E16. A major overhaul of SH STANEVAL audit processes is required, in particular to increase the gravitas of the team and to enhance the respect in which it is held by sqns – visits to sqns need once again to become a 'knee-knocking' experience. Improved single-Service standards, direction and advice to the JHC STANEVAL team would promote wider awareness of lessons and trends across the entire air and aviation communities, and reinforce Full Command links with JHC aircrew. **Paras 5.14 to 5.15**

LESSONS FOR OTHER FORCES

E17. While all the other JHC helicopter fleets are hard-pressed, the Puma situation offers some important lessons. Force ethos and supervision is better maintained when units are collocated at one base, and this is as true at home in respect for plans under Project BELVEDERE as it is in theatre [REDACTED]

FUTURE DIRECTION AND MANAGEMENT

E18. A review is required of the benefits being gained from [REDACTED] set against the cost and risk of its support, and to determine the best way in future to structure and train the helicopter force [REDACTED]

[REDACTED] For Puma, it will be important to have this thinking clear in time to influence plans for the HC2 upgrade and the subsequent attribution of the force when it returns to service. [REDACTED]

[REDACTED] Lower-level actions are required by JHCHQ to take forward a number of issues, including changes to the STANEVAL process to improve Full Command links and to clarify the establishment of Puma instructors. **Paras 7.1 to 7.3**

RECOMMENDATIONS

E19. We recommend that CsinC LAND and AIR, as co-sponsors of this Review, consider the following actions:

- Invite ACDS (Ops) to review CBHWG membership (para 7.1)
- Invite CJO [REDACTED].
- Raise as agenda items in the Joint Command Group the following issues:
 - Examines the priority they accord to the procurement of BH, with emphasis on replacing legacy platforms (para 3.3).
 - The need to reaffirm the responsibility of commanders to say 'no' to operational demands where justified, and to have confidence that the senior command chain will support them (para 5.13).
- [REDACTED]
- [REDACTED] (para 7.2).
- [REDACTED] JHC (as AOA) in directing operational standards, disposition and appointment of SH commanders in theatre. (para 7.2).
- Explore opportunities for enhanced collaboration between Air Command and JHC HQ in co-developing Joint helicopter initiatives. (para 7.2)
- Direct Comd JHC to:
 - Consider introducing safety thrust margins for Puma operations, and mandating appropriate margins for all BH (para 2.2.6).
 - Establish, through the IPT, the accuracy of Puma ODM AUM data, and to check on the status and accuracy of other BH ODM (para 2.2.7).
 - Consider the interventions recommended by the DARS at Annex C.
 - Ensure that optimum use is made of the MSHATF (para 4.6).

- Conduct a review of BH simulator training, including arrangements for converting new RAF unit commanders and to consider, where capacity exists, implementing an additional mandatory 'Return to Unit' training package for crews returning from theatre (para 4.7).
- Consult with DHFS and HQ 22 Gp on ways in which the DHFS syllabus might be enhanced and that regular feedback on output/input standards is instituted as policy (para 4.9).
- Coordinate a review with RAF PMA, HQ 22 Gp, and DHFS to investigate SH instructional policy, selection and tour lengths; and that, depending on its findings, consideration be given to broadening the work to include the Royal Navy and Army (para 4.10).
- Address Puma instructor establishments and to monitor, though SH STANEVAL, 33 Sqn OCF administration (para 4.15.5).



- Makes provision for pre-deployment training between the Puma Force and [REDACTED] and, through the Air Manoeuvre Capability Planning Group, seek to establish joint simulator training. (para 5.11).
- Conduct a high level review with the MOD Commitments to bottom out exactly what the Puma Force capability is to be, over time [REDACTED]. This review should include branch plans to cater for the planned upgrade of Puma and its subsequent possible re-employment in other theatres (para 5.15).
- Complete a staff check of AAC units to ensure that none of the issues determined in respect of Puma are extant (para 6.4).
- Review the Puma Force Commander's Directive, particularly to reflect any changes made in C2 of Puma dets [REDACTED] (para 7.3).
- Determine, with relevant single service standards bodies, an agreed approach to RW Standards and Evaluation. In the short-term, Comd JHC may consider a change to OC R&S Wgs reporting chain to make more explicit that he reports directly to Cdr JHC (para 7.3.1).
- Consider greater use be made of Reserve Service Instructors and Training Captains (para 7.3.2).

PART 1 - INTRODUCTION

1.1 BACKGROUND

Since Jan 01, eleven RAF Puma helicopters have been involved in major incidents, including three aircraft lost in 2007, in which seven people died. The frequency and gravity of Puma incidents has increased markedly since the force deployed to Iraq¹. While Chinook and Merlin incidents on operations have increased too, various investigations² following recent accidents have highlighted particular concerns which have prompted a strategic review of the Puma Force.

The inquiry by North Yorkshire Police³ (NYP) into the loss of Puma ZA934 at Catterick on 8 Aug 07 has, [REDACTED]

[REDACTED] Further, on 20 Nov 07, a note by the Puma Force Cdr, summarising the findings of a flight safety meeting⁵, catalogued a number of perceived failings in the Force. An audit carried out by staff officers from the Joint Helicopter Command (the Chatwin Report⁶) was critical of the standard and completeness of 33 Sqn's supervisory and training records.

Given the apparent extent of the problems identified, CINC Air has, in collaboration with CINC Land, directed an urgent strategic review of the Puma Force. Terms of Reference to the Review Team⁷ are at Annex A.

1.2 CONDUCT OF THE STUDY

1.2.1 Documents and People Consulted. In compiling this report the Review Team has examined numerous documents⁸, and visited a number of operational and training units, including in Iraq and Afghanistan. The team interviewed Puma Force executives, air and ground crews; officers in MOD Commitments staffs, HQs Land and Air Commands; PJHQ, [REDACTED] and JHC and helicopter operators and user units in Iraq and Afghanistan. We also commissioned substantial analysis from a number of flight safety staffs. The team visit itinerary, at Annex B, includes the full list of the ninety people interviewed and/or visited, including 20 taped interviews.

1.2.2 Record of Interviews. To avoid subsequent dispute about the conduct and record of interviews we have made tape recordings of key conversations, typed

¹ Puma HC2 Major Incidents/Accidents by Theatre of Operation Jan 98 –Mar 08 prepared by DARS SO2 RW for Puma Review dated Mar 08.

² BsOI into accidents XW221 (TELIC Jul 04); XW211/XW218 ([REDACTED] Apr 07); North Yorkshire Police investigation ZA934 (Catterick Aug 07); ZA938 ([REDACTED] Nov 07); the Chatwin Report into 33 Sqn Administration Feb 08.

³ [REDACTED]

⁴ [REDACTED]

⁵ JHC/421 dated 27 Feb 08 – [REDACTED]


⁶ Air Commodore Carl Dixon, the review team leader, is an experienced helicopter pilot and commander with an extensive background in Chinook and Puma operations. Col Neale Moss is an Army pilot with a strong background in Gazelle and Lynx. Both team members have [REDACTED] commanded units in the Middle East. Legal advice to the team was provided by Wing Commander Allison Mardell with clerical support by [REDACTED], both from HQ Air Command.

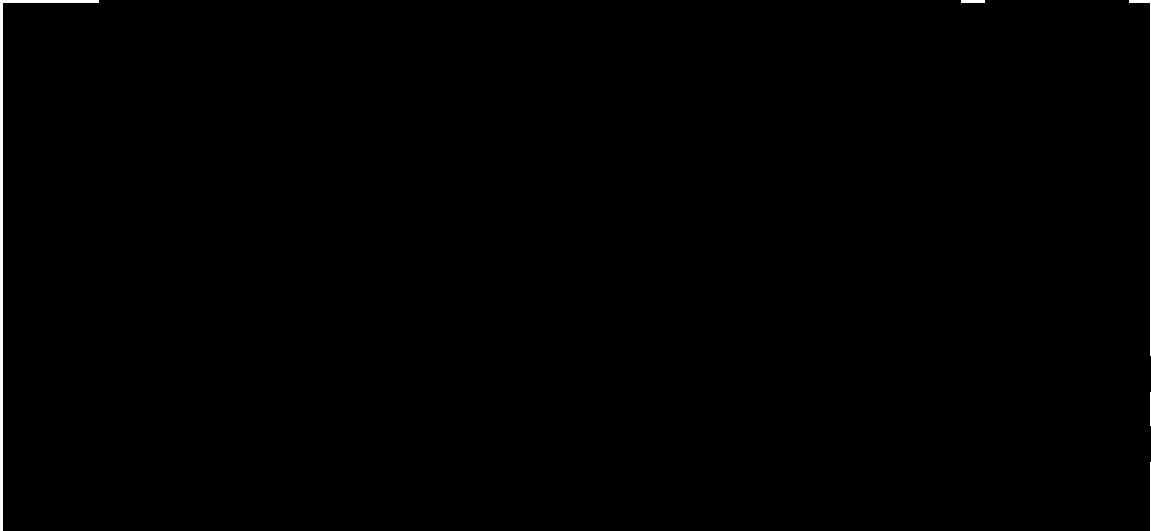
⁸ Including all those referred to in Para 4 of the TORs.

transcripts of which have been retained in the archive used in compiling this report⁹. Where interviews were not taped we took contemporaneous notes. We briefed the military personnel we spoke to that whilst recordings (and transcripts) and our notes cannot be used in disciplinary proceedings¹⁰, the possibility of administrative action based on this evidence remained. Notwithstanding this, we encouraged and received frank dialogue and several interviewees said that they were grateful for the opportunity to register their views and clear the air.

1.2.3 Benchmarking the Puma Accident Record. The TORs directed us to examine the background to several recent Puma accidents. In order properly to distil the effect of current operations, we have benchmarked major Puma incidents against Chinook, Merlin and Commando Sea King SH over the last decade¹¹. We engaged the assistance of the Directorate of Aviation Safety and Regulation (DARS, formerly the Defence Aviation Safety Centre) at RAF Bentley Priory who produced the comprehensive analysis at Annex C on our behalf. This draws out the key causal factors from DARS' extensive accident database and includes data for all the recent reports from Puma Bols¹². We asked the DARS to append their report with any of their own recommendations, on which we have made additional comment below.

1.2.4 Puma Equipment and Airworthiness. Noting that equipment issues feature in several recent Bol, there is a need to establish broadly the limitations of the Puma as an aircraft, its flying and handling characteristics and state of airworthiness. We therefore invited the Puma and Gazelle Integrated Project Team to provide comprehensive briefing material, which can be found at Annex D. Key points are commented on below.

1.2.5 Issues concerning the ZA934 Accident at Catterick on 8 Aug 07. 



⁹ The completed tapes, all classified Secret, cover many hours of interviews.

¹⁰ The team judged, with legal advice, that this approach best addressed the need for a rapid but searching study based on an undisputable record of discussions, and without the distractions of legal representation and disclosure.

¹¹ We have also requested comparative Puma accident data from the French MOD, but the results were not available in time for this report.

¹² Including the accident in Iraq in Nov 07, but not for the Catterick accident last Aug (the Bol for which is suspended pending the civil police investigation).

¹³ On 4 Mar 08.

¹⁴ NYP have already taken statements from many people at RAF Benson.

 We have accepted as published the findings of previous Bols and Uls.

1.3 CONTENT OF THE REPORT

The report begins with an assessment of the Puma as an aircraft, its capabilities and airworthiness. We then offer, benchmarked against other SH, an analysis of the most serious Puma accidents and incidents over the last decade, and an assessment of the extent to which negative or other cultural factors, including *ab initio* and later training, may have been contributing to the recent accidents. We then turn to the roles ascribed to and the performance delivered by the Puma Force since its deployment to Baghdad, focusing on its preparedness and capacity to meet various challenges. In particular we consider the extent to which the laydown of the Puma Force in theatre and its command & control, supervision and leadership, both at home and overseas may have been factors in recent accidents, drawing lessons for other helicopter components within JHC where necessary. We then consider more broadly command relationships within and between JHC and the Puma Force, and the role that Full Command might play in helping to enhance performance in future. Recommendations are offered throughout the paper, which are summarised in a conclusion and executive summary.

PART 2 -THE PUMA AIRCRAFT

2.1 HISTORY

Acquired by the RAF in 1971 and now the oldest helicopter type in MOD service, the Puma is a medium sized SH capable of carrying 12 soldiers in temperate conditions. Like other helicopters, performance reduces when operating in high air temperatures and/or at altitude. The RAF Puma fleet currently comprises 45 airframes, of which 32 are active and brigaded into two squadrons; 33 Sqn at RAF Benson and 230 Sqn at RAF Aldergrove. Originally due to be withdrawn as a type from service by 2012, a funding decision was taken in EP07 to upgrade 30 aircraft with new engines and digital cockpit¹⁵ and extend these until 2022. The MOD Assessment Phase for this upgrade is underway and, subject to a successful Main Gate, we highlight the opportunity this affords to re-consider future Puma Force attributions and basing. The Review draws out some points later in the paper that MOD and JHC staffs may wish to consider in the Air Manoeuvre Capability Planning Group (AMCPG).

2.1.1 A Structurally Sound Airframe with a Long Life Remaining¹⁶. The complex history of Puma since its original acquisition by UK in 1971 is described in detail at Annex D; however, a number of key points emerge. The MOD Puma fleet has flown approximately 480,000 airframe hours to July 2007; creating an enormous body of operational and engineering experience. The Puma originally had a service-life of 9,000 hours; however, in October 1998 Eurocopter, the aircraft Design Authority (DA), stated that based on the experience of other operators the airframe was cleared to 25,000 hours. The average age of the RAF Puma is 10,745 airframe hours with the Fleet Leader (the highest mileage aircraft) having achieved 13,416 airframe hours. The Puma is declared as an “Ageing Fleet” and a structural survey and associated Ageing Aircraft Structural Audit was completed in 2004 with no significant issues raised. These facts suggest that RAF Puma airframes, while certainly of old design, are in sound condition with just a little under half of their maximum life remaining.

2.1.2 Safety Record and Accident Rate.¹⁷ The aircraft accident rate for Puma is currently 0.46 per 10,000 flying hours. The accident rate attributable to technical failure is 0.042 accidents per 10,000 flying hours; however, the most recent accidents have yet to be included formally in the data, although none of the reports into the 3 fatal accidents in 2007 has yet confirmed any technical failure. The accident rate across the helicopter types operated by JHC has risen from 0.4 to 0.6 per 10000 flying hours, while the rate for other UK military aircraft has reduced over the same period (e.g. from about 0.4 to 0.2 for fast jets). The incidence of Human

¹⁵ Engine replacement will provide an engine power anticipator (a long-standing issue with the Puma HC1) and provide a considerable performance increase overall.

¹⁶ Data drawn from Brief on Puma HC1 Safety and Airworthiness prepared by the PGIPTL, PG/38/01/09/06 dated 31 Jan 08.

¹⁷ Information drawn from the DARS database, and as summarised in the Sharp Study. For brevity, the individual analysis tools used for each accident have not been included. Since late last year, DARS has been working with the European Helicopter Safety Analysis Team (EHSAT) on the analysis of helicopter accidents since 2000. This report on Puma accidents is the initial output of their participation in this wider study and is the first time that analysis of this kind has been undertaken by DARS. This is also the first occasion that the Human Factors Analysis and Classification System (HFACS) has been used as an analytical tool. Whilst the work is encouraging, it should be understood that the process is new and is likely to be refined further as improvements are identified. There has also not been time to subject the analysis to detailed internal or external scrutiny. The report has considered only the Puma accidents since 2000, and the results should not be used to assess the overall safety of the aircraft.

Factors (Aircrew) as a cause group is higher in JHC accidents (78%) compared to the UK Defence average (48%)¹⁸. To determine how Puma is contributing to this higher figure, the Review considers the more controversial technical aspects which have arisen in recent BsOI.

2.1.3 Monitoring of Puma Airworthiness by DE&S. DG Helicopters last conducted an airworthiness review of Puma & Gazelle on 9 Apr 08, and while these are held annually, Puma technical matters are explored more routinely during the normal DE&S IPT performance review process. Taken together these meetings, which include a wide range of staff, are sufficient to monitor and influence work on technical issues of concern. The minutes of DG Helicopters Apr 08 meeting are included at Annex E as an illustration of the depth of issues currently under consideration. However, the following section of the Review focuses on some of the particular Puma mechanical and operating issues that have arisen in recent BsOI.

2.2 TECHNICAL AND HANDLING ASPECTS

2.2.1 Aircraft Vulnerability. A comparison of the SH accident records, at Annex C, supports a common belief that Puma is more vulnerable to crash damage (and to subsequent loss of life) than other types of BH involved in similar missions¹⁹. A likely explanation for this may be the fact that, relative to other BH, Puma has a particularly high CofG. The resulting high crash moments generated by its gearbox and engines, coupled with a relatively short wheel base and tricycle undercarriage, makes for relatively poor crashworthiness compared with, for example, Chinook which has a low CofG and wheels on each corner. The propensity of Puma to turn over after a heavy landing is well known, and increases the vulnerability of crewman and passengers who are not properly restrained. We are aware of, and support, the work into crashworthy seats being carried out by MOD as part of the Puma HC2 Assessment Phase.

2.2.2 Engine Anticipators and Nr Droop. The sole Category B Hazard²⁰ on Puma HC1 is the slow engine response to demands for increased power²¹. This can lead to a transient reduction in rotor speed (Nr) and lift referred to as “Nr Droop”. This is a well-documented characteristic of the Puma, and has been extant since its introduction to service in 1971. The effect is exacerbated by the unsophisticated engine control system of the Turmo IIC4 engines fitted to the aircraft. This uses a mechanical governor to seek to maintain a constant rotor speed. The Turmo engine lacks the more advanced electric anticipator system fitted to most other helicopters which compensates for rapid changes in rotor pitch selection by the pilot. The hazard is reflected in the Military Aircraft Release (MAR), in the Release to Service (RTS) and in Puma aircrew operating publications.

¹⁸ JHC J7 Significant Occurrence Tracker.

¹⁹ [REDACTED]

²⁰ Annex C to PGIPT Equipment Safety Management Plan, DLO(VL)/38/10/03/09, Issue 3, dated May 2006. There is no Category A hazard on Puma. Category B is defined as ‘Undesirable - Requires management action to introduce control measures to reduce risk and shall only be accepted when risk has been reduced to At Lowest Acceptable Risk Possible (ALARP)’.

²¹ PG/38/01/09/06 dated 31 Jan 08.

2.2.3 Replacement of the Puma Engines – Cost Benefit Analysis. A cost benefit analysis carried out in 2006 by the Puma & Gazelle IPT²² concluded that based on historical Puma accident data, the current hazard posed by N_R droop was within the At Lowest Acceptable Risk Possible (ALARP) region, set against the technical solution of re-engining the fleet with Turbomeca Makila engines. It also assessed the aircraft ALARP against an Out of Service Date (OSD) of 2012 and, hence, that there was no case on safety grounds to re-engine Puma with so little time remaining before fleet retirement. The IPT analysis also judged the aircraft ALARP against a notional deferred OSD of 2017 but noted that, given the high sensitivity to any future accidents, consideration should be given to re-engining. Finally, the analysis judged that the aircraft was *not* ALARP against an OSD of 2022²³ and that consequently there is a possibility that given the length of time in service to 2022, the risks attached to not fitting Makila engines in terms of Flight Safety are likely to outweigh the cost of the upgrade.

2.2.4 Mitigation of Nr Droop Risk. Mitigation of the Puma's Nr droop characteristics consists of clear warnings in aircrew publications²⁴ of the system behaviour, extensive training given to pilots (including regular sessions in the flight simulator) and a system that provides an audio warning of low Nr. Notwithstanding this mitigation, Nr droop has been a contributory factor in several Puma crashes²⁵. We judge that, despite the concerted effort over many years, the measures to mitigate the Nr droop risk have not been wholly effective, and that an alternative approach is now required.

2.2.5 Solutions to the Nr Droop Problem. An anticipator system cannot be retrofitted to the Turmo engine; and only replacement with the more modern Makila engine (which includes an anticipator) would resolve the issue completely²⁶. Bids made over a number of MOD planning rounds to retrofit RAF Puma with Makila engines have been rejected on investment grounds. The assessment on each occasion appears to have been that given the imminence of the fleet OSD, risks should be mitigated by improved awareness and training²⁷; a position we think the recent accident record shows to be unsustainable. However, we note that a modification of the pilot audio device is in hand, which will give operators earlier warning of high Nr. **Assuming that MOD wishes to keep Puma in service, we recommend that a programme to retrofit Puma with Makila engines is now essential.**

2.2.6 Operating at the Margins of the Aircraft Envelope. During our visit to Iraq we learned that some Puma missions have required pilots to operate at the absolute maximum approved All-Up Mass (AUM) with little or no spare power margin. While there is a need to get the operational job done, it is clear from the recent Puma accidents in Iraq that crews may suffer lapses in concentration (e.g. XW221 Basra

²² DLO(VL)38/01/09/08 dated Aug 06.

