BOARD OF INQUIRY

INTO AN

AIRCRAFT ACCIDENT

APACHE AH1

ZJ 177

FORWARD OPERATING BASE EDINBURGH

AFGHANISTAN

4 SEP 08

VOL 1

REPORT

BOARD OF INQUIRY
INTO AN
AIRCRAFT ACCIDENT OR OTHER OCCURRENCE

AMENDMENT LIST

AMENDMENT NO	DATE OF AMENDMENT	AMENDED BY	SIGNATURE
(a)	(b)	(c)	(d)
1	22 Oct 09	[redacted]	[redacted]

The lowest classification of this form is **'RESTRICTED'** when it includes the proceedings of a Board of Inquiry or Regimental Inquiry.

RECORD OF PROCEEDINGS

of a[1]	Board of Inquiry
assembled at	Joint Helicopter Command Headquarters, Wilton, United Kingdom
on the	14th September 2009
by order of[2]	Rear Admiral C A Johnstone-Burt OBE MA Commander Joint Helicopter Command
for the purpose of[3]	Investigating the sequence of events, circumstances and causes of the accident involving Apache AH Mk 1, ZJ 177, of Joint Helicopter force (Afghanistan) on 4th September 2008 at Forward Operating Base Edinburgh, Helmand Province, Afghanistan.

PRESIDENT [redacted]

MEMBERS { [redacted]

The following person was in attendance throughout part of the proceedings in accordance with Rule 11 of the Board of Inquiry (Army) Rules, 1956.

[redacted]

*He was unrepresented.

The Board of Inquiry, having assembled pursuant to the Convening order attached at Annex B proceed to [record evidence [on oath][4] beginning at Part 11.] [hear evidence [on oath][4] in accordance with the transcript attached hereto.] (or as the case may be)

The findings *[and opinion] of the Board of Inquiry are attached at Part 5.

**Strike Out, where not applicable*

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[1] Although primarily intended for boards of inquiry and regimental inquiries convened under A.A., 1955 ss, 135 and 137 respectively, this form may be used for committees, etc., and this space may be filled accordingly.
[2] Insert here the authority, or the rank, name and appointment of the officer convening the board of inquiry or as the case may be.
[3] Here set out the terms of reference as set out in the order convening the board of inquiry or regimental inquiry.
[4] This may only be struck out where a regimental inquiry has not been instructed to examine witness on oath.

NOTE: In the case of a board of inquiry or a regimental inquiry the proceedings must be signed by the president and by each of the members. Attention is drawn to the Board of Inquiry (Army) Rules, 1956 or to the Regiment Inquiry Regulations 1956, whichever is applicable.

TERMS OF REFERENCE

Refer to Annex B (Convening Order for AH ZJ 177).

PART 1

SUMMARY OF ACCIDENT	SUPPORTING DOCUMENTATION
1. At 1835 Afghanistan Local (L) (1348Z) on 4 Sep 08, the crew of Apache Attack Helicopter (AH) Mk1 ZJ177, call sign (C/S) [redacted] of Joint Helicopter Force (Afghanistan) (JHF(A)), were cleared to depart Forward Operating Base (FOB) EDINBURGH (EDI), HELMAND Province, Afghanistan, to return to Camp BASTION (BSN). The weather was good, skies clear, visibility in excess of 10Km with a south-westerly wind of variable speed.	**Witness 1-1, 2-1, 11, 12 & 13** **Annex E** – AIEFSO Report
2. The crew were considered current (less Spatial Disorientation sortie, General Handling (GH)), correctly qualified, authorised and had completed the mandated Theatre Qualification (TQ) package on arrival in theatre. The Aircraft Commander (Ac Comd) and handling pilot (HP) (subsequently referred to as HP), [redacted] Army Air Corps (AAC) (attached to 654 Squadron (Sqn) from 3 Regiment (Regt) AAC), occupied the rear seat and the Co-Pilot Gunner (CPG) and non-handling pilot (NHP) (subsequently referred to as CPG), [redacted] AAC (654 Sqn, 4 Regt AAC), occupied the front seat. The aircraft was serviceable up to the point of impact.	**Witness 1-1 & 2-1** **Annex E** – AIEFSO Report
3. The HP lifted to the hover over the compacted mud Helicopter Landing Site (HLS), facing the FOB on a heading of 162º magnetic. The HP spot turned the aircraft through approximately 180 degrees to the right, to take up a heading of 312º magnetic. The HP commenced a normal transition from the HLS. Shortly afterwards ZJ177 was engulfed in a thick dust cloud, impacted the ground and came to rest on the port side.	**Witness 1-1 & 2-1.** **Annex E** – AIEFSO report
4. The crash resulted in the complete detachment of the tail section from the aircraft, severe damage to the Main Rotor Blades and extensive impact damage to the port stub wing.	**Annex E** – AIEFSO Report
5. The HP was able to exit the aircraft unaided and subsequently helped the NHP to open his door and vacate the aircraft. Both crew members suffered only minor injuries.	**Annex F** – Avn Med Report

PART 2

NARRATIVE OF EVENTS	SUPPORTING DOCUMENTATION
1. On 4 Sep 08, the crew (HP & CPG) of Apache AH Mk1 ZJ177 were at [redacted] notice to move (NTM) on the second day of a three-day Very High Readiness (VHR) duty at JHF(A) Forward (Fwd) as part of a 12-day duty roster. They had completed approximately 4:15 flying hours the previous day as part of the duty getting to bed at approximately 2130L. The crew were woken at approximately 0430L by a signaller to conduct the first reactive task of the day, not meeting the mandated 8 hours rest.	**Witness 1-1 & 2-1** **Exhibit A**
2. At 0550L ZJ177 lifted to escort a Sea King (SK) to deliver replacement radio crypto to a ground convoy near Kajaki (KJI). After approximately 1:00 hour flying ZJ177 landed back at BSN and conducted a hot refuel to full fuel during which time the crew received a warning order (WngO) to escort an Immediate Response Team (IRT) aircraft. During taxi ZJ177 suffered a 'Blow-Off Valve' fault and was declared temporarily unserviceable. A second AH C/S completed the IRT task whilst REME technicians and the crew of ZJ177 rectified the fault.	**Witness 1-1 & 2-1**
3. At 0730L the crew of ZJ177 attended the JHF(A) Fwd morning brief before updating their VHR authorisation for the subsequent 24 hour period with the JHF(A) Fwd Chief of Staff (COS). The crew then went to breakfast before returning to the VHR crew rest tent. At approximately 0930L the crew received a WngO to pre-position to FOB EDI [redacted] authorised by JHF(A) Main. The crew had worked with the same ground C/S on a previous operation and were content with their role but read up on available information in preparation for the task. The CPG was briefed on weaponeering aspects (including gun tape of a previous mission) by the Comd JHF (A) Fwd, which led to the decision to request an additional two Hellfire missiles over and above the standard Op HERRICK load of [redacted] missiles. As Ac Comd the HP agreed the request and a message was passed to the groundcrew to load an additiona [redacted] missiles on to the aircraft. The crew had an informal discussion with one of the AH Sqn Flt Comd before walking to the aircraft	**Witness 1-1, 2-1, 3-1, 3-2, 6-1 & 25**
4. At approximately 1100L the crew walked to the aircraft to prepare for departure. During the pre-flights checks the CPG was unable to fully focus the picture on his Helmet Mounted Display (HMD) but the symbology was clear and the fault considered acceptable so the crew departed BSN for FOB EDI. ZJ177 approached the compacted mud (dust suppressed) HLS at FOB EDI (within the area of the berm that surrounds the FOB), in to wind, from NE to SW (approx 250º) using a standard zero-zero technique. On short finals a member of the ground crew (provided by the Tactical Supply Wing (TSW)) attempted to marshal the aircraft onto the compacted mud HLS. Once safely on the ground and closed down to the auxiliary power unit (APU), the CPG left the aircraft to debrief the TSW individual to make it clear that the technique to approach and land at a dusty HLS did not require a marshaller and all ground crew should remain clear of the approaching aircraft for their own	**Witness 1-1 & 2-1**

safety.