²³ The new OSD agreed in EP07.

²⁴ E.g. Puma Aircrew Manual and SOPs.

²⁵ Examination of the accident data assembled by DARS for this study shows a number of accidents to have been exacerbated by slow engine response. The BsOI into accidents on XW200, XW207 and XW227 recommended that Puma should be fitted with anticipators. NR droop was also a factor in the loss of XW221 at Basra in July 04 [REDACTED]

²⁶ The retrofitted Makila engine has been widely adopted by legacy Puma operators worldwide. [REDACTED]

2004 and XW211/218 Baghdad 2007). We are aware that the Puma Force Cdr has already initiated a study into thrust margins, and this work needs to be translated into a revised safety policy in theatre. **We recommend the imposition of safety thrust margins for future Puma operations, and that JHC considers mandating appropriate margins for all BH.**

2.2.7 Problems with the Puma Operating Data Manual (ODM) ²⁸. The Puma ODM is a key aircrew publication containing the performance graphs from which crews establish mandatory aircraft limitations at various ambient conditions. The Puma ODM is known to contain some irrelevant charts, or charts which yield figures different to other aircrew documents; and the publication overall has not been re-validated since the 1980s. The document is valid only up to +43 degrees, which is less than the peak temperatures encountered in Iraq, which can touch 50 degrees in summer. Performance data between +43 to +50 degrees is provided by charts for the civil variant SA330 Puma, and promulgated for RAF use as Service Deviation (SD) 117. As a result of an investigation directed by the Puma Force Cdr following the recent spate of incidents, a comparison of overlapping performance data between ODM vs SD117 found that the Maximum All Up Mass (MAUM) figures derived from SD117 (the ones mainly used on ops) were approx 250kgs greater across the entire temperature range than those derived from the ODM. The Puma Release to Service Authority (RTSA) is unable to recommend the renewal of SD117 (which is unbounded) without raising the risk profile. The RTSA (on the advice of QinetiQ) will release, as an interim measure, an amendment to SD117 advising crews to *reduce* MAUMs derived from the civilian charts by 250kgs. As a further interim measure Puma IPT will task QinetiQ to produce as soon as possible a Puma rapid planning document including charts for hover and low speed²⁹. These charts will be produced from data already captured and should be available by end of Jun 08. The IPT will also task QinetiQ to produce a new ODM by end of 08. The provision of suitable ODM for the Puma is a basic safety requirement and, in light of recent incidents, the issue plainly needs speedy resolution. We understand that QinetiQ believe that this new task will not affect any other current projects for the Puma and have indicated there may be (as yet) undetermined conflicts with other current/future platform projects for which a priority decision will be required from JHC. **We recommend that work is put in hand by JHC to establish these priorities and, through the IPT, provide direction to QinetiQ; and to check on the status and accuracy of other BH ODM.**

²⁹ Hover Inside and Outside Ground Effect, and Hover Outside Ground Effect with a 5% thrust margin.

PART 3 - ANALYSIS OF RECENT PUMA ACCIDENTS

3.1 SORTIES SELECTED

A synopsis of all the major defence helicopter incidents over the last decade is provided at Annex F. This is useful as an historic backdrop to several periods of high operational tempo. We have, in accordance with the TORs, and with the very considerable help of the DARS, examined in detail the following specific accidents³⁰:

Date	Ac	Location	Event/Situation	Main Source of Information
20 Nov 07	ZA938	Iraq	Night formation; ac impacted ground in recirculating conditions; 2 fatalities, 2 x T2 casualties.	Bol Part 1.2 without Annexes
15 Apr 07	XW211 XW218	Iraq	Two ac collided during repositioning of lead ac, who had landed in wrong field; both ac provisionally Cat 5. Two fatalities.	Bol Parts 2 to 5 without Annexes
19 Jul 04	XW221	Iraq	Crash Basra Airport . Inappropriate downwind approach. One fatality.	Bol Aircraft Accident Report Summary
16 Mar 02	XW227	UK – NI	Ac crash, Jonesborough.	“
21 Jan 02	XW234	UK –N I	Ac crash Ballykelly, Cat 5 damage.	“
9 Apr 01	XW200	Kosovo	Ac crash near Pristina.	“
19 Apr 00	XW207	UK	OCF Op trg phase; ac recovered from zoom descent resulting in heavy ldg.	“

Figure 1: Specific Puma Accidents (2000 to 2007)

3.2 RESULTS³¹

All of the published Puma accidents from 2000 to 2007 were strongly in the human factors cause group. Annex D gives a graphical presentation of the results of the DARS analysis of each accident. These graphs can be considered to outline a human factors ‘spectrum’ of each Puma accident³². Overall, the key causes of the accidents appeared to be:

3.2.1 Supervision. In some accidents those in supervisory positions appear to have felt inadequately prepared (XW200) or insufficiently experienced (ZA938) for their duties. The mission leader of the ZA938 formation, as well as the crews of the other aircraft, may have benefited from more detailed pre-flight guidance about the correct balance to strike between mission success and safety; there is a strong sense of mission creep. In the XW200 accident, the high workload of the Det Cdr may have affected his ability to consider more fully the guidance given to the crews in the event of inadvertent Instrument Meteorological Conditions (IMC).

3.2.2 Authorization. While the operational pressures on the crew of ZA938 were considerable, the authorization process in itself did not provide any supervisory

³⁰ The Catterick accident of Aug 07 has been excluded as *sub judice*, for the reasons explained in the introduction.

³¹ The following section is drawn directly from the DARS analysis commissioned by the team for this study.

³² It is important to note that while the graphs give an outline of the events of each accident, for a more detailed assessment, reference should be made to the source documents and the detailed information captured in each analysis tool.

function. While crew selection for XW221 & XW234 was made before the authorization stage, a supervisory input at this stage might have provided a final defence in questioning the crew composition. The authorization process for the XW200 sortie could have provided a final means (with knowledge of the weather and task of the day) of discussing with the crew their intentions in the event of inadvertent IMC.

3.2.3 Violations. The accident reports collectively do not point to a major systematic problem of *deliberate* violations. There are some examples (ZA938 Radar Altimeter setting procedures & XW218 F700 record of fault) of violations of regulations and SOPs. In the main, personnel appear to have become too task focused and were not using the procedures and feedback systems available to request the reassessment of regulations / SOPs.

3.2.4 Reporting Culture. While there is no direct evidence, it is possible that 'near-miss' events have occurred in the past which perhaps could, had they been reported, raised awareness earlier of some of the latent failures identified by BsOI.

3.2.5 Knowledge of Aircraft Performance Limitations. The XW207 accident in 2000 highlighted the need for more information and advice to crews on aircraft handling. While better information was made available, the XW221 accident in 2004 highlighted that there remained a lack of understanding of the effect of the operational environment on aircraft performance.

3.2.6 Approach Profiles &

Such profiles are safe if conducted properly but, on some occasions (XW227 & XW221), a lack of awareness of the wind led to urgent and large unanticipated power demands. The consequent Nr droop and height loss resulted in impact with the ground. There have also been occasions (XW207 & XW234) where the wind direction was known but mishandling still caused rotor droop and height loss that could not be recovered. The record shows that the selection of approach profile is important, as is awareness of the risks in flying manoeuvres that leave little room for error or recovery (XW227 & XW221).

3.2.7 Wind Knowledge, Crew Co-operation & Monitoring. Knowledge of the surface wind is important for all helicopter aircrews, particularly operating conventional single main rotor aircraft like the Puma, because performance tends to reduce when facing out of wind. In the XW227 & XW221 accidents, the handling pilots were unaware of the wind direction and/or strength which, combined with the approach profiles flown and attempted recoveries, ended in accidents. In some accidents (XW221 & XW227) there were insufficiently robust briefings and active and inquisitive interest from the other crew members in the plans of the handling pilot. The wind-related accidents are good examples of the need for effective monitoring and crew co-operation; for non-handling crew members to have the ability and confidence to voice any concerns to the handling pilot; and for a culture which

makes a virtue of spotting mistakes or flawed thinking, and of challenging these robustly.

3.2.8 Mission Training and Planning. Having landed in the wrong field, the repositioning of XW211 led to a fatal collision. More contingency planning at the briefing stage (with the other crews in the formation and with the troops) may have helped prevent the accident.

3.2.9 Unrestrained Passengers & Fire. The loss of unrestrained passengers from XW218 occurred at an unopposed landing site where, moreover, there was seemingly no expectation of enemy action. Unrestrained people have been shown to be at significant risk of injury during many Puma crashes (XW227, XW218 & ZA938). The non-handling pilot of XW221 appears to have been overcome by smoke.

3.2.10 Situational Awareness Enhancements. In some accidents, crews encountered poor visibility (XW200 inadvertent IMC; ZA938 brown-out). A lack of visibility of wires and obstructions, as well as tactical information on the position of other aircraft (XW211), appears to have been a key factor.

3.3 INTERVENTIONS

Arguably, insufficient emphasis has been given in the MOD equipment programme to the replacement of the older BH such as Puma, Sea King and Lynx. For example, a feature of the Chinook accident record in theatre is that, by comparison to Puma, a greater robustness of design is translating into better survivability. An illustration of this is to consider the experience of recent Chinook incidents where, during desert/dust landings at night, aircraft have lost wheels but still survived (and in some cases even flown away). The difference with Puma is that these same conditions will be far more serious. While the relatively low crash tolerance of the Puma does not absolve crews, training staff or the JHC HQ from ensuring that the fragility of the aircraft is mitigated (and SOPs already do this), the fact remains that, given its characteristics, the aircraft is less ideal than some modern designs for operations in demanding theatres. The MOD has taken the view that Puma is still capable of carrying out its current [REDACTED]

[REDACTED] However, given the reliance of our soldiers on the helicopter force in both theatres (possibly for some time to come), we sense that the time has come for a reassessment by the JCG of their procurement priorities to reflect the need for more capable and survivable aircraft. **We recommend the JCG examines the priority they accord to the procurement of BH, with emphasis on replacing legacy platforms.**

The DARS team have proposed a detailed list of interventions referenced to the relevant Puma accidents. These are reproduced in full at Appendix 4 to Annex C. The Team considers that, particularly given the planned extension of Puma in service, all the interventions are worthy of being taken forward as part of JHC's Puma Reset Plans; however, in the interests of brevity, a few general ones are extracted here:

3.3.1 Cross Monitoring. The importance of cross monitoring, prioritising of tasks and the communication of critical information should be emphasised to Puma crews.

3.3.2 Short Approach Brief. Unless operationally essential, or prevented by an emergency, consideration should be given to Puma crews conducting a short approach brief. The approach brief should include: the expected forecast wind, cross-checking against available internal and external wind indicators, the type of approach and what monitoring is required from the crew.

3.3.3 MAWS checks. MAWS checks should be challenge and response or verified by visual check from other crew members.

3.3.4 Escape Equipment. Research should be conducted into the possibility of aircraft carrying simple equipment that can assist in raising an aircraft sufficiently to allow a trapped person to escape.

3.3.5 Synthetic Vision Systems. Consideration should be given to the use of Synthetic Vision Systems to give better situational awareness in conditions of reduced vision e.g. brownout, whiteout, night, poor weather and in assistance in recovery from inadvertent IMC.

3.3.6. Recording of Data. Cockpit Voice Recorders (CVR) should always be used and suitable Accident Data Recorders (ADR) / Flight Data Recorders (FDR) should be fitted to aircraft to give better information sources for investigators as well to assist as debriefing and engineering resources. Encrypted systems should be investigated for use where needed.

3.3.7 ORM-Type Systems. Consideration should be given to the use of systems (e.g. Operational Risk Management) to formally capture the risk of missions and provide information to supervisors.

PART 4 - PUMA FORCE CULTURE, FLYING AND TRAINING

4.1 HISTORICAL INFLUENCES AND ETHOS

The Puma HC1 helicopter has had a long and varied history in RAF service, amassing close to half a million flying hours in nearly 40 years. Procured as part of Anglo-French defence equipment collaboration in 1971, and a decade before UK acquired Chinook, it represented a big step forward in payload and speed over the 1950's vintage SH then in service. However, like its older counterparts, Puma lacked the anti-icing and navigation systems required for passage of controlled airspace and, consequently, flying was invariably conducted visually and, particularly in poor weather, at low level. For its first 20 years' service the aircraft was flown by a single pilot/captain, assisted by a crewman who alternated between working in the cabin and, during transit, assisting with navigation from the aircraft's left hand pilot's seat. During the Cold War, and with the two sqns based respectively in Germany and southern England, the Puma Force held a diverse range of NATO and other roles, including a regular remit to self-deploy to central, northern and southern Europe. [REDACTED]

[REDACTED] Arguably this range and mode of flying bred a distinctive ethos; of independent and individualistic self-reliance, a penchant for tactical formation and default towards low flying and a culture which made a virtue of reaching the destination come what may. In the opinion of some³³, many Puma aircrew at this time had a vision of themselves as a thing apart³⁴; as the pathfinders of the SH Force; but perhaps not always a part of the team.

4.2 MOVING WITH THE TIMES

Entering service in 1981, the Chinook quickly became the prime mover of choice for most operations. Unlike Puma, the Chinook could operate at sea³⁵ and [REDACTED], arguably has become the major spur to SH lines of development³⁶. Puma Force fortunes changed in 1992 when 230 Sqn relocated to Northern Ireland, losing the leading higher readiness NATO deployable role it had enjoyed in RAF Germany³⁷. Some people posted to Northern Ireland (NI) may have felt, particularly as the operational tempo fell away after the Good Friday Agreement, that the Puma Force's best days were behind it and that the aircraft would, as had the Wessex before it, wither away while other SH types cut new ground. Evidence of declining Puma Force morale, particularly in NI, was certainly clear at this stage to the RAF Personnel Management Agency (PMA)³⁸. They struggled to fill experienced aircrew slots because there was little appetite amongst crews to seek a second tour on type, particularly if this involved a move from England to Ulster. But, just as PMA was intervening successfully to address the leakage of experienced people³⁹, the Puma Force enjoyed an operational renaissance, beginning with the deployment to the

³³ [REDACTED]

³⁴ 33 Sqn's former HQ and hangar complex at Odiham was referred to as 'RAF Long Sutton' (a nearby village); a mark perhaps of the sense of Puma insularity at the time.

³⁵ Unlike their French counterparts, RAF Pumas have never been cleared for ship operations.

³⁶ [REDACTED]

³⁷ 230 Sqn's NATO readiness reduced from R2 to R4 as the unit moved to RAF Aldergrove.

³⁹ We consider the effect of this action later in the paper.

Balkans in 1999 (Op AGRICOLA), then to Iraq in 2003 (Op TELIC 1 and 2), [REDACTED] and, later in 2004, the Baghdad Helicopter Detachment [REDACTED]. It came as no surprise to those who have watched the Puma Force over the years that it seized eagerly at the opportunity offered, [REDACTED].

4.3 PUMA FORCE CULTURE TODAY

Given their background in low level flying and focus on achieving the destination, a slightly negative view has emerged that the Puma Force may have acquired an attitude of 'anywhere, any time'⁴⁰. If true, there is a risk that this could lead to an appetite for risk-taking, particularly if flying is mundane and unchallenging. We sensed from our own visit to the BHD that the flying involved is potentially under-arousing and therefore a major pitfall for the unwary. Given its evolution over the years, there may be a tendency in the Force to push the limits and we would point to the obvious risk that that this poses for crews lacking in awareness or experience, particularly when their skill or luck runs out. However, nobody we spoke to throughout the Review believed, or had evidence to support, the presence of a 'bad apple' cadre in the Force, and we discuss later how role selection during training and posting action by PMA have in any case made this unlikely. The picture today is of a Puma Force that believes, and rightly, that it is doing an important job in a difficult theatre. The initial eager enthusiasm [REDACTED] has long since given way to an acceptance of the need to crank the roulement handle for the long haul, and we detected a tired resignation in some we spoke to. The Force as a whole appears still to evince its customarily proud 'can do' attitude; but morale, particularly on 33 Sqn, is now fragile. Many we spoke to are wearying of the length of scrutiny after recent accidents, and becoming bitter that the setbacks are not being set properly against the background of their substantial record of operational success [REDACTED] in theatre⁴¹. There is a sense that Puma personnel feel that their reputation as a force has now been seriously tarnished. There is a risk that this could cause an unhealthy introspection and we therefore believe strongly the need now for cdrs at all levels to work hard at cultivating a 'one team' culture in the SH Force, and to be sensitive to any tendency for the Puma Force to either remain or become disconnected from the wider SH team. We also endorse strongly the need to deliver current plans to collocate the Puma Force onto a single operating base under Project BELVEDERE. We think that this would help to increase force centre of gravity. The enhancements planned under the HC2 upgrade enabling future duty in Afghanistan also offers a valuable opportunity to further integrate the Puma with other BH types on operations.

4.4 ROLE OF CREWMEN

In thinking about how readily some Human Factors (Aircrew)-related accidents might be averted, it is possible that something of the early Puma ethos remains in the way the single crewman relates to and perhaps more readily acquiesces to actions taken by those in the cockpit. Where 2 front-enders set off on a course of action about which the crewman has a concern, the 'two on one' gradient in the aircraft may, particularly if the crewman is inexperienced, be less conducive to promoting a 'speak up' culture than in Chinook or

Merlin where 2 operating crewmen are better able to exert a positive influence. [REDACTED] the SH Force's Chief Examiner, is of the view that there are still some negative practices which hark back to the days of a single pilot and crewman⁴². He has observed a lot of what, in his opinion, might be seen as cockpit activity still residing with the crewman; for example, pre-flight calculations of aircraft performance. He believes that this may promote a non-ownership of key aspects of the sortie by the front crew, and that there is still a tendency by crewmen to come forward into the cockpit area when perhaps this is not appropriate. He cited the STANEVAL report to 33 Sqn in 2006 that had commented on a tendency for inexperienced Puma crewmen coming forward to look inside the cockpit area instead of maintaining aircraft lookout. [REDACTED] also observed that when crewmen are manning the gun during operations they are no longer providing the degree of support to the pilots that they are used to.

4.5 INCULCATING THE RIGHT CREW ETHOS

It follows that particular attention needs to be paid to promoting the right ethos in aircraft operating with a single crewman (or in the case of Army aircraft, door gunner). There are many possible ways to inculcate the right culture, which needs to begin right at the start of helicopter training and be sustained throughout flying careers. We are satisfied having spoken to staff at the DHFS that trainee crewmen are required in the syllabus to respond fully to aircraft emergencies and, while assisting the captain with aircraft drills, to question and challenge his or her actions. We are also content that this important crew cultural principal is being sustained through SH OCF training. However, it is less clear how well crewmen on front line sqns are being encouraged to take a share of the responsibility for aircraft safety (albeit recognising the aircraft captain's responsibility for the overall safety of the aircraft).