5. Whilst the HP remained on APU the CPG attended a 'ramp' brief (on the back ramp of a CH-47 aircraft) with the Ground and Air Mission Commanders and the JTAC to clarify ZJ177's role. The HP then closed down ZJ177 and the crew entered a period of VHR alongside the other SH aviation assets (two CH-47 and two SK) [redacted]. The crew had lunch between 1300L and 1400L approximately and consumed drinks provided from FOB EDI. Throughout the afternoon the crew hosted a number of visitors to look round ZJ177 including a member of the media, [redacted] and individuals from FOB EDI. Between visits they either remained with their aircraft or spent time with the other crews [redacted] At approx 1530L the CPG received a 'go' and notified the HP who in turn started the aircraft. After a short delay of approx 15 mins the mission was launched but aborted at the target site, returning to FOB EDI. ZJ177 remained clear of FOB EDI to the North until all other aircraft had landed and refuelled. Once back at FOB EDI the crew elected to refuel ZJ177 to approx 2800lbs, taking on an additional 750lbs of fuel with reference to the aircraft performance page, noting 95% inside ground effect (IGE) performance. At approx 1820L the operation was stood down due to the lack of a night option and all aircraft crews prepared to return to base locations (SH to KAF, AH to BSN).

Witness 1-1, 2-1, 11, 12, 13 & 18

6. At 1818L the crew of ZJ177 started the APU and carried out limited pre-flight procedures. The pre-flight Back Up Control System (BUCS) check initially identified a BUCS fault, but this cleared after the Ac Comd ran a second check. The Ac Comd started number one engine at 1825L and number two engine at 1826L. The APU was switched off at 1827L. The Ac Comd then carried out limited pre-flight checks, failing to use the mandated challenge and response technique prescribed in the Flight Reference Cards.

Annex E – AIEFSO Report

7. During start the SH closest to ZJ177 became unserviceable at 1831L delaying the packet departure in order to revise the pax loading plan. At 1833L, the crew of ZJ177 requested permission to depart independently and at 1835L the crew were given clearance to depart by the Air Mission Commander (C/S LIFTER 1). The HP vocalised his decision to depart to the north. The ground hazards to the north included a berm, roughly 1.5m high with a 15m vehicle access point, situated approximately 60m from the compacted mud HLS. The compacted mud HLS is bordered by tracks leading to the northerly access point, creating the potential for heavy recirculation.

Witness 1-1, 2-1, 11, 12 & 13
Annex E – AIEFSO Report

8. Unable to gain comms with 0H (EDI Buzzard), the CPG attempted a blind departure call at 1836L on FM2. The HP lifted in to hover over the compacted mud HLS, heading 162º magnetic, changed to hover symbology climbing to 10' then descended to 8' and engaging the Radalt height hold encountering light recirculation. The HP initiated a spot turn through approximately 180º to the right, whilst verbalising his intent to turn and depart downwind. Having reached a heading of 312º magnetic the HP disengaged the height hold and immediately commenced a normal transition. The aircraft was initially accelerated to approx 10kts ground speed whilst maintaining level flight and changing to transition symbology. The CPG initially verbalised Tq readings and as the aircraft left the

Witness 1-1, 2-1, 11, 12 & 13
Annex E – AIEFSO Report

...out and included height calls.

The HP allowed the aircraft nose to pitch up 13º above the horizon and climb to approx 25' AGL, briefly emerging from the dust cloud. The CPG then prompted the HP to "keep accelerating", the HP pushed the nose forward to approx 4º above the horizon and the aircraft began to descend, yawed 10º to the left and drifted right. The aircraft again pitched 15º nose up whilst drifting sideways at approx 12kts ground speed. As the aircraft descended the CPG called "5 feet" immediately followed by the low height audio warning (set at 10' AGL). At 1837L the tail wheel struck the ground, the aircraft rapidly yawed and rolled right. The CPG called for the HP to "go contingency" as the aircraft pitched forward striking the nose on the ground before rolling left, continuing to yaw and coming to rest on the left hand side on a heading of approx 215º magnetic.

9. Once the aircraft had come to rest the following audio warnings were enunciated: tail rotor hydraulic failure, Engine Electronic Control Unit (EECU) one failure, EECU two failure and hydraulic failure. The aircraft tail section became detached from the fuselage, the Main Rotor Blades sustained severe damage and the port stub wing suffered extensive impact damage. The CPG confirms the HP is okay. The HP confirms that he has [redacted] the [redacted] and [redacted] The CPG initially directs the HP to keep the cockpit door closed until the main rotor head had come to rest and it was safe to egress. The HP egressed first and assisted the CPG to open his cockpit door. The CPG experienced difficulties opening his cockpit door and had resorted to kicking the door before it was opened from the outside by the HP. The CPG and HP then moved clear of the aircraft [redacted]

Witness 1-1 & 2-1
Annex E – AIEFSO Report

10. The crew were assessed by [redacted] at the crash site before moving to the FOB EDI medical centre where a more detailed assessment was conducted by the resident medics which confirmed neither of the crew had sustained major injuries. Urine samples were taken, the crew wrote 'hot statements' and awaited recovery to BSN. They were recovered at approx 0030L were met by Comd JHF(A) Fwd and Comd JHF(A) Fwd (Des) who accompanied them to the BSN Field Hospital Emergency Department. Following a further medical examination the crew retired between 0130L and 0145L.

Annex F – Avn Med Report

PART 3

MATERIAL FACTS FOUND AT THE SCENE	SUPPORTING DOCUMENTATION
GENERAL	
1. Initial post crash management of the crash site was carried out by personnel located at FOB EDI. Overall control was placed with a LCpl of the Royal Signals Corps who was trained as an Aircraft Landing Point Commander (ALPC). The ALPC placed a mine tape cordon approximately 30m south of ZJ177, to prevent personnel from FOB EDI from entering the crash site. ZJ177 was over-watched by the on duty sentries in Sangar 4 of FOB EDI, approximately 200m from the crash site, who were instructed to report any breaches of the cordon. A number of Warrior Armoured Personnel Carriers (APCs) from the Princess of Wales Royal Regiment (PWRR) were placed in an arc approximately 2km to the north of the crash site to warn off any local persons from entering the area. Some of the Warrior APCs drove through the crash site when transiting to and from FOB EDI, potentially interfering with evidence on the ground.	**Witness 10** **Exhibit B**
2. The Post Crash Management Incident Officer (PCMIO) arrived at FOB EDI at 0656L on 5 Sep 08 along with his team. The Warrior APC cordon had already been removed prior to the arrival of the PCMIO. An ATO assessed the safety of the aircraft as a priority and with the assistance of an ALPC completed a weapon download by 1149L, with the exception of all 30mm munitions which, without hydraulic power available, remained on the airframe. All stores removed from the aircraft were placed in a secure ISO container on the southern side of FOB EDI, to await disposal.	**Witness 10** **Exhibit B**
3. The PCMIO co-ordinated the recovery of available cryptographic material from the airframe and also of personal weapons and minimal personal equipment from the cockpits. This was quarantined and passed to the BOI on their arrival.	**Witness 10** **Exhibit B**
4. The BOI team arrived in Kandahar (KAF) at 2300L on 6 Sep 08. [redacted] AIEFSO and [redacted] AIEFSWO, arrived in KAF at 2100L on 7 Sep 08. AIEFSO, AIEFSWO and the BOI team arrived at the crash site of ZJ177 at 1130L on 8 Sep 08, owing to poor weather precluding aircraft movement.	**Witness 10** **Annex E** – AIEFSO Report **Exhibit B**
5. After an initial brief from the PCMIO, the BOI team carried out a survey of the crash site before AIEFSO and AIEFSWO carried out their initial recce and commenced the site and technical investigation.	
AIRCRAFT WRECKAGE- GENERAL	
6. For full details refer to (AIEFSO) Annex E. In summary the aircraft wreckage was centred on Grid 41S PR 60136 82117 to the North of FOB EDI. Aircraft parts were found as far out as 254m from this point. The tail section, which had become completely detached, lay approx 5m from the main fuselage to the east. The fuselage was facing 270º magnetic, lying on its port side, with the port wheel	**Annex E** – AIEFSO Report

assembly, the remains of the port stub wing and what was left of the tail boom as the points with ground contact.