4.6 USE OF THE SIMULATOR

While noting that it is optimised for pilots, the MSHATF simulator facility at RAF Benson seems to us a good training vehicle to help build crewman competence, confidence and to grow moral authority. We asked the civilian simulator instructors for their broader view of the attitudes they saw displayed by SH crews attending training⁴³. They thought that the Merlin and Chinook crews worked closely together, providing mutual support and discipline; that they took responsibility for themselves and others and that, overall, they shared ownership of the mission. By contrast there appeared to be less evidence of this for Puma crews who, unless designated as the mission leader, had more of a tendency to 'do their own thing'. Puma crews generally appeared to be more free-spirited and less well disciplined, and not as welded to the mission as their counterparts on Merlin and Chinook. One reason offered for this was that only one Puma crew is able to train at any one time in the (single) simulator (there are 3 Chinook and 2 Merlin boxes) and that, consequently, there was less opportunity for peer review. If true, then now is the time for effective leadership to inculcate an appropriate SH team spirit during simulator training. The Puma civilian instructor told us that 230 Sqn appeared more conscientious than 33 Sqn, who always seemed to have 'other things to do'⁴⁴. The explanation he offered for the disparity was that those from RAF Aldergrove were able to treat simulator visits as a deployment with

[REDACTED]

no other distractions, whereas 33 Sqn seemed always to be 'pushed' for time. We have also heard anecdotally that over a year ago 33 Sqn was falling short of the mandated requirement for crewman attendance in the simulator⁴⁵. However, attendance has improved over the last year as a result of a re-assessment of the essential 'crewman required' simulator sorties and the focus provided by the 'fight by flight' process⁴⁶. We conclude from this that optimum use of the simulator may not have been made, particularly by 33 Sqn crewmen, during the period leading up to the 2007 accidents. However, we note the effort that has been put in over the last year to remedy the situation and these efforts need to continue in the future to ensure that optimum use is made of this expensive facility. However, we should also put some of the comments we heard in the MSHATF in their proper perspective. For example we have established that, while civilian instructors are at liberty at any time to raise negative reports about specific crew behaviour, the civilian Puma instructor had at most raised only one per year in his 8 years of service. Moreover, when pressed, instructors said that they perceived no 'downhill slope' in overall standards or flying. We also note that the issue of attitudes towards simulator training has already been taken up by the Puma Force Cdr and we endorse his initiative, launched last autumn, to institute a Flight Safety feedback from the civilian instructors, through SO1 MSHATF⁴⁷. **We recommend continued focus by JHC, and audited by STANEVAL, to ensure that optimum use is made of the MSHATF.**

4.7 'RETURN TO UNIT' TRAINING PACKAGE

Some MSHATF instructors feel strongly – and have done for some time – that there is inadequate leadership, example, and supervision of simulator-based training, and no consistent policy guiding it⁴⁸. This extended, they said, to the OCFs, where new flight cdrs routinely reinvent the wheel, or elect not to do segments of the syllabus. Another key factor reported was the short, usually unstructured, conversion training given to new unit (and stn) cdrs which was, in their view, far too little to enable senior executives to lead and supervise with any confidence. We take these strongly held views seriously not least because MSHATF staff, who have no axe to grind, sit at a crossroads of the SH force and are able to take a broad view of the relative skills, attitude and morale of all our Puma, Merlin and Chinook crews. We invited the civilian instructors to suggest ways in which the facility might contribute more to the 'recovery' to peacetime standards of crews returning from theatre, particularly given that that funded spare capacity exists within the PFI contract for the MSHATF. They recommended, and we agree, that a new simulator-based RTU training course should be developed for all SH types⁴⁹, aimed at reorienting crews returning from overseas to the more regulatory complex environment at home⁵⁰. Mandatory attendance on such a course would help to achieve the positive 'decompression' of crews and allow a measurable reintroduction to UK-based flying. The aim of this RTU training package should be to re-establish peacetime flying and operating standards and to re-emphasise that the safe and efficient operation of the aircraft is paramount. We think that sqn executives (perhaps down to and including deputy flight commanders) should participate in this training personally to ensure that the correct teaching points are brought out; that the right approach

⁴⁶ Statistically over the last year 33 Sqn crewmen provided more support than 230 Sqn; a crewman from 33 Sqn logged an average of ~15.4 hrs in the simulator over the last year compared with ~13.5 hrs for a crewman from 230 Sqn.

⁴⁷ BEN/7/1/CO dated 24 Sep 07.

⁴⁹ The feasibility of these proposals for Sea King and Apache would need to be tested in light of the training facilities and contracts in place at Culdrose and Wattisham, but we believe the concept should be applied across JHC if possible.

⁵⁰ We understand that Chinook already a training package called Op JERICO.

to operating in peacetime is re-established and to re-acquaint themselves with the standards and capabilities of returning crews. We note that courseware already exists for all 3 types in MSHATF syllabuses to support the package⁵¹. **We recommend a review by JHC of BH simulator training, including arrangements for converting new unit cdrs and to consider, where capacity exists⁵², implementing an additional mandatory 'Return to Unit' training package for crews returning from theatre.**

4.8 QUALITY OF AIRCREW

The team looked at the earlier stages of training to assess whether the quality of trainee aircrew had changed over recent years. In particular we wondered whether impressionable young people were in any sense arriving in the Service with, or were acquiring during training, any malign attitudes that might be contributing to the Puma accident record. We visited RAF Shawbury and the Defence Helicopter Flying School (DHFS), and were greatly encouraged by the whole-person approach being adopted during the training of pilots and crewman. The instructor cadre at Shawbury seemed to us a balanced mix of experienced individuals, including some 40% civilians (mostly ex-military) with the balance of serving instructors from all 3 Services. The PFI contract to provide training aircraft appeared to be working well with conspicuously high levels of daily aircraft serviceability contributing to a productive and busy flying programme. Far from the PFI undermining Service ethos we found that the civilian instructors, many of whom were of older-school outlook, saw it as a part of their normal business to inculcate the correct modes of behaviour and the sense of responsibility that has always been a requirement of military flying training. Commandant DHFS actively encouraged this, and his staff told us that the trainees coming from basic training were of no less quality than anyone could remember. Trainee crewmen tended these days to be brighter academically, but larger numbers of direct entrants meant that military experience was less overall. Some instructors thought that basic students required more spoon-feeding and sometimes lacked common sense - the 'X-Box Generation'. We were also told that students tended to be older, more often graduates, more individualistic and questioning, but also accepting of answers. However, all said that they were still seeing people of high calibre too. We took this as an encouraging sign that recruitment and aircrew selection processes are still working well and that we are able to attract good people in a competitive market.

⁵¹ At minimum, we think the package should comprise:

- a. Local area general handling to include academic low flying, underslung loads, confined areas and tactical approaches and departures, all under peacetime constraints and procedures.
- b. A simple task set in a non-operational terrain database, to include a range of operational techniques such as Electronic Warfare, but again conducted as an academic exercise under peacetime constraints.
- c. Procedural instrument flying.
- d. A night flying session to include a range of academic exercises conducted under peacetime constraints.
- e. Malfunctions training embedded in the general training sessions rather than in 'tick box' sessions, emphasising the peacetime interpretation of procedures.

⁵² We have been informed [REDACTED] that over the last 4 years Puma Force utilisation of the Puma simulator at the MSHATF has never exceeded 70% of funded capacity, and normally settles around 66%. The latest low figure (60% from Apr 07 to Mar 08) is lower than normal because of the cancellation of No 161 OCF Course, and the loss of the normal throughput of students, with the associated disproportionate effect on simulator usage. CAE ATS, the service provider, is contracted to deliver 77% [2487 hrs] of the 100% expected usage hrs [3553hrs] until 1 Apr 2012. Notwithstanding the predicted additional usage of the simulator as a result of the Puma 2 modification [an enduring 71%] there are 11% of hours currently available for use at no extra cost. This equates to 390 hrs or, on average, 1.5hrs per day. Given the focus on current operations the view of the simulator instructors is that these hours could be used for re-orientation training. We suggest that creation of courseware could be funded from 'gain share' from the contractor and would, therefore, be at no additional cost to the Authority.

4.9 STANDARD OF TRAINING AT DHFS SHAWBURY

Commandant DHFS believes that the standard of training output is higher now than at any time in the past, pointing to the increased inclusion in the syllabus of Night Vision Devices, procedural instrument flying, tactical and formation flying. While he had received no complaints from the customer, he observed that JHC staff did not visit Shawbury often or provide feedback. He also thought that a lot more could still be done at DHFS to offload front line SH OCF's, and was keen to explore the possibilities with the JHC and HQ 22 Gp. Considering the relatively higher cost of Puma flying hours compared with DHFS Squirrels and Griffin, and noting the constraints on BH training at home, we think that this idea bears further study. **We recommend that JHC consults with DHFS and HQ 22 Gp on ways in which the DHFS syllabus might be enhanced and that regular feedback on output/input standards is instituted as policy.**

4.10 QUALITY OF DHFS INSTRUCTORS

A recurring theme in our discussions with the front line is that an effect of the high operational tempo is that young aviators have less time to settle down on their new sqns before being swept along in the tide of preparation for deployment. We conclude from this that the time spent by students with their instructors and mentors at DHFS is more important now than ever in helping to instil the right ethos and as early an appreciation as possible of the trust vested in them as military aircrew, and the responsibility this brings for the lives of others. We feel strongly that to fulfil properly this mentoring role, military flying instructors need to have the credibility that derives from relatively recent operational experience⁵³. Commandant DHFS believes, and we agree, that newly qualified instructors should have a period of consolidation in pure instruction and then return to front line duty. We understand that there has been some difficulty in releasing experienced people from operational duty, and that this is resulting in some instructors remaining too long at DHFS. We wonder whether part of the problem may be a 'bed-blocker' cadre of military instructors at Shawbury who, for various reasons, are preventing the introduction of new blood. Either way, we sense the need here for single-Service guidance and direction. **We recommend a review by RAF PMA, HQ 22 Gp, DHFS and JHC to look again at SH instructional policy, selection and tour lengths; and that, depending on its findings, consideration is given to broadening the work to include the Royal Navy and Army.**

4.11 ROLE SELECTION

We were keen to learn how particular students at DHFS are selected to fly Puma, what the criteria were, and whether it is possible for a crop of bad apple aircrew to end up in a single sqn or force barrel. Role disposal boards meet regularly at DHFS and comprise a mix of officers including the Chief Flying Instructor, OC 60 Sqn, several line instructors, a representative from the SAR Training Unit, and staffs from PMA, HQ 22 Gp and JHC. Each course member is presented on PowerPoint to the Board, including a character narrative, a précis of performance, strengths and weaknesses and posting preferences. Specific assessments include officer/SNCO qualities, general handling, captaincy, Crew Resource Management, mountain flying and an overall assessment. PMA desk officers then disclose the 'slots' available on front line sqns. Discussion centres on the most suitable slot for each student and while individual preferences are considered they are not a priority, although the

⁵³ We think applies equally for OCF instructors.

highest scoring pilot and WSOp⁵⁴ will if suitable get their first choice - a 'carrot' we agree is a good incentive for students to do well. Weaker individuals are highlighted, and have tended to be sent to Chinook because it is perceived as a relatively forgiving aircraft to fly⁵⁵ and because they can benefit from a slightly longer work-up to CR⁵⁶. Stronger students are generally considered for Puma slots, although DHFS was quick to point out that any graduate of 60 Sqn is, as a pass standard, required in theory to be suitable for any slot. Once complete, the role disposal session result is error checked and ratified by all members of the Board. We are satisfied in all that DHFS is maintaining an effective approach to role disposal, and that a balanced look is being taken at the strengths and weaknesses of individuals, and the needs of the front line. Given the robust training, reporting and disposal apparatus in use at Shawbury, we think it most unlikely that malign individuals could routinely pass undetected through the system, or arrive in numbers on any particular front line aircraft⁵⁷.

4.12 DILUTION

We have looked into RAF helicopter posting policy over recent years and interviewed a key former PMA desk officer⁵⁸, to see if it has been possible for a cadre of disgruntled aircrew to develop within the Puma Force and become a long-standing negative influence on younger novice aircrew. During the period 2002-2004 there was a specific concern in the Puma Force about high levels of dilution and haemorrhaging of experienced people. This was exacerbated by the fact that 230 Sqn was larger than 33 Sqn, which meant that an automatic second-tour policy for everyone could not be established. Moreover, we have noted already the reluctance among some Puma aircrew over that period for a second tour on type. We are satisfied that the PMA took active steps to address these concerns by employing quite a number of trained ex-Royal Navy and Army Air Corps aircrews who had elected to join the RAF. This had the effect of introducing significant new blood and a broader experience within the Puma Force. We think it unlikely that any established 'bad apple' cadre would have survived unchallenged in this increasingly 'multicultural' force.

4.13 CURRENT AIRCREW MANNING⁵⁹

To meet the building demands of the SH front line, the OASC is meeting set targets and still has a healthy application and success rate for pilot recruitment. DHFS is working at full capacity (IPS of 44 building to 49) and is meeting its target. Additionally, there is an active transfer market from the other services (mostly from the AAC) and these gains to service are now starting to join the front line, and are critical to meet the extra requirements. For Puma, the small (4 pilots) but regular courses are adding aircrew to the force and PMA is, in conjunction with the Puma Force, actively managing the outflow rate and internal postings in order to build a fifth flying flight later in the year (we discuss this later). Of note, the strain of the current op tempo is limiting any appetite for cross fertilisation between types, but with aircrew manning broadly sufficient but stretched across all types. All forces are reluctant to

⁵⁴ Weapons System Operator - a relatively new brevet that combines a number of former RAF aircrew trades, including Navigator.

⁵⁵ A view that appears to be born out by the accident record.

⁵⁶ We have compared respective forces' times to CR, and found little difference.

⁵⁷ This view is supported by [REDACTED], who has commented that the product from RAF Shawbury is very good indeed.

release their crews to anything other than remaining on type and staying on Ops. This may cause problems in time if individuals begin to feel “stuck” on a particular fleet.

4.14 FLYING THE PUMA

Aerodynamically streamlined, the Puma is flown in the cruise with fixed collective pitch and is piloted mostly by cyclic stick, resulting in an engaging ride at low level. [REDACTED]

[REDACTED]. The aircraft is uncomplicated technically, easy to start and administer in the air, and is small enough for pilots, crewman and passengers to communicate visually and audibly, all of which makes for an intimate flying experience for everyone on board. However, there is nothing unique in the aircraft that requires or justifies any more spirited flying or manoeuvring than any other helicopter. Rather, as with any other military aircraft, a Puma pilot’s awareness of his limitations, whether imposed by the machine or his own skill, comes down to good training, captaincy and a collective sense of responsibility amongst the crew.

4.15 PUMA OCF

4.15.1 The Training Syllabus. Conversion onto Puma is carried out centrally by the 33 Sqn OCF. The course includes a comprehensive groundschool and comprises a range of flying exercises designed to introduce people to (or refresh them on) Puma. General handling is a feature throughout the course, including dedicated sorties in the real aircraft and the flight simulator and a keen focus on Nr droop, engine and rotor handling. The Operational Phase of the course begins with a second dedicated groundschool and sorties seek to build on the experience already gained at DHFS by introducing themes likely to be encountered in current operations. The course has hitherto culminated in a land-away on the Continent which helps to build airmanship and a wider appreciation of foreign procedures. However, this aspect of the course has recently been falling off the programme due to pressure on aircraft availability⁶⁰.

4.15.2 Problems of OCF Productivity. It is clear from a number of interviews that there have been particular difficulties on 33 Sqn OCF over recent years⁶¹. [REDACTED]

[REDACTED] This was exacerbated further by the apparent strain the OCF was under to achieve an IPS target of 24 pilots per year. The sqn cdr thought this IPS ‘ridiculous’ because the target appeared to him to be being driven by a need to replace experienced Puma aircrew that were being posted out to other types, typically Merlin and Chinook. He characterised this period as one where the Puma Force had in effect become a training ground for other forces, with too little experience being retained to cover difficult Puma operations. Efforts were made to reduce the outflow of experienced aircrew (and thus OCF output), but it took 18 months to reduce the IPS to 14 pilots/year. Unfortunately, this coincided [REDACTED] where it appears that OCF instructors were diverted away to help

sustain experience levels on the detachment. At this stage it is also claimed that because of the operational commitment, long term sickness and other gaps, 33 Sqn had 60% manning and 40% availability of OCF instructors. Therefore, instead of the revised establishment for 10 OCF instructors the Sqn had only 4 available.

4.15.3 Quality of OCF Administration. More recently, in 2006, a senior officer undertaking Puma refresher training had cause to chide 33 Sqn ops staff for the lack of maps and other essential en route publications⁶³. Another senior officer commented on the prevalence of staff planning to leave the Service, including OCF staff, which he thought unhealthy⁶⁴. The team notes that the current OCF flight cdr is shortly to retire from the Service to join an airline.

4.15.4 Matching OCF Output to enable the Puma Force to 'Fight by Flight'. The current OC 33 Sqn expressed concern about his ability to find the spread of manpower to populate the planned fifth flight for the proposed 'Fight by Flight' structure called for by the Puma Reset⁶⁵. He is concerned that this will not be possible without 'raiding' other flights, which would break Harmony. He also doubts the OCF's capacity to continue to produce the throughput required. In his view, the main pressure is the number of QHIs and QHCIs (especially the latter) available on sqns to enable the continued training of OCF graduates. He thinks there is insufficient robustness in the OCF manning plot and outlined a fundamental disagreement with the JHCHQ over Puma instructor establishments.

4.15.5 Recommendations for OCF. The team concludes that the OCF has been a focus for particular problems in the Puma Force, and that some key issues have still to be addressed. The lack of agreement over instructor establishments must be resolved quickly by the JHC if the Puma Force 'fight by flight' concept is to succeed. We sense too the need still to monitor stability in aircrew dilution of the Force, particularly during the period where the 'fight by flight' process beds down. There is also a need constantly for cdrs to monitor standards on the OCF, particularly given its location in a separate building from 33 Sqn HQ. **The Team recommends action by JHCHQ to address Puma instructor establishments and to monitor, though SH STANEVAL, 33 Sqn OCF administration.**

[REDACTED]

PART 5 - LEADERSHIP AND MANAGEMENT

5.1

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

⁶⁸ Bol ZA938 – Interim Report.

[REDACTED]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

⁷² JHC/J35 – Commitments/Platforms/Puma dated 8 Aug 07.

⁷³ JHC/001 dated 13 May 2008.

[Redacted]

5.2 BAGHDAD HELIDET (BHD)

Beginning in Jan 2005 the BHD called for [REDACTED] Puma lines to [REDACTED]
[REDACTED] BHD flying is relatively straightforward, involving flights across the city between a few prepared landing sites. However, [REDACTED], flying for the BHD involves [REDACTED] and the need to think and operate in complex airspace and to respond quickly to incidents on the ground. The Puma Force has for some time been using BHD as a training opportunity to introduce new crews to [REDACTED] [REDACTED]. Whilst the JHC HQ acknowledges that this sort of training on operations is not ideal (and is born in their view out of paucity of resource and over-tasking by MoD), in the context of the 'war on two fronts', they see it as pragmatic and useful.⁷⁵ Moreover, they think this training is as good as it could be without a re-set. While BHD looks relatively simple [REDACTED] [REDACTED], this small and potentially under-arousing detachment is not, as we have noted earlier, without its own supervisory challenge. Supervision of BHD generally appears to have been good but punctuated by occasional intervals of poor management. [REDACTED]
[REDACTED]

⁷⁵ JHC/001 dated 13 May 2008.
[REDACTED]

5.3 C2 IN THEATRE

[REDACTED]

[REDACTED]

[REDACTED]

⁷⁷ A weakness identified in the Bol for ZA938 at Para 57.a

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

[REDACTED]

[Redacted text block]

[Redacted text block]

[Redacted text block]

[Redacted text block]

[Redacted text block]

[Redacted text block]



5.8 EXPERIENCE LEVELS IN THE PUMA FORCE

We have heard often during our discussions with the Puma Force that they were struggling badly with a lack of experienced aircrew [REDACTED]. Appreciating that it is the second tourist (or more) aircrew that form the backbone for operations, we commissioned some analysis to gain an historical perspective. This diagram shows the position on Puma second-tourists since 1998⁸⁴:

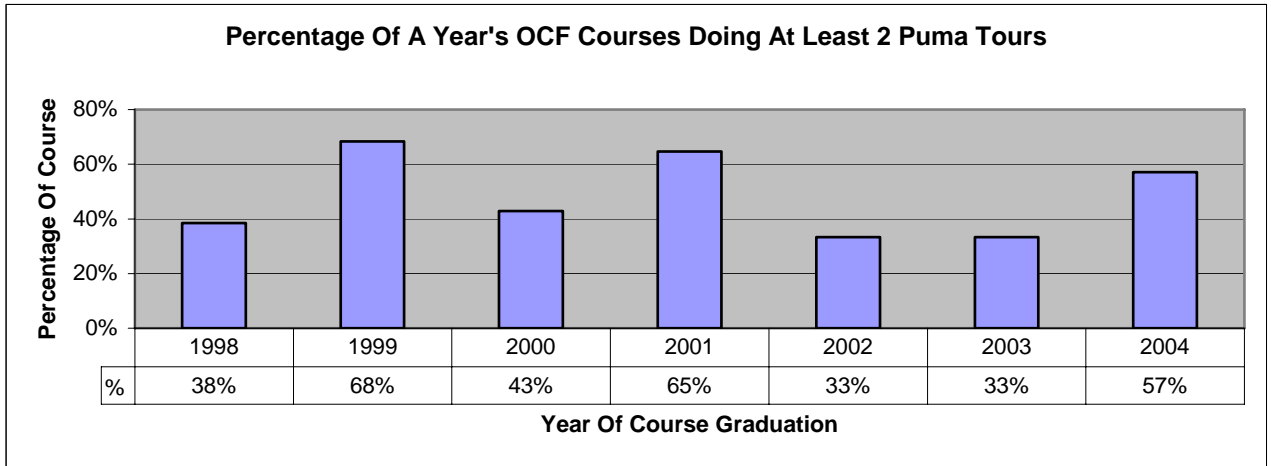


Figure 4: Percentage of Students on OCF Courses doing at least 2 Puma Tours

Whereas historically about 55% of Puma OCF graduates would normally move on to complete a second tour on type, only about a third of those graduating in 2002-3 did so. The others, for interest, departed for:

Chinook	3
Merlin	3
Search & Rescue	3
DHFS	3
QFI	2
Nav to Pilot X-over	1
Promotion	4
Staff appointments	6

Figure 5: Where Puma first tourists went to.

Over the wider period 00-06, the Puma Force appears to have lost 17⁸⁵ experienced front enders (8 to Merlin and 9 to Chinook) while it gained only 3 experienced people in return - all navs - from other SH types. On balance therefore we accept that the Force was struggling with experience over a difficult period. But we would point also to the Service's need to respond over the same period to individual's legitimate aspirations in terms of professional progression and sense that if these postings had been prevented we would today have been seeing a significant exit rate. This is, after all, still a volunteer Service.