DIAGNOSIS OF CAUSES	SUPPORTING DOCUMENTATION
POSSIBLE CAUSES 1. The Board dismissed Non-Service Control, Not Positively Determined and Human Factors (Non-aircrew) on the grounds that there was no evidence to support them as causal or contributory factors of the accident. 2. Once all evidence, including documentary evidence, witness statements, eye-witness accounts, photographs of the scene, aircraft flight data and specialist reports were made available, the Board examined the following possible causal and contributory factors of the accident involving Apache AH Mk1, ZJ177: a. Organisational. b. Operating and Natural Risk. c. Technical Failure. d. Human Factors (Aircrew).	
ORGANISATIONAL 3. **Structural.** The Board considered the following structural factors: a. **AH Sqn HQ/Aircrew De-synchronisation.** Early in the development of the 4 Regt AAC Op HERRICK 8 & 9 FET the chain of command identified that as a consequence of CTR output, individual posting, those leaving the military and HARMONY guidelines there were insufficient AH aircrew to split the 12 month commitment into 3 sub-unit deployments. The decision was taken to de-synchronise the AH Sqn HQ from the 3 subordinate Flights of aircrew. As a result each Sqn HQ planned to deploy for 4 months whilst the aircrew were separately managed to man four detachments of 3 months. At the time of the accident this de-synchronisation saw the 664 Sqn HQ coming to the end of their 4 month tour having subsumed the Tranche 2 (654 Sqn) aircrew 4 weeks earlier. Therefore, the 664 Sqn HQ had no ability to influence the PDT of Tranche 2 aircrew or develop an intimate knowledge of their individual ability and experience. When finalising the AH crewing, the 664 Sqn HQ had to rely on previous incidental association with Tranche 2 aircrew and advice from 654 Sqn HQ, who had no previous experience of AH operations in theatre or comprehension of AH experience beyond his CTT/CTR course. Furthermore, 664 Sqn HQ implemented a supervisory philosophy based on the performance, experience and ability of the Tranche 1 aircrew with whom they were far more familiar. The 4 Regt chain of command recognised that Tranche 2 were less experienced but 664 Sqn HQ	**Witness 3-1, 4-2, 6-2, 7-1 & 7-2** **Exhibit C**

underestimated their inexperience and capability. As a result one crew were dissolved owing to poor captaincy and collectively Tranche 2 had to be regularly re-briefed on voice procedure and gunnery. In order to mitigate the inexperience and an initial performance poorer than anticipated, the 664 Sqn HQ chain of command introduced informal, ad hoc mitigation (including the removal of the ZJ177 crew from [redacted]). Throughout the Force Generation process CO 4 Regt AAC was deployed as CO JHF(A) and unable to oversee or contribute as he may have wished owing to his geographic dislocation. A critical element of appropriate supervision is an innate understanding of the experience, ability and competency of aircrew under command. In this instance de-synchronisation compromised this well understood guiding principle of aviation supervision.

The Board believes the AH Sqn HQ/Aircrew de-synchronisation, which resulted in the inability to influence PDT, a lack of knowledge of individual aircrew and a supervisory philosophy based on a previous and more capable detachment, was a contributory factor in this accident.

b. **Augmentation.** In order to deliver the FET, 4 Regt required 4 augmentees from 3 Regt and this included the Ac Comd of ZJ177. The provision of these augmentees was confirmed early in 2008 whilst they were deployed with 3 Regt AAC. They returned in May 08 and following POL were subsumed into 654 Sqn but no formal handover covering experience and ability took place. The HP of ZJ177 had a particularly complicated passage in the 6 months prior to deployment, floating between 2 Sqns and 3 OCs, finally ending up in theatre under the command of a 4th OC. Despite being detached to 654 Sqn from Jun 08 he was not included in PDT until the MRX in Jul and received no consistent supervision or planned development. As a result the OC in theatre did not have adequate knowledge of the HP when deciding crew composition and subsequent levels of supervision.

Witness 1-3, 4-2, 5-2, 6-2 & 23

The Board believes that the use of individual augmentees from other Sqns (Regt) without early, formal and detailed handover was a contributory factor in this accident.

4. **Supervision.** The Board considered the following supervisory factors:

a. **Authorisation.** The crew of ZJ177 were correctly authorised for the 24 hour Very High Readiness (VHR) 2 duty in accordance with the JHF(A) Flying Order Book (FOB) by COS JHF(A) Fwd after the 0730L Morning Brief. However, the Authorising Officer was unable to fulfil all of his duties in accordance with JSP 550 – Reg 301, owing to additional demands on his time. The Board noted that the 24 hour period of the authorisation appears to be a retrograde step from previous more experienced detachments which re-authorised crews every 12 hours. It is unclear when the migration to the longer authorisation period occurred. The authorisation that

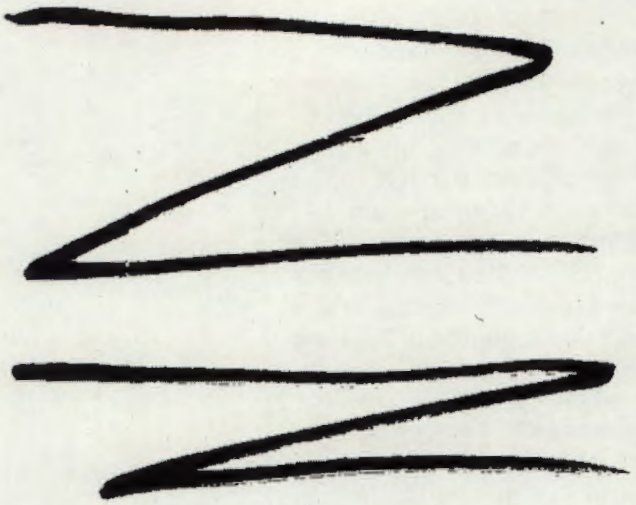
Witness 1-1, 2-1, 3-1, 3-2, 4-1, 6-1, 6-2 & 7-1 Exhibit A & AG

morning brief involved the Authorising Officer, the crew of ZJ177, the CH-47 IRT crew and included an update on intelligence, current ops, MET and included a fatigue level check (which did not note that the crew had only had 7 hrs rest (2130L – 0430L) vice the 8 hours mandated in JSP 550 and the JHC Flying Order Book). The Authorising Officer then stood in for the JHF(A) Fwd Operations Officer (OpsO) and flew as part of the crew for VHR1 and was airborne when the crew of ZJ177 [redacted] and departed to FOB EDI. Comd JHF(A) Fwd specifically briefed the CPG on likely gunnery aspects of the mission, using gun tape footage of a previously unsuccessful engagement of the same HVT. Comd JHF(A) Fwd was unequivocally content that the crew were suitable for the task despite no formal review of their performance [redacted] and believed that once the crew left BSN the Ac Comd was responsible for his own supervision. When the Authorising Officer returned from flying he was informed of the task and although content was clearly unable to influence preparation or confirm the crew's knowledge of the recently developed FOB EDI procedures. Meanwhile the JHF (A) Fwd OpsO was briefing to conduct a famil with Comd JHF (A) Fwd (Des) and flying at the time of the accident. At no stage from authorisation at 0730L to the time of the accident was any formal supervision or review of authorisation implemented by the Authorising Officer or the chain of command in light of the crew's recognised relative inexperience or potential fatigue. The Board believes that the morning brief, authorisation and supervision were disjointed, lacked thoroughness and did not include any discussion on potential short notice tasks or stipulate any review of the authorisation in the event of changes.

The Board accepts that it will not always be possible for the Authorising Officer to be present when VHR missions are launched. The Board concluded that the disjointed supervision and focus on gunnery resulted in the lack of confirmation that the crew fully understood the implications of operating at FOB EDI and subsequent inadequate supervision of the task were contributory factors in this accident.

b. [redacted]

Witness 1-1, 2-1, 3-1, 5-2, 6-2 & 7-2



c. **Single Aircraft Operations.** The Board identified that on Op HERRICK it had become routine for AH to operate as single aircraft to provide a greater level of coverage across Helmand. AH CTR and Op HERRICK PDT is primarily geared to AH pairs operations with the more experienced and able officer fulfilling the role of Flt Comd with the less experienced crew flying as wing. The Board remains concern that sending *ab initio* crews on single aircraft ops immediately after CTR and PDT, where the focus of training has been on pairs, is an unacceptable risk. The Board assessed that as *ab initios* the crew of ZJ177 had not had the relevant training to operate as a single aircraft. Allied with the reduced levels of supervision, the increased cockpit workload and levels of responsibility, the Ac Comd acting as HP, Ac Comd and Flight Comd was well beyond his ability and that of the crew.