⁸⁴ Data prepared for us by the Puma/Merlin FHQ – Puma Study RFI Question 3, dated 10 Apr 08.

Our instinct is that if we accept that postings of the kind above are essential, the Puma Force may simply be too small in terms of the numbers of aircraft, crews and flying hours to have had any chance of sustaining the numbers of experienced aircrew [REDACTED]

[REDACTED] We think that an effective estimate leading to a long-term plan, jointly conducted and owned by the Puma Force HQ and JHC back in 2005-6, might have flagged up the problem more clearly.

[REDACTED]

[REDACTED]

⁸⁶ JHC/J35 – Commitments/Platforms/Puma dated 8 Aug 07, Paras 10 and 11.

⁸⁷ [REDACTED]

⁸⁹ This diagram was presented and explained to JHC [REDACTED] in a meeting to take the 'Long War' update, which we believe took place in Aug 07.

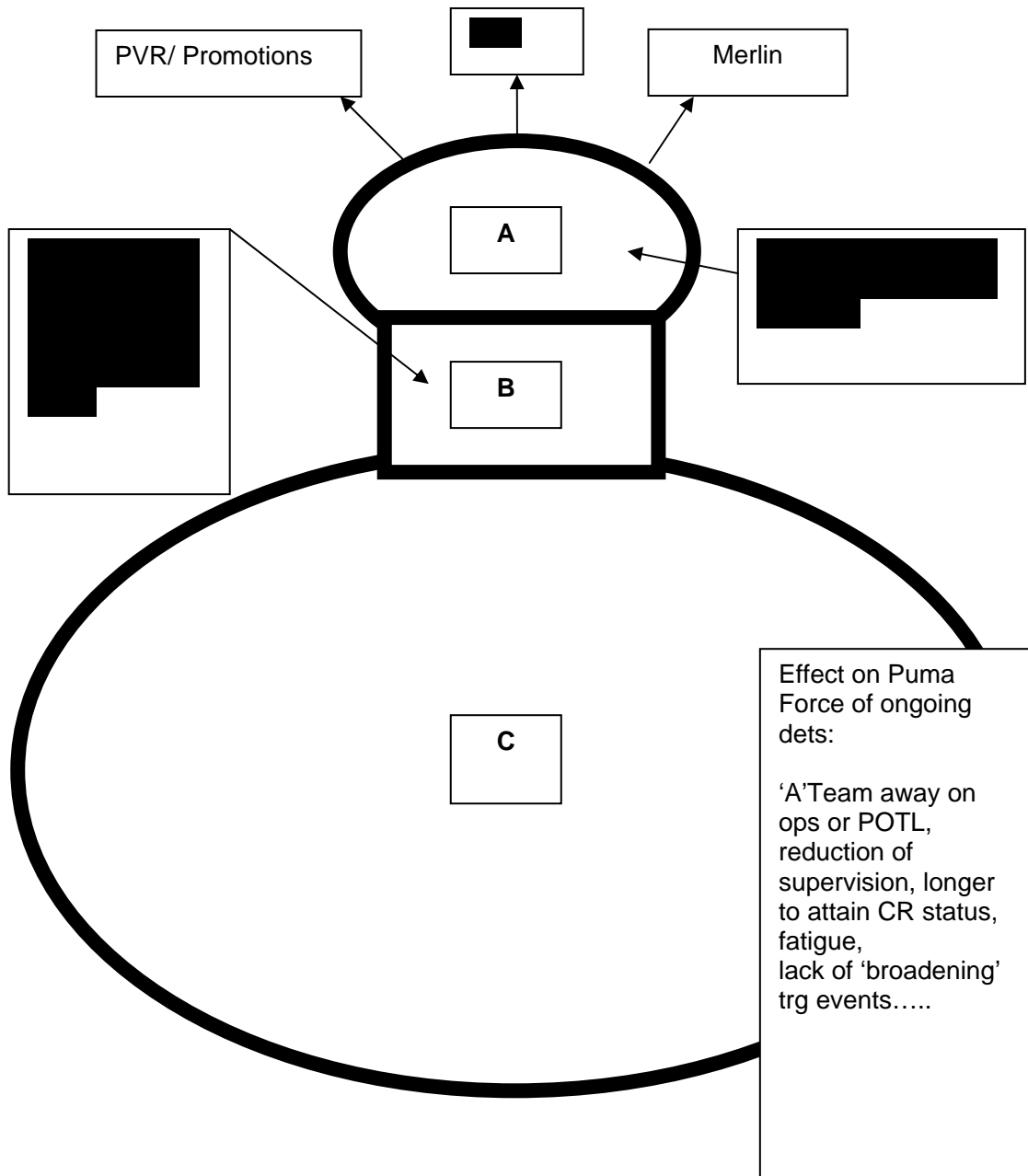


Figure 6: The Bowling Pin [REDACTED]

We commissioned work from JHC to try to establish whether any Bowling Pin problem actually existed, and the extent to which the unavailability of experienced people at home was impeding CR work-ups for junior aircrew. In respect of CR work-ups, the data shown below demonstrates that time being taken to CR is only slightly at variance from the 10 year average, and that the Puma position (Figure 7) remains broadly comparable, for example, to the Chinook (Figure 8).

Puma Force Average Time to CR by Year and Sqn - AL1

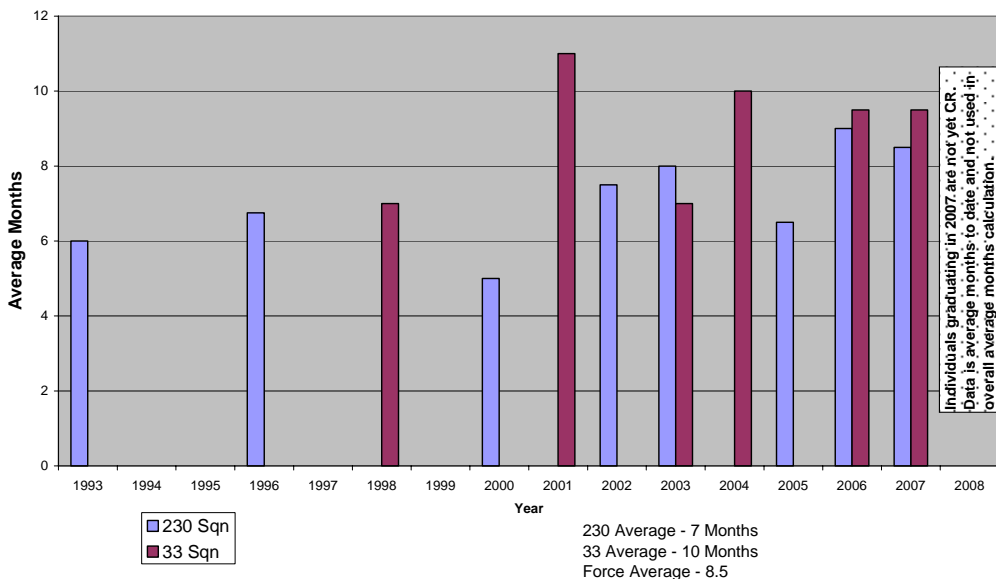


Figure 7: Puma Force Average Time to CR

Chinook Force Average Months to CR

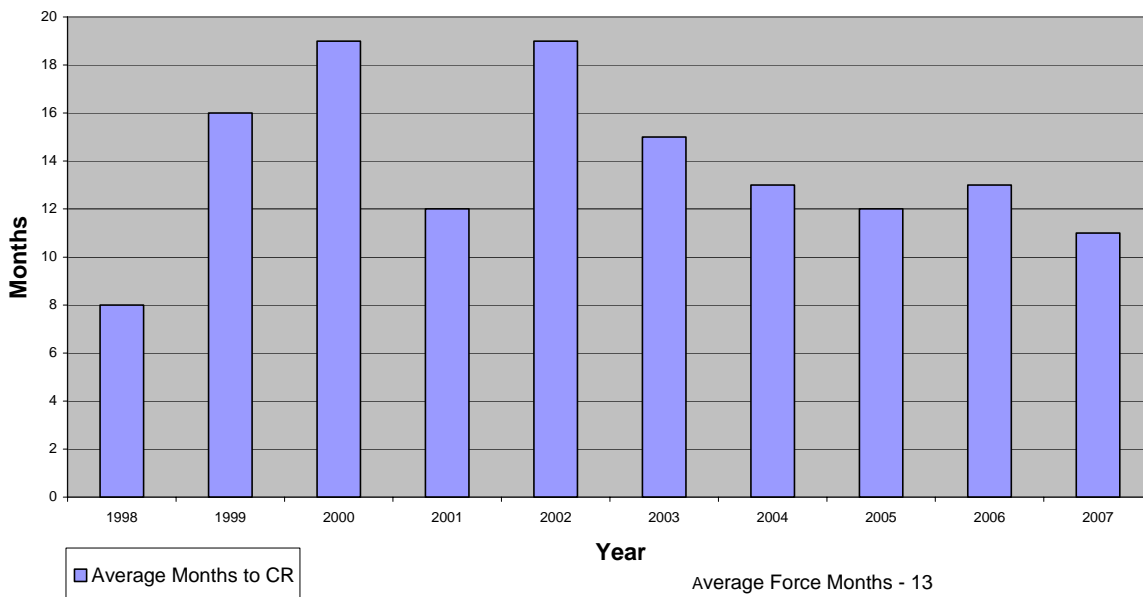


Figure 8: Chinook Force Average Time to CR

However, we gathered from interviews a strong sense from people in the Puma Force that the continued utilisation of their pool of experienced aircrew at this high rate was unsustainable, and of their deep frustration that JHC did not appear to accept the problem or act to limit the commitment. For its part the JHC did appear to listen to the Puma Force concern, but had difficulty accepting their explanation without hard data. We do not suggest

that there was any systemic or directed disinclination to deny Puma Force concerns. Rather, there was a marked reluctance by JHC to risk its reputation in the MoD Capability area in any effort to say 'no' without what it considered was sufficient evidence; data we believe should have been thrashed out to determine an agreed picture before anyone went to MOD. Following a meeting in Aug 07⁹⁰, the JHC realised the extent to which the Puma Force was mortgaged to its Bowling Pin model, and the degree to which it was trying to configure detachment crewing to meet its perception that the role required an all [REDACTED] [REDACTED] From JHC's perspective this highlighted the Puma Force's misunderstanding [REDACTED]

We think that much of the underlying stress now evident in the Puma Force springs from this issue.

5.10 [REDACTED]

[REDACTED]

5.11 TRAINING & PREPARATION

The Review Team is satisfied that, on the basis of the resources allocated to it, the Puma Force has in general directed significant energy to training and preparation for operations in Iraq. We note with approval the efforts by both Puma sqns to secure realistic training in Northern Ireland and on Salisbury Plain⁹⁵ and the work carried out at Abingdon which has included multi-ship night tactical formation. However, there is still little or no opportunity to practise dissimilar night formation [REDACTED] prior to deployment. Although the training overall appears sound, we note with concern the evidence revealed in the latest Bol

⁹⁰ There is a discrepancy of recollection of the dates of this key meeting ([REDACTED]).

[REDACTED]

⁹⁵ Including simulation in-theatre radio procedures and flying evolutions in flying in and out of the FIBUA complex as a good simulation of day and night urban operations.

for the ZA938 accident in Nov 07, and subsequently in the Chatwin Report, that some personnel on 33 Sqn held operational status for which they were not correctly trained or qualified, and we deal with these administrative issues next. **We recommend that JHC makes provision for pre-deployment training between the Puma Force [REDACTED] and, through the Air Manoeuvre Capability Planning Group, seek to establish joint simulator training.**

5.12 33 SQN ADMINISTRATION

As noted in the introduction to this report there has been a concern over the quality and depth of supervision and record keeping on 33 Sqn. The staff check carried out by Cdr Chatwin demonstrated that, as recently as mid-Feb 08, there were some serious omissions in flying supervisory records. We have looked closely at the potential causes of these lapses and have spoken in detail to sqn executives and key training staff whose responsibility it is to maintain a proper control of the administrative process. We were able ourselves to track evidence of shortcomings back to Apr 2007, because STANEVAL produced a matrix of documentary discrepancies following the first of their two visits to 33 Sqn that year. However, there is also further evidence of some minor documentary failings in the Sqn's 2006 STANEVAL report. While we acknowledge fully that 33 Sqn was extremely busy operationally over this period, the most likely explanation of the shortcomings discovered by Chatwin is a lack of a proper system of checks and balances, which is the responsibility of the sqn cdr and his executives to implement. Moreover, and on a theme not raised by Chatwin, we feel bound to comment on the apparent lack of pride by individual sqn aircrew in maintaining their personal training records and supervisory clearances. The Team feels that both issues: a proper system of checks and an appropriate ethos of personal responsibility are functions of command and leadership. We accept that cdrs at RAF Benson had several positive indications of 33 Sqn's performance over quite a long period (including laudatory STANEVAL final reports for 2006 and 2007, and positive views from theatre⁹⁶). We also note that 33 Sqn cannot recall having received the half-time matrix of discrepancies produced by STANEVAL in April 07. Nor can STANEVAL prove to our satisfaction that the Sqn did receive this matrix. However notwithstanding all this we were still surprised, given the extraordinary levels of scrutiny of the Puma Force by various BsOI and the civil police throughout 2007, that OC 33 Sqn, the Puma Force Cdr or any other Puma executives at RAF Benson did not appear curious enough to probe more deeply into the administrative health of 33 Sqn. Nonetheless we record that great efforts have now been expended to remedy the shortcomings Chatwin identified. Indeed, indications from OC R&S Wg suggest that 33 Sqn's current approach to document checks is probably now the highest benchmark in the SH Force. We certainly thought so ourselves having re-checked some of 33 Sqn's training records at the conclusion of our visit to RAF Benson. The team notes too that Comd JHC has widened staff checks to include 230 Sqn (the results were entirely satisfactory) and that he has directed an extraordinary STANEVAL visit to 33 Sqn to confirm finally that the Chatwin issues have been addressed.

5.13 MANAGING CONCERNS ABOUT OVERTASKING

[REDACTED]

[REDACTED]

[REDACTED]

The then Puma Force Cdr produced a paper for JHC, 'the Puma Force – The "Long War"', which agreed that the Force could meet the surge tasks but highlighting problems that would quickly emerge in relation to manning, experience and Harmony should the requirement endure beyond 6 months. Originally scheduled to end in Jun 07, this surge continued as a permanent commitment [REDACTED]. The Team regards the 'Long War' paper as a good example of what we have termed a 'Yes, but...' culture that pervades much of the correspondence between the Puma Force, JHC, PJHQ and MOD at this period. We have learned from our interviews that from MOD downwards there appeared to be no doubt or questioning about the tactical need for the additional Puma task lines; but that rather, there was merely an expectation that these should be delivered. Indeed, JHC HQ has characterised the difficulty being faced by the Puma Force as being indicative of a Departmentally-endorsed incremental ratcheting up of demand, usually couched in terms of short period requirements⁹⁷. However it is not clear to the Team who, at any stage, felt that they owned the 'buts'. We sense that a safe line may have been crossed, probably in the early part of 2006 [REDACTED]. [REDACTED] the Force was becoming vulnerable. We feel that more could have been done by the Puma Force and JHC to mitigate risk and that, in agreeing to further open-ended growth of the Puma commitment, the many 'buts' should have been elevated more comprehensively by JHC HQ to CJO and the user who, as the operational commanders, ought to have been in the best place to present a balanced view of the risks in MOD [REDACTED].

We point again to the lack of a properly staffed and agreed estimate and plan, and the lack of an agreed picture of the available resources. We point also to the blizzard of missives passing backwards and forwards between Puma Force executives and the lower tiers of the JHC staff and sense that far too little of the real picture of difficulty was being divined by or being distilled out at higher level⁹⁸. The team was struck powerfully by a comment [REDACTED] how much he had dreaded through his [REDACTED] in command the phone ringing to report the loss of a Puma in Iraq. If this was truly his view at that time, we are surprised that none of his strength of feeling appears to have soaked through to the top of the organisation including to Full Commanders. Perhaps what is needed now is a move away from a 'Yes, but' culture to one which commanders have the confidence to say 'No, because' and be prepared to back this up with fact, and then to have the confidence to stick to their guns. **We recommend that the JCG reaffirms the responsibility of commanders to say 'no' to operational demands where justified, and to have confidence that the senior command chain will support them.**

5.14 PUMA RESET

The JHCHQ received what it considered to be proper evidence of the worsening situation over Puma with the initial BOI findings of the 2-ship accident in late Jul 07.⁹⁹ This was supported by an assessment, also in Jul 07, by JHCHQ staff into the ongoing

⁹⁷ JHC/001 dated 13 May 2008.

⁹⁸ An example of this emerged in interview with [REDACTED] who suggested that the import of the 'Long War' paper appeared to have been watered down as it was staffed.

⁹⁹ Presented formally on 14 Aug 07.

dispute over crew availability, the use of navigators and lack of flt cdrs [REDACTED]. This debate was overtaken by the Catterick crash and resulting Reset. Multi-stranded in approach, the Reset has put in place the longer term planning and monitoring that we feel was missing previously. Although the Reset did not at first address the key problem, [REDACTED], the loss of ZA938 in Nov 07 prompted a decision to [REDACTED]; the position that remains today. [REDACTED]

[REDACTED] We note and endorse strongly the efforts by JHC to reassert its authority over what is done in theatre by its crews, and the extent and scope of tasks that it is content to see carried out by its aircraft. In our opinion, this authority to set the limits should remain from now on exclusively with the CsinC, exercised through Comd JHC.

5.15 FIGHTING BY FLIGHT

Realising that the Puma Force approach [REDACTED] had become unsustainable, the JHC took action in mid-2007 as part of the Puma Reset to institute a new approach to roulement planning which is known as 'Fight by Flight'. Well established on SH units elsewhere, this concept involves balancing out the available experienced aircrew over 5 flying flights, each commanded by a sqn ldr. The perceived advantage of this is that sqn training and aircraft resources can be better focused on each flight as it works up towards deployment, rather than the piecemeal approach adopted previously [REDACTED]

[REDACTED] We note that that the funding and delivery of people for the 5th Puma flying flight is not yet fully in place. We believe that this additional provision is essential if the 'Fight by Flight' initiative is to succeed. The Team is aware that JHC has now made very clear to the user and MOD that this is the price of regaining and sustaining stability within the Puma Force. [REDACTED]

[REDACTED] **We recommend a high level review of this issue by the MOD Commitments staffs which should include branch plans to cater for the planned upgrade of Puma and its subsequent possible re-employment in other theatres.**

PART 6 - LESSONS FOR AND FROM OTHER FORCES

6.1 MERLIN FORCE

The TORs require us to check whether any of the issues extant in the Puma Force could bear on other units. We visited 28 Sqn at RAF Benson and recognised immediately many of the pressures of aircraft availability, limited training and high tempo that we had encountered on Puma. Sqn executives were concerned about the high level of experience dilution (claimed to be 40%) and that poor aircraft availability at home (assessed as 30%) was resulting in lengthening time taken to achieve aircrew CR (formerly 6 months but now, apparently, 8-12 months)¹⁰⁰. Executives were also concerned about the slender diet of training and the lack of opportunity to broaden CR skills and competence. OC 28 Sqn was reasonably upbeat about his ability to sustain the current commitment, but only on the basis that promised delivery of improved spares and depth support performance was delivered. He described seeing some 'green shoots' in this regard. We looked at a cross-section of aircrew paperwork and found this in good order, and noted that lessons from the Chatwin experience on 33 Sqn had been applied. We also visited the Merlin detachment in Basra which we found in good heart, and particularly well run by a RM officer. Personnel were coping well with the pressures of living and operating at Basra in a high threat environment and, although no specific concerns were brought to our attention, we are aware of the results of AOC 1 Gp's soundings during his recent visit to theatre. The morale issues he picked up on may well be symptomatic of a wider view prevalent in the SH Force that, perhaps above most in the RAF, more has been consistently asked of them over the years with too little corresponding investment in return. We would point to the delays in deciding the basing outcome of Project BELVEDERE and the effect on long term morale of the ongoing blight at the current SH stns. The creation of 78 Sqn at RAF Benson and the formation of a Merlin Wing structure for engineering and support offers a useful model of how the Puma Force might be set up should 230 Sqn relocate to the mainland.

6.2 CHINOOK FORCE

The Team took extensive soundings at RAF Odiham. By way of a benchmark for Puma we looked closely at 27 Sqn's aircrew training and supervisory records and found a good level of husbandry overall. The Chinook Force is plainly comfortable with Wing operations and the three sqns appear to be working harmoniously through their Force HQ. The 'Fight by Flight' structure is mature, well run and works well. There appeared to us to be less evidence at RAF Odiham of the underlying fatigue apparent at RAF Benson. We conclude from this that much is riding on the ability of the Benson command team to deliver Wing operations and 'Fight by Flight' as the best means of injecting some stability and consistent direction to individuals.

6.3 COMMANDO HELICOPTER FORCE (CHF).

At the request of Comd JHC we visited RNAS Yeovilton to take stock of the CHF, its training and preparation for Ops HERRICK [REDACTED]. We also visited 846 NAS in Kandahar. Our impression overall is that the CHF has set about its new commitments with great energy and a good instinct for the limitations of crews and its aircraft. There is

¹⁰⁰ [REDACTED]

evidently a close working relationship between sqn cdrs and CO CHF and we noted that the whole training effort had been pulled together and optimised for one theatre. In some respects this early model of utilizing Sea King, partly for normal HERRICK tasking [REDACTED] Like the early experience on Puma in Baghdad, RN Sea King crews are pleased to be doing a cutting edge job with their old aircraft, and are plainly relishing the experience of being at the centre of the user's effort in theatre. However, the Force needs to look ahead to the time when this novelty will have worn off, when the broader skills born of other theatres and tasks have fallen away and repetitive roulement pressures have taken their toll. We note, with interest, that 846 NAS was contending with a PVR rate of 10% last year while the force was engaged in its relatively mundane previous task in Basra. We were told that this exit rate has certainly reduced as a result of changing theatres, and we applaud the management effort that has turned things around. However, just like Puma, it will be important for JHC and the CHF to ensure that the Sea King operation is planned for the long haul with due care paid to the conservation of CR skills, and with an eye to the risks inherent when operating [REDACTED]. And, as with Puma, the extent to which JHC in future agrees increases in user demands for more aircraft will need careful and consistent command effort. CO CHF reassured us that the Force had learned lessons from its experience in Iraq and was confident of his ability to plan and sustain the operation. We were also pleased to note his comment that attempts to increase commitments to the user beyond a sustainable level had already been resisted successfully. However, the JHC needs to remain 'eyes on' Sea King to ensure that any future pressures are identified quickly and acted upon.

6.4 ARMY AIR CORPS (AAC)

[REDACTED]

The unit was coping as well as it could with an aircraft of limited performance, and plainly had the confidence of the SO1 Air Det Cdr who raised no supervisory or administrative issues of concern. We note that the AAC is committed to both theatres with Lynx, and extensively in one with Apache. Lynx detachments are punctuated seasonally because of the need to rest aircraft during the hot summer. This necessarily makes for a busy detachment routine as units and aircrew shuffle in and out of two theatres, and there may be a risk that individual unit administration could be taking second place. **Although we heard or saw no evidence to suggest any particular problems, we recommend a staff check by JHC to ensure that none of the issues determined in respect of Puma are extant in AAC units.**

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

PART 7 - FUTURE DIRECTION AND MANAGEMENT

7.1 ISSUES FOR MOD

We have looked closely at the processes within MOD for determining BH commitments and in particular the role of the CABHWG. We are content that while the purpose of this committee is to decide how to fill, rather than to debate the need for, any particular requirement, processes are flexible enough to permit a frank dialogue about the capacity or capability of any JHC element. We were reassured that, above the CABHWG, ACDS Ops is sensitive to the pressures on JHC and that he maintains regular dialogue with the Comd¹⁰². The Commitments staff does have a good record of influencing political judgements, as recent decisions on Merlin in Afghanistan, an end-date to the Harrier detachment and the progressive approach to increasing Chinook hours in theatre all demonstrate.

[REDACTED]

We therefore recommend a review by ACDS (Ops) of CABHWG membership.

7.2 ISSUES FOR FULL COMMANDERS

[REDACTED]

[REDACTED]

¹⁰² Interview ACDS Ops – 4 Apr 08.

[REDACTED]

There is a feeling amongst some that Air Command has been 'slow to bless and quick to chide' in respect of current Puma Force difficulties. The Team does not share this view, but would point to the potential danger of the whole Puma Force being undeservedly tarnished by the actions of a relatively small number of people. Whilst the various investigations into the Puma Force need to run their course and draw their own conclusions, we feel that there is a need, and soon, for a show of confidence by senior commanders in the work and worth of the Puma shop floor. We suggest that better relations might be fostered with JHC, including a visit to see the workings of the HQ by CINC Air. We think there is a role too for greater involvement by staff officers from Air Comd in helping the JHC to shape the helicopter debate in MOD by participating in the Air Manoeuvre Capability Management Group¹⁰³. We note that 1 Stars from FLEET already do so. **We recommend work through Comd JHC and AOC 1 Gp to foster closer practical ties between respective staffs in co-developing Joint helicopter initiatives.**

A key conclusion we draw from this Review is that, if Defence desires to meet the current and aspirant [REDACTED] a bigger and better resourced helicopter effort is required. We point again to the extent the Puma Force has struggled to deliver a relatively modest capability overall, and the way in which the SH Force, as a whole, seems to have to scratch around for the last aircraft and crew to keep the show on the road. We think that the capabilities offered by our SH forces are too important to continue in this haphazard way, and the extent to which Four Stars are able to put their full Joint weight behind a concerted programme of improvements will, in our view, be the litmus test of Full Command in future. **We recommend a review by the JCG of the overall level of resourcing for helicopter operations and sustainability.**

7.3 ISSUES FOR JHC

Following the ending of Op BANNER and to simplify force preparation for deployments overseas, Comd JHC has directed¹⁰⁴ CO RAF Benson to be Puma Force Cdr, with OC JHF(NI) as his deputy. Overall we think that the Directive lacks detail, is woolly and seems to us to rely overly on 'Mission Command', rather than grasping some important C2 nettles. There is, for example, no responsibility granted to the Puma Force Cdr for selecting or monitoring overseas command executives. We think this is important to re-establish AOA influence on the way assets are being employed. The Directive is also not clear enough about personal responsibilities, particularly when things go wrong. **We recommend that JHC change the Puma Force Cdr's Directive to reflect these points and to accommodate any changes in C2 arrangements agreed with the user.**

¹⁰³ The Team received a number of practical suggestions from Air Cdre Falla [REDACTED]

¹⁰⁴ JHC Directive 07/08 Part 1.

7.3.1 External Scrutiny of Puma Force Standards – Role of CFS and SH STANEVAL. Our examination of the Puma Force and knowledge of some of its failings has prompted us to question the value and utility of the current SH STANEVAL process. This organisation has the remit annually to visit SH sqns to carry out an appraisal of combat readiness and administration. The example of the two STANEVAL visits to 33 Sqn in 2007, and the issues surrounding the dissemination of the discrepancies matrix which culminated in a laudatory report, illustrates these concerns. Furthermore, we were concerned to be told by the STANEVAL examiner who led the first visit that he could not recall seeing anything of particular concern that stood out over any other sqn. While we accept that many of the entries in the discrepancy matrix were of a minor nature, some were less so, and virtually all would not have arisen had there been an adequate system of internal audit or a more thorough check before the STANEVAL visit. We conclude from this that the STANEVAL process overall may now lack the gravitas necessary to prompt sqns to create and maintain appropriate safeguards. Moreover, having enumerated several discrepancies in training and other records during their first visit, there was in our view no justification for STANEVAL's bland final report which did not bring to the new sqn cdr's attention the lack of a proper internal audit system, the absence of which was still apparent when Chatwin visited in Feb 08. It is worth noting that the requirement for a robust audit trail and effective management, particularly regarding Flight Safety, is now more important than ever in light of recent legislation concerning Corporate Manslaughter¹⁰⁵. We are aware that JHC would like to build on its recent work to incorporate HQ Director Army Aviation into the JHC HQ, and to develop a joint approach to standards, doctrine and force development. There are acute single-Service sensitivities in play here, and whatever is finally decided we feel strongly that there needs to be a much closer role for the Full Command chain in setting the tone for, and delivering instructions to, any joint JHC standards body. **We recommend a review by JHC and respective single Service standards bodies to determine an agreed approach. We separately recommend, in the interim, that JHC considers a change to OC R&S Wg's reporting chain to make more explicit that he reports directly to Cdr JHC.**

7.3.2 Provision of QHIs/QCIs. We have heard often that the Puma Force is short of QHI/QHCIs and that inexperienced B2 instructors are returning too early from DHFS with too little depth to impart basic handling techniques and skills. We are aware too of suggestions made by the Puma Force last year that there may be merit in seeking a new 'Q' qualification for sqn training captains. We understand that this idea has been rejected by CFS. We agree with them that, on balance, to introduce a new qualification solely for SH would be confusing and of limited operational utility. Separately, a Chinook sqn cdr¹⁰⁶ has told us that, although most people's instinct is to employ only instructors who can deploy, he felt strongly that there was still an important role for 'old hands', and perhaps even Reserve Forces to bolster the basic training capacity and supervision back home. In view of the pressures being experienced by all JHC units, we think this idea bears further consideration. **We recommend a study by JHC to examine the greater use of Reserve Service Instructors and Training Captains.**

¹⁰⁵ Corporate Manslaughter and Corporate Homicide Act 2007.

PART 8 - CONCLUSIONS

8.1 Now MOD's oldest medium helicopter, the Puma continues to offer an important capability. With about half its maximum life remaining the fleet is airworthy and subject to regular technical review by DE&S. The aircraft has been approved, subject to Main Gate, for life extension until 2022. A 1960's design, the Puma HC1 has certain design features which require particular aircrew focus. The lack of an anticipator device in the engines can result in slow engine response and the loss of rotor speed if the aircraft is mishandled when heavy. A long undercarriage and short wheelbase makes the aircraft prone to roll over during a forced landing. New engines including an anticipator have been included in the planned upgrade. The IPT is working to improve aircraft operating data in high ambient conditions.

8.2 An analysis of recent Puma BsOI shows that Human Factors (Aircrew) issues predominate, but there is no major single causal theme linking the most recent accidents. In Iraq, contributory factors appear to include a combination of operating the aircraft towards the limits of its capability, and the potential distractions of a busy operational mission. As with other military aircraft, the Puma accident record underscores the perennial need for crews to keep on top of their aircraft, to fly to SOPs and to operate within the boundary of their own limitations and training, experience and authorisation.

8.3 Puma Force ethos has evolved from its early single-pilot/crewman mode of operation and a long history of self-deployments for training across Europe, spells in RAF Germany and in Northern Ireland and several big expeditionary operations overseas. The culture of the Force is slightly introspective but 'can-do', with a very strong will to get the job done. The age of the aircraft and a sense of being marginalised by newer helicopters may have prompted a competitive spirit and a desire in some Puma crews to prove themselves in front of their peers. The crew dynamic, with just one crewman to monitor and influence 2 pilots, is probably less effective than in other larger SH in moderating poor decision making, particularly when people are inexperienced.

8.4 Like other SH, the outlook of Puma crews is shaped initially during basic and advanced helicopter training at the DHFS at RAF Shawbury. Overseen by a mixed community of experienced civilian and service instructors, this training is well structured and effective. Great care is taken to inculcate high standards of discipline and professionalism in young students, the quality and outlook of whom is comparable to any in the past. Role selection for Puma is well administered and judged, matching individual students carefully to the most suitable slots available on front line squadrons. The result of this process is a good balance of characters and individuals across the helicopter force.

8.5 Like other SH, Puma units seek constantly to manage dilution levels by balancing the need to retain experience against the need to draw in new blood. Striking the right balance on Puma, always difficult, was made more so by the difference in size of the 2 sqns which forced a constant outflow of experienced people from the force, and because most people preferred to live and work on the mainland. At one point the growing imbalance of experience, particularly in Northern Ireland, required PMA to take action to recruit a body of experienced aircrew from the other Services. Joined with the existing bedrock of established aircrew and building on specific operational training in Northern Ireland, this

equipped the Puma Force well to join in high-end operations [REDACTED]
However, the Force has since been struggling again to retain experienced individuals, who have been drawn away into other high priority roles including Merlin and [REDACTED]

8.6 Preparation of the Force for deployments overseas begins with OCF training at RAF Benson and continues through a process of more focused operational training on sqns, culminating in the award of CR status. Further qualifications, to BMQ and FMQ, are awarded only after the completion of an additional short training package.

8.7 [REDACTED]

8.9 C2 arrangements in theatre differ in some important aspects from those that have applied in operations elsewhere. [REDACTED]

[REDACTED] Taken together these pitfalls warrant enhanced supervisory arrangements. The most effective step would be to mandate a helicopter aircrew officer as the senior detachment cdr in theatre [REDACTED]
[REDACTED] The selection of this senior officer should, as elsewhere, be the responsibility of the AOA, the JHC, which is able to draw on experienced aviators from all 3 Services, pick an individual of the right calibre, and then back him up with the full professional services, direction and guidance of a 2 Star Joint aviation headquarters.

8.10 The picture of Puma Force preparations for operations in the Baghdad area is mixed. On the flying side, pre-deployment training has been well done with good use being made of the small number of additional funded flying [REDACTED]

[REDACTED] Problems have been compounded by the lack of a proper estimate and plan, and by the failure for some time by JHC HQ and the Puma Force HQ to agree on the calculus to be used to assess the overall capacity of the Force to generate capability. This situation has been exacerbated by a patchy relationship between key individuals. [REDACTED]

8.11 Set against a strong record of professionally flown missions in theatre, one outcome of the high operational tempo has been a loss at home of focus on routine sqn administration, most notably on 33 Sqn at RAF Benson. Stronger leadership over this period would have ensured better processes to supervise administration and inculcated an awareness in individual aircrew of the need to take a pride in the completeness of their own records. Executives should have taken as a cue from the various accidents and investigations, the need for rigorous self-audit and action. This has resulted in the need to 'inspect in', rather than to 'check on' standards. Executive awareness of the problems, already low, was not helped by the poor quality of the external audit process by SH STANEVAL. This not only lacked rigour but, by failing to include sufficient admonishment in final reports, has failed to be the wake-up call that it might have been. However, the intense recent scrutiny has prompted very substantial improvements in Puma administrative processes, and the lessons of this have percolated through to other forces.

8.12 Looking to the future, the JHC has now directed that the Puma Force is re-structured to break-away from the requirement to have most of its experienced people in theatre at any one time. The new model, being delivered under the JHC's Puma Reset and known as 'Fight by Flight', offers the potential for better long-term planning and stability. [REDACTED]

8.13 A major overhaul of SH STANEVAL audit processes is required, in particular to increase the gravitas of the team and enhance the respect in which it is held by sqns – visits to sqns need once again to become a 'knee-knocking' experience. Improved single-Service standards, direction and advice to the JHC STANEVAL team would promote wider awareness of lessons and trends across the entire air and aviation communities, and helpfully reinforce Full Command links with JHC aircrew.

8.14 [REDACTED]

[REDACTED] . For Puma, it will be important to have this thinking clear in time to influence plans for the HC2 upgrade and the subsequent attribution of the force when it returns to service.

Annexes:

- A. Puma Review – Terms of Reference.
- B. Puma Review Team Itinerary.
- C. DARS Analysis.
- D. IPT Airworthiness Survey.
- E. Minutes of DG Hels Meeting – 9 Apr 08.
- F. Charts Showing BH Accidents Against Time (1998-2008).

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PUMA REVIEW - TERMS OF REFERENCE

A. OBJECTIVES AND SCOPE

1. A strategic review of the Puma Force is to be carried out on the direction of CINC Air (with the agreement and involvement of CINC Land).
2. The objectives of the Review are to:
 - a. Consider the standards of operation of the Puma Force since the start of Op TELIC (or earlier if shown to be appropriate)¹ in the light of the fatal accidents involving the loss of Pumas XW221 (TELIC, Jul 04) XW218/XW211 [REDACTED] Apr 07), ZA934 (Catterick, Aug 07) and ZA938 [REDACTED] Nov 07) and any other relevant incidents.
 - b. Identify any systemic factors that have adversely impacted, are adversely impacting, or may impact upon the overall standards of operation of the Puma Force, including (but not limited to) consideration of the nature and extent of current operational demands and tempo.
 - c. Consider the extent to which the impact of any systemic factors identified may extend beyond the Puma Force and into the operation of other RAF support helicopter (SH) forces².
 - d. Consider the extent to which systemic factors may be present in *ab initio* crews joining the Puma Force.
 - e. Consider whether any risks to the safe operation of the Puma Force have been adequately identified, properly controlled and effectively managed.
 - f. Recommend any further necessary remedial action.

B. COMPOSITION

3. The Review Team will consist of Air Cdre C Dixon [REDACTED]

C. BACKGROUND

4. The Review should take into account all existing relevant material, including (but not limited to):

¹ Agreement is to be sought from CINC Air and CINC Land prior to reviewing any earlier period.

² Should even broader issues arise (ie pertaining to non-RAF elements of the JHC), the Review Team should raise these with Comd JHC immediately.

- a. The Nov 07 report by Air Cdre Sharp – “A Review of Flight Authorisation and Supervision in the JHC.”
- b. The Puma Force Action Plan (JHC/001 dated 14 Dec 07).
- c. Stn Cdr RAF Benson’s “Puma Flight Safety Update” (20080130-PU_FS-PUFC-RM dated 30 Jan 08).
- d. [REDACTED]
- e. The final report from Comd JHC’s “Review of Aviation Procedures – 33 Sqn RAF”, due for completion Fri 22 Feb 08.

D. PROTOCOLS

- 5. The Review may, wherever possible, solicit comments from relevant parties and subject matter experts but will not approach any person who is a witness in the current investigation by the North Yorks Police (NYP) into the deaths arising out of the loss of Puma ZA934 without the consent of the NYP Senior Investigating Officer ([REDACTED]).
- 6. In the event that the Review does discern/conclude that any systemic factors identified may (or already do) extend into the operation of other RAF SH forces, it is to advise CINC Air Cmd (and CINC Land) immediately, as well as including appropriate comment/advised action within the final written report.
- 7. DLS(RAF) will make a legal officer available to the Review.

E. OUTPUT

- 8. The Review will commence on Wed 27 Feb 08 and is to submit a written report jointly to CINC Air and CINC Land by end-Apr 08 (or earlier if possible and/or appropriate).

Signed:

Agreed by:



Sir Clive Loader
Air Chief Mshl
CINC Air Cmd

Sir David Richards
General
CINC Land Command

Dated: 22 Feb 08

Dated: Feb 08

**ANNEX B TO
PUMA REVIEW**

PUMA REVIEW TEAM ITINERARY

Ser (a)	Date (b)	Name/Posn/Base ¹ (c)
1	27 Feb	[REDACTED] (Air Comd)
2	29 Feb	Gen Sir David Richards (CinC Land)
3	29 Feb	Maj Gen Coward (Comd JHC)
4	3 Mar	AVM Bryant (COS Pers/Air Sec)
5	4 Mar	[REDACTED] (N Yorks Police)
6	5 Mar	Gp Capt Prowse (Stn Comd)
7	5 Mar	Capt Westwood RN (Comdt DHFS)
8	5 Mar	Group discussion with instructors at DHFS
9	7 Mar	AM McNicoll (DCinC Ops, Air Cmd), Air Cdre Bryant (COS Pers/Air Sec)
10	10 Mar	Gp Capt Lyall (Stn Cdr BEN - Ser 153),
11	10 Mar	[REDACTED] Ser 154)
12	11Mar	[REDACTED] Ser 155)
13	11Mar	[REDACTED] -Ser 163)
14	12 Mar	[REDACTED] 166)
15	12 Mar	[REDACTED] Ser 164)
16	12 Mar	[REDACTED] (Ser 165)
17	12 Mar	[REDACTED] (Ser 158)
18	12 Mar	[REDACTED] - Ser 157)
19	12 Mar	[REDACTED] - Ser 159)
20	13 Mar	Gp Capt Stubbs ([REDACTED] - Ser 160)
21	13 Mar	[REDACTED] - Ser 161)
22	13 Mar	[REDACTED] (Des) - Ser 162)
23	16 Mar	[REDACTED]
24	16 Mar	Aircrew Brief (Ops Rm)
25	16 Mar	[REDACTED]
26	16 Mar	[REDACTED]
27	17 Mar	[REDACTED]
28	17 Mar	Merlin Flt Crewroom
29	17 Mar	Medics
30	17 Mar	Maj Gen White-Spunner (GOC MND(SE))
31	18 Mar	[REDACTED]
32	18 Mar	[REDACTED]
33	18 Mar	[REDACTED]
34	18 Mar	[REDACTED]
35	18 Mar	[REDACTED]
36	19 Mar	[REDACTED]
37	25 Mar	[REDACTED] ex COS BEN)
38	25 Mar	[REDACTED] Ex Stn Cdr ALD and Sim Director)
39	25 Mar	[REDACTED] (Simulator Instr)
40	25 Mar	[REDACTED] (Simulator Instr),
41	26 Mar	[REDACTED]
42	26 Mar	[REDACTED] (HFU)
43	26 Mar	[REDACTED] (AIU)
44	27 Mar	[REDACTED] (ex OC 33 -Ser 156)
45	31 Mar	[REDACTED] (DJtCap), [REDACTED] (SO1 Jt Cap)
47	1 Apr	[REDACTED] (FS)
48	2 Apr	[REDACTED]
49	2 Apr	[REDACTED] (QinetiQ Study Leader)

¹ Serial Number against name in brackets refers to taped interview.

50	3 Apr	ACM Sir Clive Loader (CinC Air), AM McNicoll (DCinC Ops); AVM Harper (AOC 1 Gp)
51	3 Apr	Air Cdre Bagwell (ACOS J5),
52	3 Apr	Brig Marriott (ACOS J3)
53	3 Apr	[REDACTED] (PJHQ J5), [REDACTED] (SO1 Avn)
54	3 Apr	Maj Gen Coward (ex Comd JHC).
55	4 Apr	AVM Nickols (ACDS(Ops))
56	7 Apr	[REDACTED]
57	7 Apr	[REDACTED]
58	7 Apr	[REDACTED] ex [REDACTED]
59	7 Apr	[REDACTED]
60	8 Apr	[REDACTED] Flt Com 28 Sqn
61	8 Apr	[REDACTED] (STANEVAL),
62	8 Apr	[REDACTED]
63	8 Apr	[REDACTED]
64	10 Apr	[REDACTED] JHCHQ) - Ser 172,
65	10 Apr	[REDACTED] ex [REDACTED] JHCHQ),
66	10 Apr	[REDACTED] JHCHQ),
67	11 Apr	[REDACTED] (Ser 169)
68	11 Apr	[REDACTED] Ser 170
69	11 Apr	[REDACTED] (Ser 171)
70	11 Apr	Rear Adm Johnstone-Burt (Comd JHC),
71	11 Apr	XXXXXX (ex DACOS J3/7, JHCHQ - Ser 168)
72	16 Apr	[REDACTED]
73	16 Apr	[REDACTED]
74	24 Apr	CINC Land
75	24 Apr	DComd JHC

DARS ANALYSIS

[REDACTED]
JHC HQ
Erskine Barracks
Wilton
SALISBURY
Wilts SP2 0AG

Reference: DARS/3/14/8

Date: 14 Apr 08

PUMA ACCIDENT STUDY - ACCIDENT ANALYSIS

Reference:

A. DARS/3/14/8 dated 10 Apr 08.

1. Please find enclosed the analysis report on Puma accidents that occurred during the period 2000 – 2007.

2. You should note the following points:

- The report represents a summary. For brevity, the individual analysis tools for each accident have not been included. These can be provided if required during your visit.
- Since late last year, DARS has been working with the European Helicopter Safety Analysis Team (EHSAT) on the analysis of helicopter accidents since 2000. This report on Puma accidents is the initial output of our participation in this wider study. It is thus the first time that analysis of this nature has been undertaken by DARS. It is also the first time that the Human Factors Analysis and Classification System (HFACS) has been used as an analysis tool. Whilst the line of work is encouraging, it should be understood that the process is still in its infancy and is likely to be refined further as improvements are identified. Furthermore, due to the time constraints, the report has not yet been subjected to any detailed internal or external scrutiny.
- The report has only considered the Puma accidents that have occurred since 2000. The results should not be used to assess the overall safety of the Puma aircraft and operations.
- It is recognised that some of the recommendations may already be under consideration and/or implementation. The recommendations in this report may be used to support such work.

3. We look forward to seeing you on 17 Apr 08 to discuss the report. During our meeting, any comments regarding the methodology of the process and the usefulness of the output would be welcomed.

[REDACTED]
Lt Col
[REDACTED]
For DDARS

Enclosure:

1. DARS Summary of Puma Accident Analysis. (As Appendices)

**APPENDIX 1 TO
ANNEX C TO
PUMA REVIEW**

PUMA AIR ACCIDENTS ANALYSED BY THE DARS TEAM

Date (a)	Aircraft (b)	Location (c)	Main Source of Information (d)
20 Nov 07	ZA938	Iraq	Bol Part 1.2 without Annexes
15 Apr 07	XW211 & XW218	Iraq	Bol Parts 2 to 5 without Annexes
19 Jul 04	XW221	Iraq	Bol Aircraft Accident Report Summary
16 Mar 02	XW227	UK – NI	Bol Aircraft Accident Report Summary
21 Jan 02	XW234	UK –NI	Bol Aircraft Accident Report Summary
9 Apr 01	XW200	Kosovo	Bol Aircraft Accident Report Summary
19 Apr 00	XW207	UK	Bol Aircraft Accident Report Summary

DARS HELICOPTER SAFETY TEAM – ANALYSIS METHODOLOGY & PROCESS

1. The analysis process undertaken by the DARS Helicopter Safety Team was very similar to the methods employed by the European Helicopter Safety Analysis Team (EHSAT). An outline of the EHSAT methodology is given below. The DARS team did not use the quantitative assessment of 50% set out below for a level 2 of importance.

EUROPEAN HELICOPTER SAFETY TEAM ANALYSIS PROCESS

2. The analysis process consists of several steps:

- a. Enter General Information;
- b. Describe and analyse the accident;
- c. Assign Standard Problem Statements (SPSs) and HFACS codes;
- d. Determine corresponding Intervention Recommendations (IRs);
- e. Score findings based on validity, importance, ability and usage.

3. Each step will be described in detail. Reference is made to the worksheets in the EHSAT Analysis Tool.

4. The analysis aims at identifying all factors¹ that played a role in the accident. Factors are coded in terms of Standard Problem Statements (SPS). Among these, human factors are coded using a specific system called Human Factors Analysis and Classification System (HFACS). Note: The underlying assumption is that accidents are the result of a chain of events that could have been prevented by altering or eliminating one or more of the “links” in the chain. Instead of focusing on an accident’s “primary cause”, the process focuses on identifying and removing one or more links in the accident causal chain, which often initiate hours, days or even weeks before the accident.

5. The next analysis step thus consists in identifying IRs to prevent all factors, directly or more remotely involved, from occurring.

6. This analysis is accomplished by a team of subject matter experts “brainstorming” about what happened and why it happened (the chain of events), and what might have been done differently (interventions) to prevent a similar event in the future.

7. The last step consists in scoring factors and IRS on four specific criteria: Validity and Importance for factors and Ability and Usage for IRs.

¹ Accident investigations often distinguish “causes” and “contributing factors”. Such distinction is not used by EHSAT/JHSAT.

SCORING FACTORS

8. All SPSs are scored on Validity and Importance on a scale from 0 to 4:

- **Validity (V)** is a measure of the ability to make informed decisions when assigning a standard problem statement. This measure is dependent on the level, quality and credibility of data and information available in the event report: SPSs associated with hypothetical events not supported by documented evidence are scored low on validity.
- **Importance (I)** is the measure of the identified standard problem statement's importance in the event's chain of causal factors.

Validity (a)	Importance (b)
Based on the available accident information, how valid or credible is this particular <u>Standard Problem Statement</u> in the accident?	How important is this particular <u>Standard Problem Statement</u> in this accident causal chain?
4 = Absolutely valid (the event documentation was detailed and the analysis team was able to identify a problem statement was directly linked to the information in the event record)	4 = Absolutely important (the standard problem would have caused this accident all by itself and without this problem/contributing factor this accident would not have happened)
3 = Quite valid	3 = Quite important
2 = Moderately valid (the event documentation had sufficient detail for the analysis team to identify a problem statement that could be reasonably inferred by the information in the event record)	2 = Moderately important (the standard problem was a link in the causal chain of problems and elimination of this problem would reduce the likelihood of this accident by about 50%)
1 = Slightly valid	1 = Slightly important
0 = Not valid (the event documentation was sparse and problem statement from the analysis team was the result of an expert opinion without any substantiating information in the event record)	0 = Not important (the standard problem had no influence on this accident)

9. All IRs are scored based on Ability and Usage on a scale from 0 to 4:

- **Ability (A)** is the measure of how well an intervention can mitigate an event's problem or contributing factor, assuming it performed exactly as intended.
- **Usage (U)** is the measure of how confident we are that this intervention *will* be utilised and *will* perform as expected given this particular accident scenario.

Ability	Usage
How well <i>can</i> this particular <u>Intervention</u> mitigate the cause or contributing factors of this accident scenario?	Given this accident scenario, how confident are we that this <u>Intervention</u> <i>will</i> be utilised and <i>will</i> perform as expected in the real world?
4 = Completely effective	4 = Completely confident
3 = Quite effective	3 = Quite confident
2 = Moderately effective	2 = Moderately confident
1 = Slightly effective	1 = Slightly confident
0 = Not effective	0 = Not confident

Note: The analysis team should not spend too much time debating small differences in opinion about a particular score, but work towards consensus.

RESULTS FROM ANALYSIS OF PUMA ACCIDENTS

1. Since all of the published Puma accidents from 2000 to 2007 were strongly in the human factors cause group the results of the analysis are most easily displayed using in human factors terms. Below are the human factors ‘spectrum’ of each Puma accident. It is important to note that while the graphs give an outline of the events of each accident, reference should also be made to the source documents and the information captured in each analysis tool.

2. During the analysis of an accident, appropriate events were assigned HFACS ‘nano-codes’ if the team felt they met the definition of the nano-codes. HFACS nano-codes are detailed at Appendix 5 and were produced by US Navy to help assist in the analysis of human factor events. The significance of each event captured was weighted by combining the validity and importance scores (see Appendix 2) according to the table below. The ‘weighted’ individual human factor elements in an accident were combined to produce the HFACS ‘spectrum’ for each accident. The events depicted include significant pre-flight events (e.g. poor briefings, inadequate supervision), in-flight events as well as relevant during crash and immediate post crash survival events. The lack of collective pitch anticipators, lack of CVRs and other regulatory issues are depicted as organizational events.

3. The graphs are displayed in the following order.

Page (a)	Description (b)
C-2	HFACS Spectrum of XW207 Accident - 19 Apr 2000
C-3	HFACS Spectrum of XW200 Accident - 09 Apr 2001
C-4	HFACS Spectrum of XW234 Accident - 21 Jan 2002
C-5	HFACS Spectrum of XW227 Accident - 16 Mar 2002
C-6	HFACS Spectrum of XW221 Accident - 19 Jul 2004
C-7	HFACS Spectrum of XW211& XW218 Accident - 15 Apr 2007
C-8	HFACS Spectrum of ZA938 Accident - 20 Nov 2007

4. The weighting system used for combining the Validity and Importance of particular human factor events is through a multiplication system and is shown in the table below.

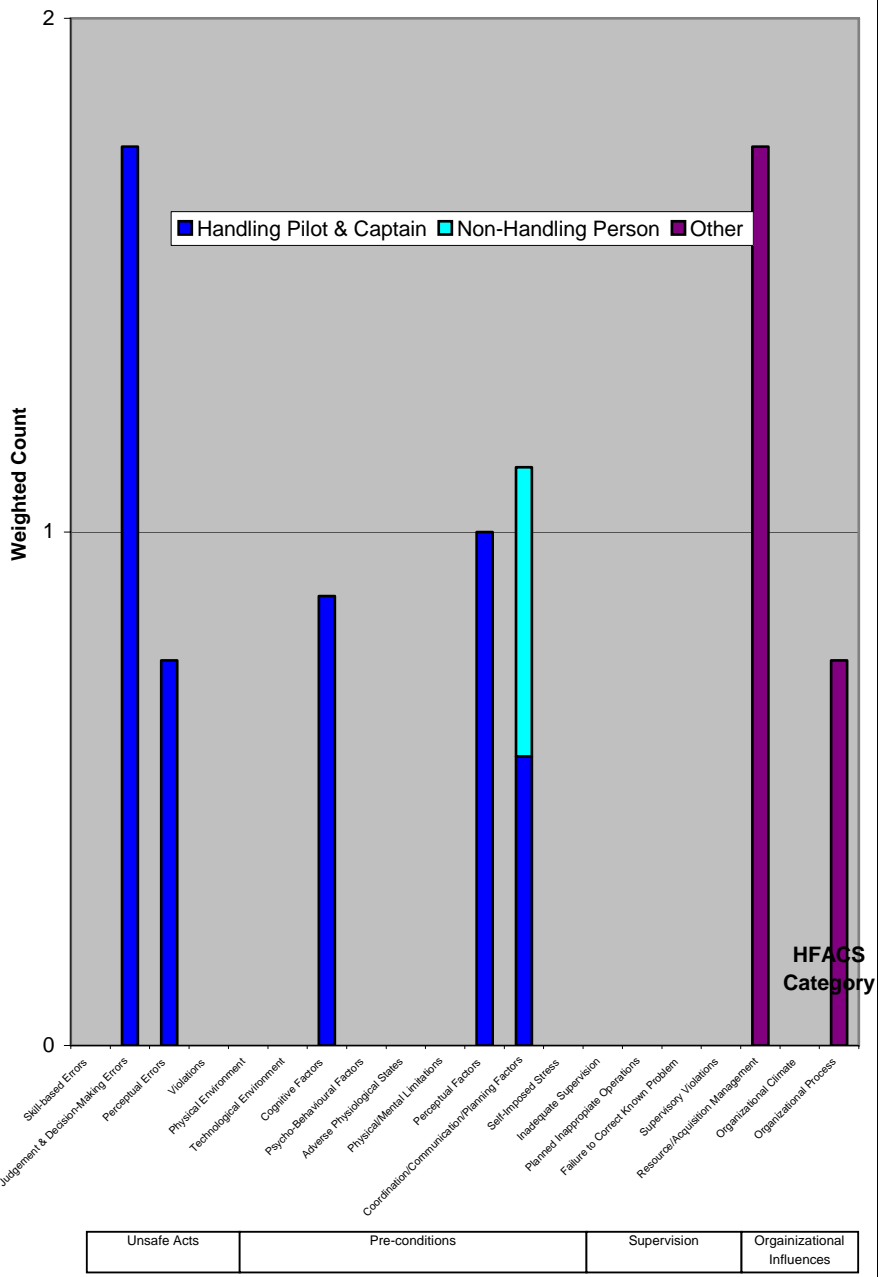
Validity Importance	0	1	2	3	4
0	0	0	0	0	0
1	0	0.06	0.12	0.18	0.25
2	0	0.12	0.25	0.37	0.50
3	0	0.18	0.37	0.56	0.75
4	0	0.25	0.50	0.75	1

5. A systematic colour scheme has used across the graphs to try and best indicate the involvement of various people in an accident.

DARS HFACS Spectrum for XW207 - 19 APR 2000

UK; Non-Ops; Cat 4; 1 Major Injury

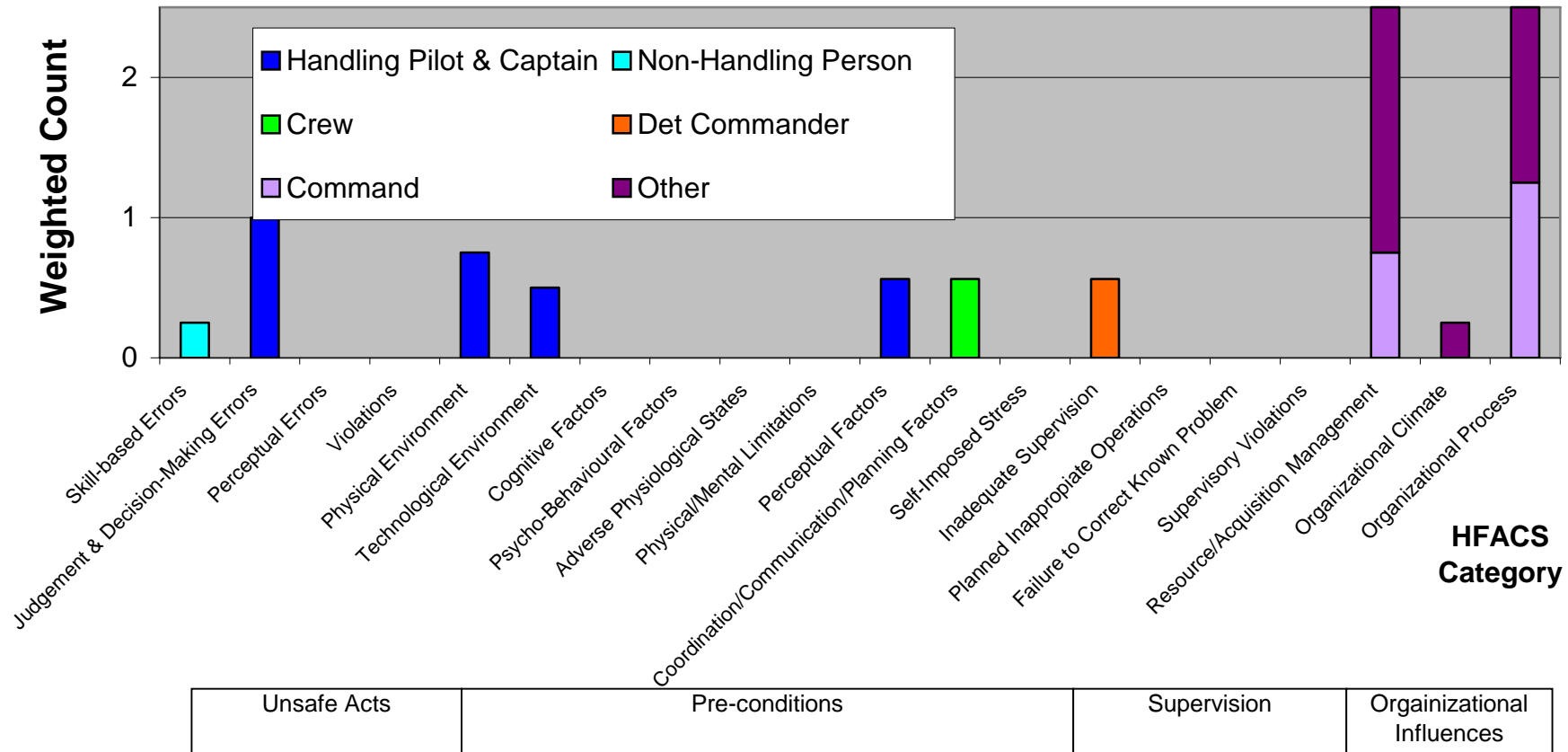
N.B. Graph for outline purposes only; refer to the analysis tool & source documents for full details about the accident.



DARS HFACS Spectrum for XW200 - 9 Apr 2001

Kosovo; Ops; Cat 5; 2 Fatal; 1 Major Injury

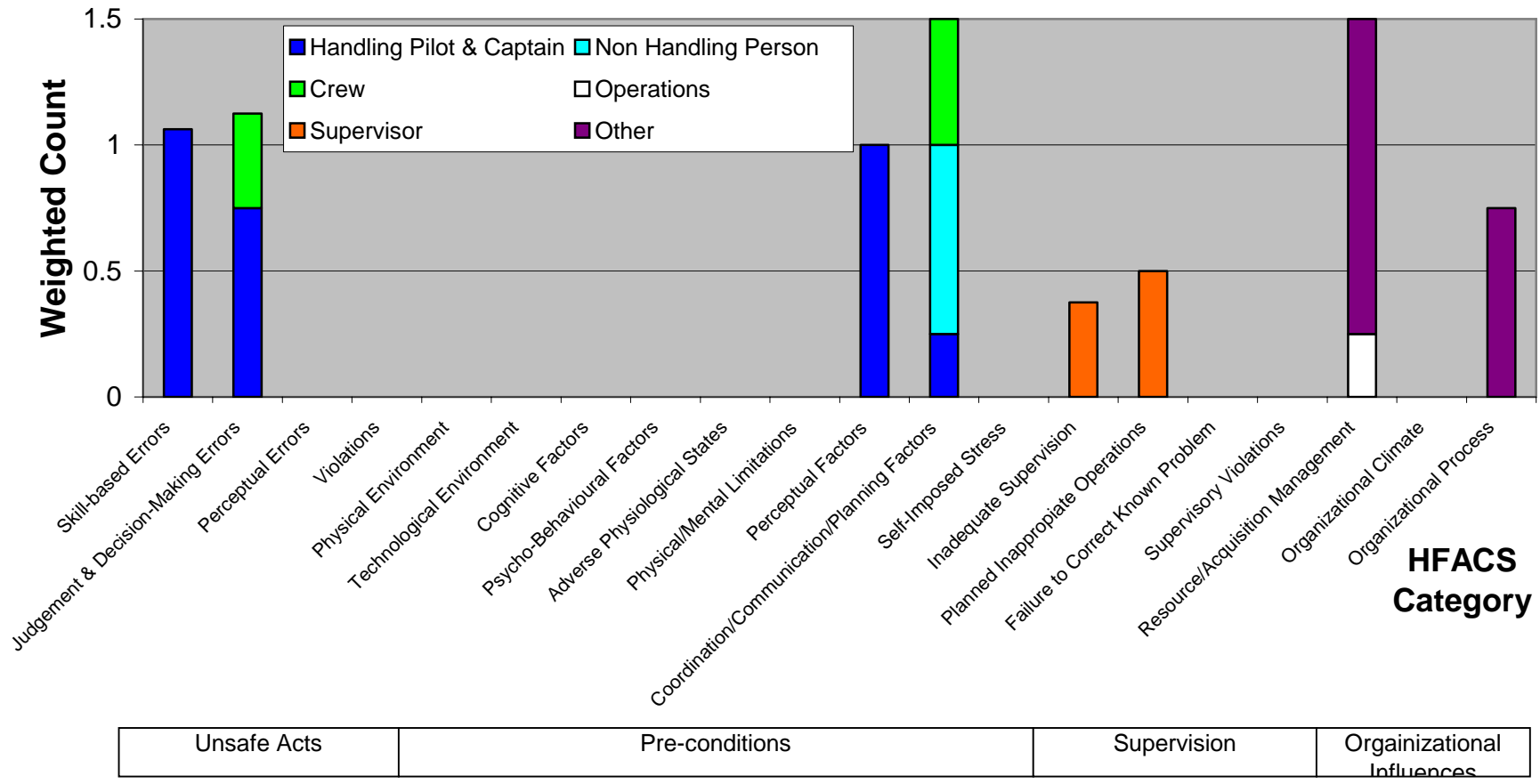
N.B. Graph for outline purposes only; refer to the analysis tool & source documents for full details about the accident.



DARS HFACS Spectrum for XW234 - 21 Jan 2002

UK-NI; Ops; Cat 5; 1 Major & 1 Minor Injury

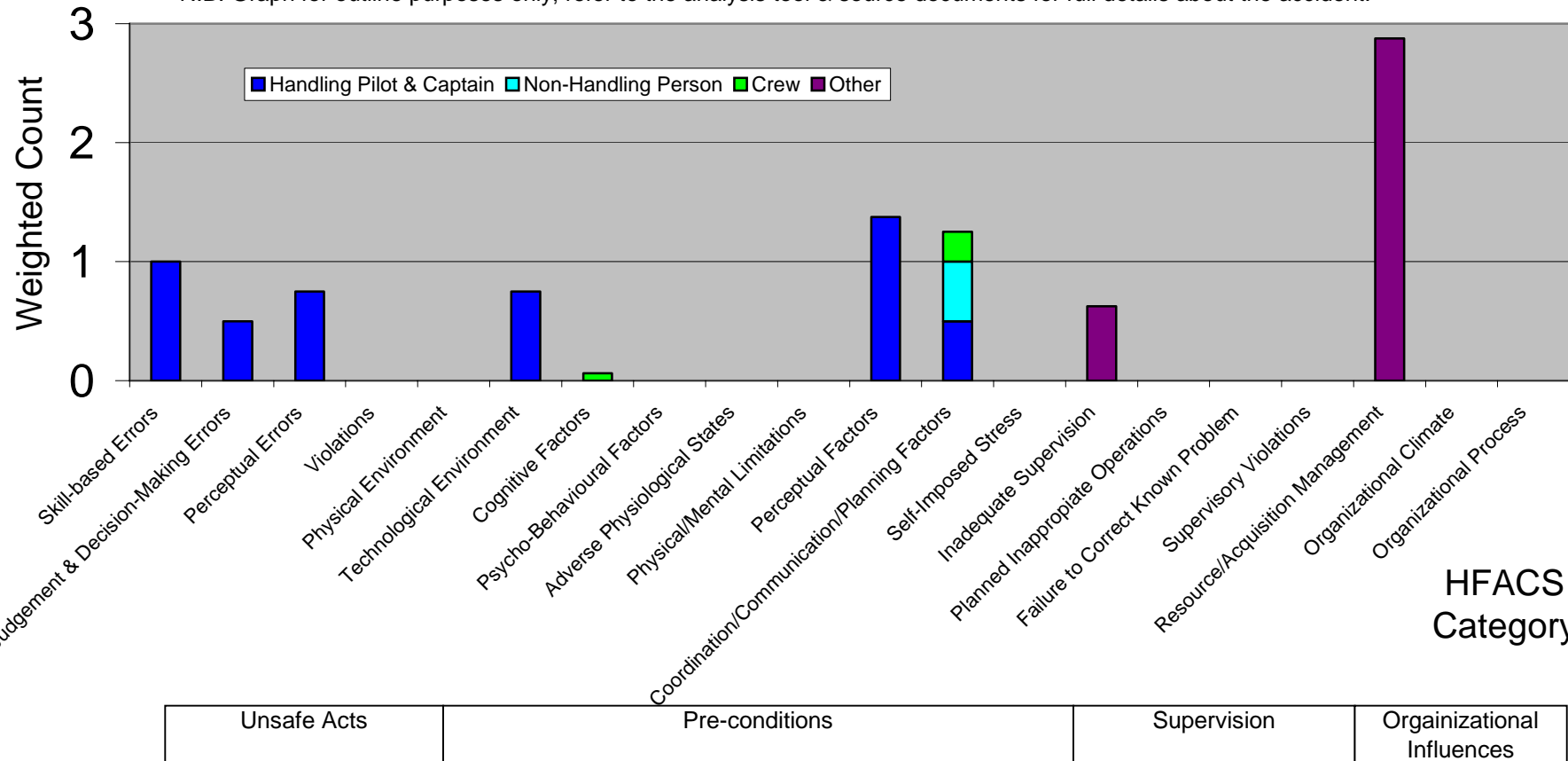
N.B. Graph for outline purposes only; refer to the analysis tool & source documents for full details about the accident.



DARS HFACS Spectrum for XW227 - 16 Mar 2002

UK-NI; Ops; Cat 5; 4 Major & 3 Minor Injuries

N.B. Graph for outline purposes only; refer to the analysis tool & source documents for full details about the accident.



**APPENDIX 4 TO
ANNEX C TO
PUMA REVIEW**

DARS ANALYSIS TEAM – MAIN PUMA RECOMMENDATIONS

Below are more detailed recommendations based on the information captured in the analysis tool. Most Bol recommendations are not included below since they are captured and assessed in the ASG ‘Yellow Book’. Some of the intervention recommendations may already be under consideration by others and so the fact DARS has also recommended a particular intervention (based on the accident data) could be used to help support such work.

<i>SUBJECT</i>	<i>SUGGESTED INTERVENTIONS</i>	Reference
Human Factors (HF) / Crew Resource Management (CRM) Training (N.B. much of this training could also be made integral in other ground, simulator and airborne training. Reference should be made to specific examples from Puma accidents)		
Cross-Monitoring	The importance of cross monitoring, prioritising of tasks and the communication of critical information should be emphasised to Puma crews. Examples from Puma accidents should be used.	XW207, XW221, XW227
Intervention & Communication of Critical Information	All crews should receive training in methods of effective communication. Crews should be exposed to techniques of graduated emphasis leading to how to communicate critical flight safety information. This training would also be useful where any significant cockpit gradient exists. An example of such a technique is ‘Probe-Alert-Challenge-Emergency’.	XW211, ZA938, XW221,
Operational Pressure & Emotional Response	Training should detail the possible range of emotional responses to operational pressure, the effect on performance and coping strategies.	XW211/XW218
Time Pressure, Planning & Balance of Risks	Training should detail the how to make accurate assessments of real (and perceived) time pressures. Examples could be the actual times saved against the risks from rushed or poorly briefed activities.	XW234
Single Person Safety Critical Tasks	Training should detail the risks of only one person being involved in a safety critical task such as judging the separation from the rotating disc by sole reference to an aircraft. (especially if other can assist).	XW211/XW218

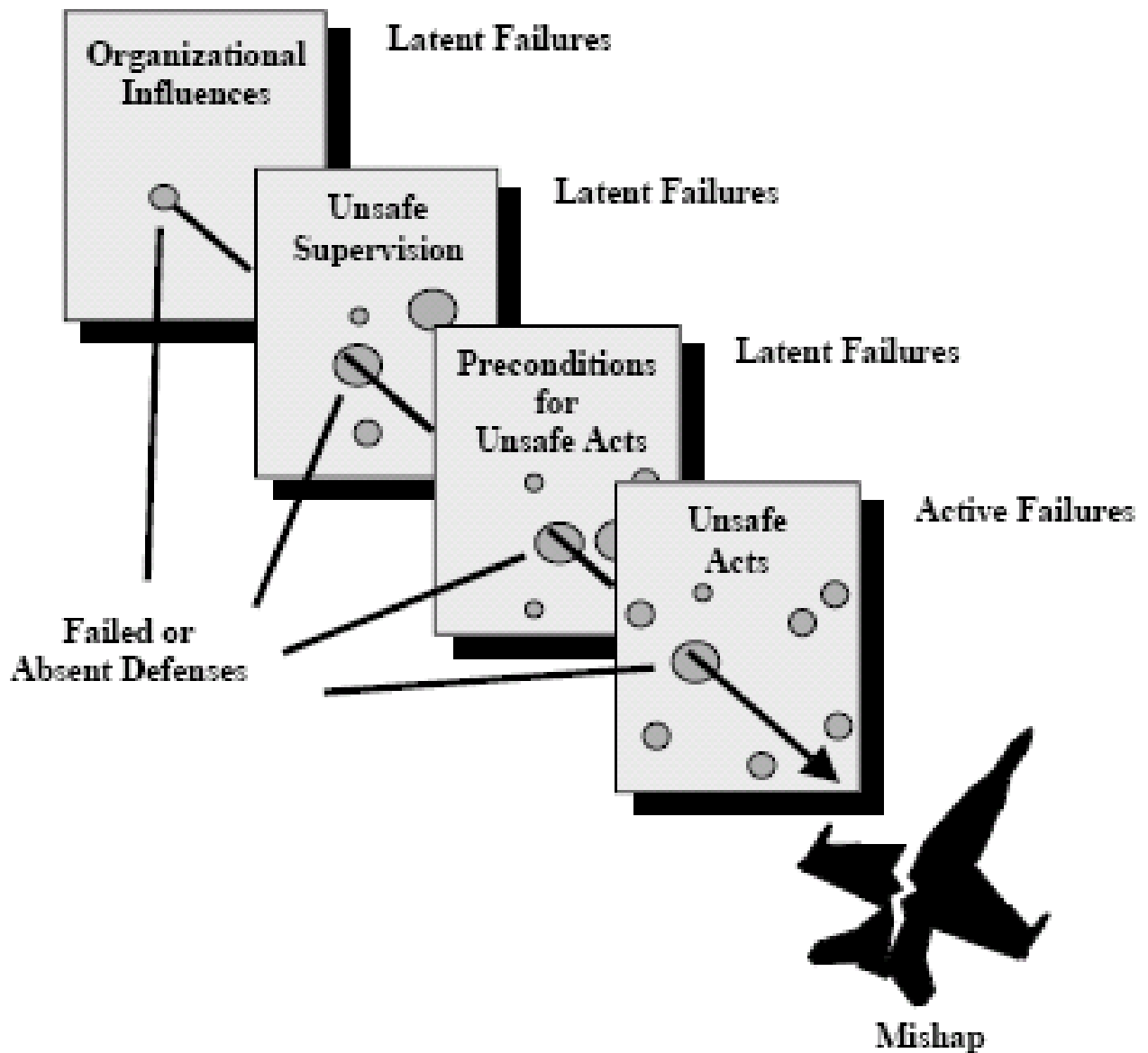
SUBJECT	SUGGESTED INTERVENTIONS	Reference
PUMA FLYING & SIMULATOR TRAINING		
Intervention & Communication of Critical Information	An element of Puma flying and simulator training should allow personnel to practice the graded communication of critical flight safety information such a technique of 'Probe-Alert-Challenge-Emergency'. This could be either on specific sorties designed to bring out this form of crew interaction or if it occurs through events on a sortie. In important aspect being that crews feel confident in how to effectively monitor and communicate.	XW221, ZA938
Practice of Formation Wrong Landing / Reposition Actions	Training at an appropriate point should include the practice of managing the landing a formation in the wrong location / repositioning and the decision-making process, risks and techniques available. This could be introduced into a training exercise as a no-notice change of plan reposition if the target-landing site was correctly achieved. Emphasis should be made to crews that this will not always be carrying out the same actions as another aircraft in the formation.	XW211/XW218
Training to Reduce the Changes of Wrong Field Landings	Re-evaluate the operating procedures & training to try and reduce further the possibility of landing at the wrong position. This could involve the use of in theatre simulator systems to give crews the ability to rehearse missions if they cannot practice into a particular landing location.	XW211/XW218
Limited Pre-Briefed Wrong-Field Plan Actions	Relevant mission briefings should have a specific 'wrong field plan' to reduce the time and decision making required if the target field is missed on overall reduce the risk from having to formulate a plan in a time constrained environment.	XW211/XW218
Flight to Minimum Obstacle Limits	Aircrew training programmes should expose crews to ground training and to the air experience of operating the aircraft to the minimum allowed separation distances from fixed objects and aircraft.	XW211/XW218
Wind Awareness, Approach Brief & Monitoring	Unless Operationally essential or prevented by an emergency, consideration should be given to Puma crews conducting a short approach brief which includes the expected forecast wind, cross-checking against available internal & external wind indicators, the type of approach and what monitoring is required from the crew.	XW227, XW221, ZA938
[REDACTED]	[REDACTED]	ZA938
Severity of Approach Profile	Better consideration of the flight profile to be flown and risks associated with them should be emphasised to crews.	XW227, XW221
Crew Management	The aircraft commander must ensure that Ng are adequately monitored either directly or by the an appropriate crew member and the information passed to the HP.	XW207
MAWS Flight Procedures	MAWS checks should be challenge & response or verified by visual check from other crew member	XW200
Departure Briefings	Consideration should be given to incorporating a 'risk based departure briefing' in the Puma pre-take off checks to ensure there is good crew cooperation. The brief would need to balance the risk of the activity with the speed of action required.	XW200

SUBJECT	SUGGESTED INTERVENTIONS	Reference
Collective Training	Collective training should include scenarios which induces the requirement for inter & intra aircraft communication and cooperation.	XW211/XW218
AIRCRAFT DESIGN		
Collective Pitch Anticipators	If the Puma is to remain operating in the Support Helicopter role then the aircraft should be upgraded as is necessary such that it can operate with a collective pitch anticipator.	XW207, XW221, XW227, XW234
INCIDENT REPORTING		
Encouragement of Greater Incident & Near-Miss Reporting	Flight safety organizations should further emphasises the 'just' culture to try and further encourage the reporting of near miss events. Examples of the factors present in accident could be used to suggest typical areas where such near miss events could have occurred.	Nil
RESEARCH		
Rear crew Restraint System	Research into a suitable restraint system that allow rear crew to undertake their duties but prevent them from falling out of the aircraft should take place.	XW207; ZA938; XW211
Release of Trapped Personnel	Research should be conducted into the possibility of aircraft carrying simple equipment that can assist in raising an aircraft sufficiently to allow a trapped person to escape. Such a device would have to be easily accessible & easy to operate (for example a simple inflatable 'jack'). If passengers continue to fly un-restrained then this should be undertaken as a matter of urgency.	XW207, ZA938, XW211
Crash Survivability	Research should be undertaken into improved survivability of the aircraft structure & seats as well as the use of internal & external airbags.	XW200
Safe Separation Judgement	Bol Recommendation. A full investigation is undertaken to determine what distance can safely be used between aircraft when landing at an unmarked landing site. The investigation should examine the physiological ability to judge distances to and from a rotating disc. It should also evaluate what technical aids could be made available that might assist the judgement of small distances. It should also establish the training requirements needed to achieve and maintain this ability to judge the specified minima.	XW211/XW218
AIRCRAFT EQUIPMENT		
Systems to Counter Reduced Visibility	Consideration should be given to the use of Synthetic Vision Systems to give better situational awareness in conditions of reduced vision e.g. brownout, whiteout, night, poor weather & in assistance in recovery from inadvertent IMC.	XW200, XW211/XW218, ZA938
Use of CVR / ADR / FDR	Cockpit Voice Recorders (CVR) should always be used & suitable Accident Data Recorders (ADR) / Flight Data Recorders (FDR) should be fitted to aircraft to give better information sources for investigators as well to assist as debriefing and engineering resources. Encrypted system should be investigated for use where needed.	XW207; W234; XW227; W200; XW211/XW218; XW221

SUBJECT	SUGGESTED INTERVENTIONS	Reference
Secure Weapons Storage	A crash worthy weapon and ammunition stowage should be provided for aircrew weapons.	XW200
Vortex Ring Warning System	Consideration of providing a warning system to the crew that the aircraft is approaching Vortex Ring conditions such that safe recovery action can be taken.	XW234
SUPERVISION		
Experience, Training & Workload	Supervisors should be adequately experienced, trained & have a reasonable workload to allow them to pro-actively supervise.	XW200; ZA938; XW211/XW218
[REDACTED]	[REDACTED]	ZA938
[REDACTED]	[REDACTED]	ZA938
Inadvertent IMC	If there is a significant hazard from inadvertent entry into IMC (e.g. entry into icing outside the flight envelope) more restrictive day & night VMC weather limits should be considered.	XW200
REGULATIONS		
Safe Separation Judgement	Bol Recommendation. Pending the results of the investigation at para 66a, an interim minimum distance (greater than 10ft) be specified to ensure that aircraft can land safely next to each other at unmarked HLS (para 66b).	XW211/XW218
Formation Separation Distances	Regulations & Authorization for formations should specify at what point (if any) the formation separation may be reduced below the in-flight specified separation e.g. hover taxiing, one ac on the ground and another still airborne.	XW211/XW218
Unrestrained Passengers	A review of the risk assessment allowing unrestrained passengers should be carried out to ensure optimum risk / benefit is being achieved.	XW211/XW218; ZA938

HUMAN FACTORS ANALYSIS AND CLASSIFICATION SYSTEM (HFACS)

The interpretation of the results of the DARS Puma analysis requires outline knowledge of the Human Factors Analysis and Classification System (HFACS). The details of the structure of HFACS is below as well as a more detailed explanation of various categories. Fundamentally, HFACS attempts to capture the 'active failures / unsafe acts' that are normally the direct cause of most human factor accidents as well as the various levels of 'latent failures' of contributory, aggravating or other factors which allow the final unsafe act to occur. Latent failures can be considered to occur at a number of different levels: pre-conditions to unsafe acts (e.g. poor mission planning, fatigue etc.), unsafe supervision and organizational failures. The HFACS model is effectively a detailed version of the 'Swiss cheese' accident model where the latent and active failures, on occasion, 'line-up' and accidents occur.



IPT AIRWORTHINESS SURVEY

PG/38/01/09/06

31 Jan 08

PUMA HC1 SAFETY AND AIRWORTHINESS

General Aircraft Information

- The Puma HC1 is derived from the SA330E ac developed by Sud-Aviation, now Eurocopter. French and UK versions of the Puma share a common basic airframe and engine, but the comms, nav and mission systems are specific to UK ac. Eurocopter is the Design Authority (DA) for the basic aircraft, while Westland is DA for UK specific aspects. The Anglo-French Memorandum of Understanding governs the split of DA and configuration control processes.
- The Puma HC1 received initial CA Release on 21 Jan 71. All Pumas are currently to HC1 configuration, albeit with some variation in Theatre Entry Standard equipment. There were 2 production runs of HC1 ac: Jan 71 to Feb 73 (40 ac) and May 80 to Apr 81 (7 ac). In addition, a single former Argentine ac (original build 1977) was converted to HC1 in 2001 and qty 4 former South African ac (original build 1974-76) were converted in 2006/7. The planned OSD for HC1 is 2013, with the ac being upgraded to HC2 standard for service beyond this date.
- The MOD Puma Fleet currently has 43 ac comprising 25 ac in the Operating Fleet and 18 ac in the Sustainment Fleet. [REDACTED]
- The MOD Puma Fleet has flown approximately 480,000 airframe hrs to Jul 07. The Puma originally had a service-life of 9,000 hrs; however, in Oct 98 EC stated that based on the experience of other operators the Puma airframe was cleared to 25,000 hrs. The average age of the Puma is 10,745 airframe hrs with the Fleet Leader having achieved 13,416 airframe hrs. The Puma is declared as an "Ageing Fleet" and a structural survey and associated Ageing Aircraft Structural Audit has been completed in 2004 with no significant issues raised.

Safety Case.

- Environment and Safety Management Plan (ESMP). The Puma HC1 ESMP is compliant with POSMS and POEMS, and is at Issue 3 dated May 2006.
- Independent Safety Auditor (ISA). ERA Technologies are under contract to the IPT as ISA.
- Military Aircraft Release (MAR). The Puma currently has no MAR; the RTS is at Issue 4, released on 27 Jan 05 and is based on a Military Certificate of Airworthiness (MCoFA) dated 16 Jan 95. The PGIPT has been working closely with the RTSA to uplift the MCoFA to Generic MAR standard; the content of this has been agreed and the final draft for 2* approval it planned to be ready by May 08.
- Statement of Operating Use and Intent (SOIU). Was satisfactorily reviewed in 2007, supported by operating spectrum data already obtained through MDRE and active monitoring of Ground-Air-Ground rates.

- Operational Data Recording (ODR). Has not been carried out on Puma HC1. In light of the planned 2012 OSD and reviewed SOIU, an ODR exemption is currently being staffed for 2* approval.
- Hazard Log. The Puma Hazard Log was reviewed and updated by Echelon Ltd in 2007. There are no Cat A hazards and one Cat B hazard (Nr Droop, see below).
- Maintenance Schedule. The Puma maintenance schedule is derived from the EC design criteria that identified the need to control fatigue lives of certain components through finite Service Life Limit (SLL), Operating Time Limit (OTL) or Time between Overhaul (TBO). The UK MoD schedule includes the use of zonal inspections. The maintenance schedule is currently subject to continuous improvement review using Reliability-Centred Maintenance methodology. In addition, the packaging of the extant maintenance tasks is currently being reviewed and optimised.

- [REDACTED]

Safety Record

- Accident Rate.
 - The aircraft accident rate for Puma is currently 0.46 per 10,000 Flying Hrs. The accident rate for Puma attributable to Technical Failure is 0.042 accidents per 10,000 Flying Hrs; however, the most recent accident investigations have not reported their findings although each initial report has indicated no suggestion of a technical failure.
 - Six Pumas were involved in accidents during 2007, with 3 ac Cat 4 and 3 ac Cat 5. Two of these were damaged on the ground in freak weather conditions. Although the investigations of the other accidents have not formally reported their findings, the IPT has not been made aware of any technical cause to the accidents. JHC are currently conducting a "reset" of the Puma Force, with particular emphasis on aircrew supervision and training. [REDACTED]
- Nr Droop. The sole Cat B Hazard on Puma HC1 is slow engine response to demands for increased power. This can lead to a transient reduction in rotor speed and lift referred to as "Nr Droop". This is a limitation inherent in the Turbomeca Turmo 3C4 engine control system, which has no anticipation system. Mitigation is provided by extensive aircrew training, warnings in relevant publications and audio alerts triggered by a Rotor Over Speed Monitoring Unit (ROSMU). However, a number of Puma accidents have been exacerbated by slow engine response. An anticipator system cannot be retrofitted to the Turmo engine; and replacement of the Turmo with the Turbomeca Makila engine (which has an anticipation system) would resolve the issue. Previous bids to retrofit Puma with Makila were rejected on cost grounds. After an accident in 2004, a formal Cost Benefit Analysis was carried out which demonstrated that the Puma HC1 remained ALARP against its planned OSD. A modification of the ROSMU is being undertaken, which will give the operators earlier warning of high Nr.

Other Safety/Airworthiness Issues



- Top Deck Structure. The Puma has a long history (since the 1980s) of sustaining Cat 3 damage to the Main Rotor Gearbox and Engine support structure, typically on a 10-year cycle. This poses no structural integrity concern, but repair costs are currently high.

- HUMS/CVFDR. Although Puma HC1 is not fitted with HUMS or a Flight Data Recorder, a non-fire-resistant COTS digital Cockpit Voice Recorder (2hr loop recording) was embodied by Service Modification in 2006 to assist with accident and incident investigations.
- Crashworthiness. The Puma is not fitted with crashworthy seats and its structure is designed to a less stringent crash case than currently required by Def Stan 00-970. Modification of seats or structure for the HC1 is not feasible, but is being considered for Puma HC2.

Signed on DII



PGIPTL

Risk Matrix	The PGSM advised that there is no common risk matrix mandated in RW Cluster. This made it difficult to compare risks across platforms and commodities. DG Hels-STI to advise DG Hels on the opportunity to achieve a common risk matrix.	DG Hels-STI
MAR	The MAR has been submitted for 2* signature. PGIPTL and DES-Heli-STI were to co-ordinate progression to the signing authority. Issue GARP 6 months after issue of MAR.	PGIPTL/ DG Hels-STI PGEEng3
ODR	There is no current ODR exemption. Submit exemption case by 26th July 08. PM Note: QinetiQ will not deliver report at best until 31 Aug therefore exemption case cannot be submitted until mid Sep at earliest.	PGEEng3
Disposal	The meeting noted the ongoing discussion with DSA on Gazelle disposal options.	
Noise	The meeting noted the PGIPTL's intent to introduce mini-CEP on Gazelle, to alleviate the extant Cat B hazard. DES-Heli-STI was to review the information flow between IPTs on noise control initiatives.	DG Hels-STI
Safety Statement	Meeting agreed that Gazelle AH1 is tolerably safe to operate given that there are plans in place to ensure ALARP.	
Puma		
Deployment	  PGIPTL and JHC were to ensure that there is a risk assessment procedure in place prior to ANY deployment of Puma to new Theatres of Operation.	PGIPTL/ JHC SO2-J4
Nr Droop	The ALARP assessment of Puma Nr Droop did not take into account the Aug & Dec 07 accidents, as the accident investigations had not been issued. PGIPTL to revisit the Nr Droop assessment on publication of the relevant BOI Reports.	PGIPTL
Seats	The safety of the crewman's seat was discussed. The RTS prohibits use of the seat during take off and landing. Improved seating options were being considered for HC2. FMH TL to review crash-attenuated seating options during LEP.	FMH LEP PM EC UK Proj Man

	EC was requested to advise on what crash-attenuated seats are fitted to other Puma-family helicopters.	
GMAR	GMAR to be submitted for PGIPTL review by end May 08.	PGEEng2
ODM	The Puma ODM was under priority review by QinetiQ. Concern was raised that other priority work may delay this activity. PGIPTL to advise key stakeholders, including DG Hels, in case of any priority conflict. ODM information will be disseminated to relevant authorities, as it becomes available.	PGIPTL PGEEng2
Safety Tolerances	RTSA stated that there might be occasions where safety tolerances are reduced for operational requirements. Review any actual or proposed reduction in safety tolerances for operations across all RW Fleets.	DG Hels-STI
UOR	The requirement for safety cases to support software upgrades to UORs was discussed. There was a need to ensure a common approach across platforms. Review quality of UOR safety information. Review safety assurance requirements and processes for UOR software upgrades.	DG Hels-STI DG Hels-STI
CVR	The Puma HC1 CVR is not crashworthy and does not meet FDR requirements. PGIPTL to review CVFDR compliance requirements and draft options by end May 08.	PGIPTL
Simulator	The meeting discussed mismatches between the “as flown” and the simulator configuration. DG Hels asked DEC(ALM) to note that where relevant, the simulator should be upgraded within UOR process.	DEC(ALM) AM2
Safety Statement	The meeting noted that the accident history in 2007 indicated that Puma HC1 had not been tolerably safe to operate end-to-end, although technical factors did not appear to have been significant causal factors. With actions taken by JHC and the PGIPT, the meeting considered that the Puma HC1 was now tolerably safe to operate, end-to-end, and noted the plans in place to ensure that it is technically ALARP.	PGIPTL/ JHC SO2-J7

	PGIPTL and JHC to review Puma HC1 safety performance and produce an outline safety plan to OSD including contingency for LEP slippage by 1st June.	
Brown-outs	DEC (ALM) stated that brownout alleviation was being investigated. Work was currently focussed on Op HERRICK, but there was an aspiration for fleet-wide fit. PGIPTL stated that this is not currently being addressed in LEP.	
LEP		
Standards	<p>The strategy for application of design standards was discussed. EC expressed concern over lack of clarity.</p> <p>FMH TL/PGIPTL to submit revised strategy paper to DG Hels.</p> <p>DG Hels2 to arrange LEP 2* Airworthiness Review.</p> <p>PGIPTL/FMH TL to resolve LEP TAA issues.</p>	<p>FMH LEP PM</p> <p>D Hels2</p> <p>PGIPTL/FMHTL</p>
AOB		
	<p>Ageing Aircraft Audit will be required to baseline LEP.</p> <p>DECALM stressed the importance of meeting the LEP main gate business case timelines.</p> <p>HES ESM requested clarification on LEP engine standards. PGIPTL stated that the engine safety case would be provided through EC.</p>	
Date of Next Meeting	The next meeting will be held in approximately 12 months. Date will be promulgated in due course.	

CHARTS SHOWING BH ACCIDENTS AGAINST TIME (1998 – 2008)

Appendix 1: Puma and Sea King in NI

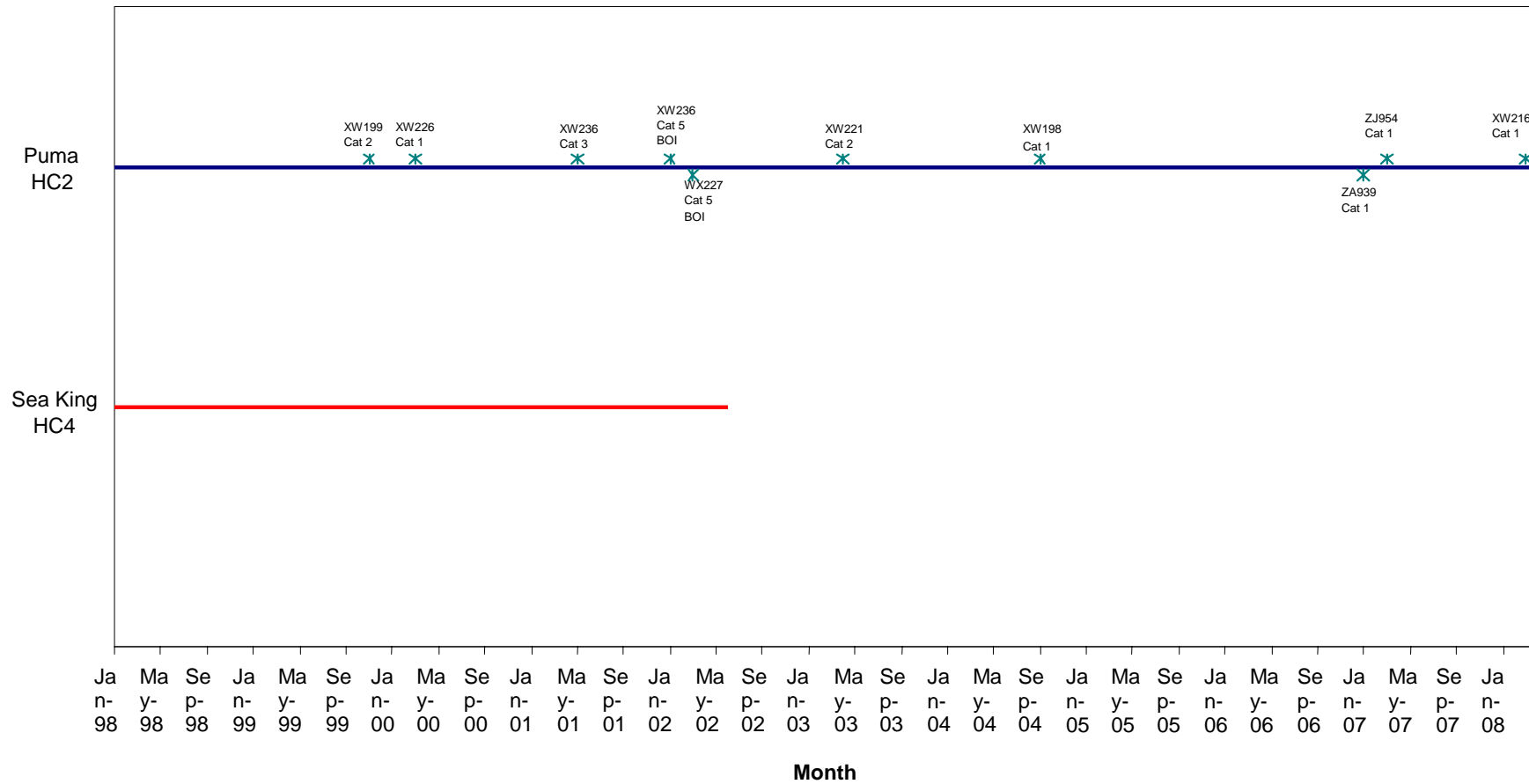
Appendix 2: Chinook, Puma, Merlin and Sea King – Non-operational

Appendix 3: Chinook, Puma, Merlin and Sea King – Iraq (2002 – 2008)

Appendix 4: Chinook, Sea King [REDACTED] – Afghanistan (2005 – 2008)

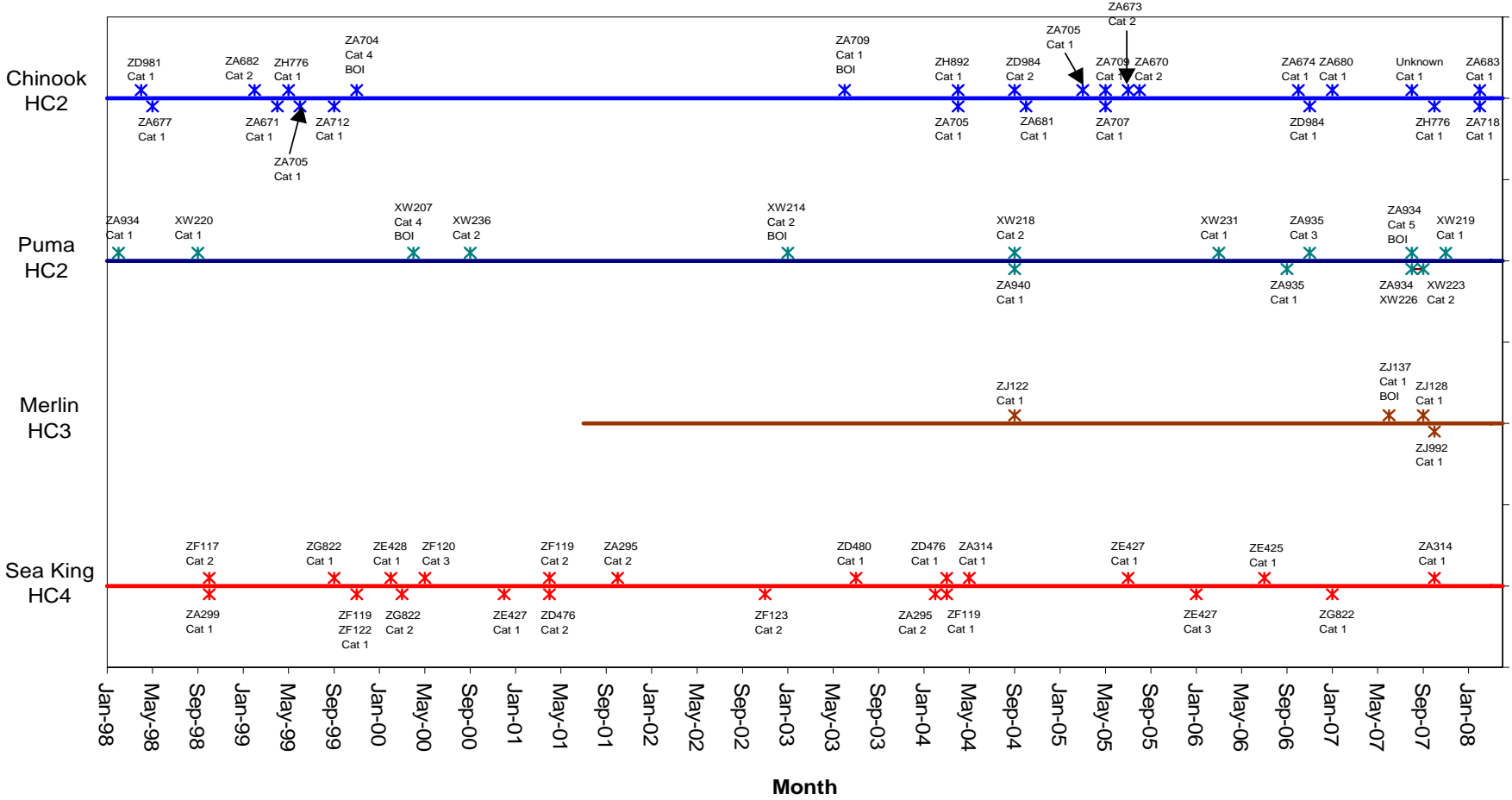
APPENDIX 1 TO
ANNEX F TO
PUMA REVIEW

SUPPORT HELICOPTER MAJOR INCIDENTS/ACCIDENTS - NORTHERN IRELAND - JAN 98 - MAR 08



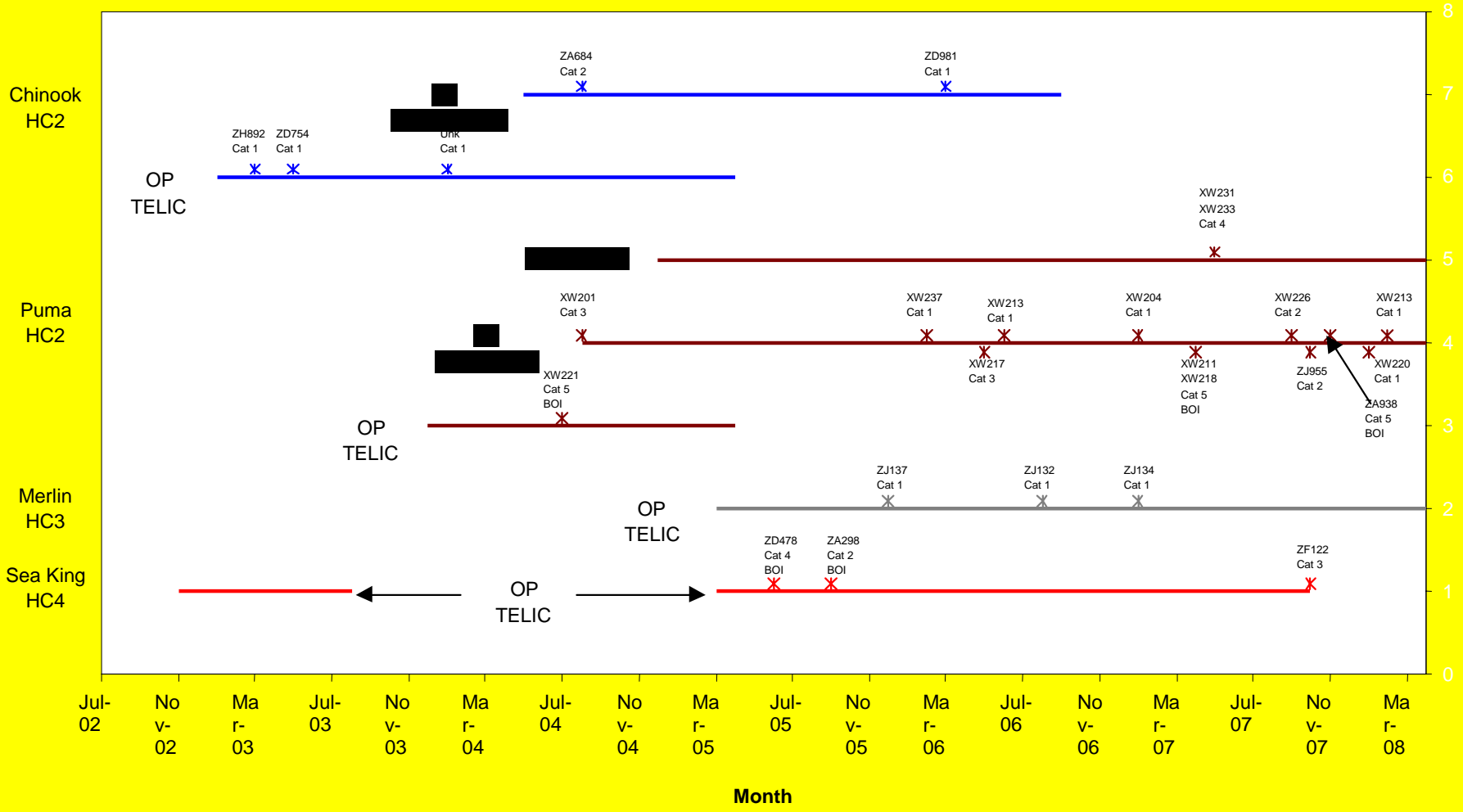
**APPENDIX 2 TO
ANNEX F TO
PUMA REVIEW**

SUPPORT HELICOPTER MAJOR INCIDENTS / ACCIDENTS - NON OPERATIONAL JAN 98 - MAR 08



**APPENDIX 3 TO
ANNEX F TO
PUMA REVIEW**

SUPPORT HELICOPTER MAJOR INCIDENTS / ACCIDENTS - IRAQ JUL 02 - MAR



**APPENDIX 4 TO
ANNEX F TO
PUMA REVIEW**

SUPPORT HELICOPTER MAJOR INCIDENTS / ACCIDENTS - AFGHANISTAN DEC 05 - MAR 08