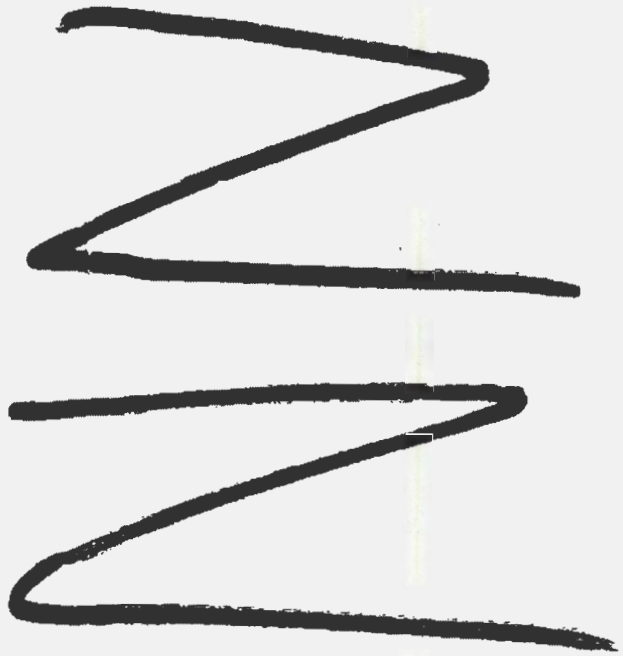
Witness 3-1, 3-2, 6-2 & 25

The Board believes that single aircraft operations and the subsequent reduction in supervision, increase in cockpit workload and responsibility was beyond the training, experience and ability of the crew of ZJ177 and was a contributory factor of this accident.

d. **AH Operating from FOB EDI.** The Board discovered that between 17 – 28 Aug 08 there had been significant deliberation between JHF(A) Main and Fwd over the routine use of FOB EDI in support of deliberate conventional force operations. Comd JHF(A) Main expressed specific concern over the routine use and suitability of FOB EDI owing to the lack of dust suppressant (Durasoil), the limited facilities and inexperience of AH crews. These discussions prompted a recce by the AH Regt QHI who re-assessed the 'compacted mud HLS' as the only suitable area for AH operations (having previously discounted it as an option) and noted that fuel and munitions would have to be taken to the aircraft once on the ground. Once AH operations at FOB EDI were established an HLS diagram was produced and briefed on a number of occasions to available AH aircrew at BSN. The JHF(A) Ops Officer briefed HLS lay out, aircraft parking and approach and departure routes with the AH Regt QHI covering specific handling techniques and associated aircraft performance.

Witness 1-1, 2-1, 3-1, 3-2, 5-2, 7-1, 8 & 25
Exhibit D
Exhibit E

Unfortunately, the crew of ZJ177 were not present at any of the briefs nor exposed to the FOB EDI HLS diagram (Exhibit E) prior to the accident.

e. 

Witness 1-1, 2-1, 3-1, 5-2, 6-2, 7-1 & 25
Exhibit D

f. **Force Generation.** The development of the individual AH crews for Tranche 2 (654 Sqn AAC) was an iterative process initiated in Apr 08 as the FET matured and the 654 Sqn aircrew completed CTR and EQ. OC 654 Sqn (Comd JHF (A) Fwd (Des)), who was personally familiar with the Sqn aircrew, instigated the process whilst keeping Comd JHF(A) Fwd appraised of his deliberations. The four augmentees from 3 Regt AAC, including the HP (Ac Comd) of ZJ177, migrated to 654 Sqn in preparation for the MRX in Jul 08, providing the first opportunity for OC 654 Sqn to assess their professional aviation ability and experience. At this time the HP (Ac Comd) of ZJ177 was considered to be the most able of the augmentees and OC 654 Sqn was entirely content with his performance. The Board believes at no stage were the individual augmentees' Flying Record Folders (FRFs) accessed nor was the chain of command aware of the HP's previous incident in theatre involving the mishandling of an AH at a fuel spot. The MRX also provided the opportunity for the emergent crews to form and fly together, including the crew of ZJ177, informing and consolidating the crewing decisions. Following the MRX the provisional crews were passed to theatre and finalised by the JHF(A) Fwd Command Team (Comd, COS, Ops Officer and AH Regt QHI) who had little/no personal knowledge of the augmentees, were constrained by the seat qualification, command status, experience and ability, and had to rely on occasional reach back to OC 654 Sqn for input. The process paired the strongest and weakest, culminating with the crew of ZJ177, resulting in two individuals of the same rank, similar experience, hours and ability and

Witness 1-1, 2-1, 3-1, 3-2, 4-2, 5-1, 5-2, 6-2, 7-1, 19, 22, 23 &25
Exhibit F

poor CRM gradient. The crewing of Tranche 2 crews was considered in isolation and without input or reference to CO JHF(A) Main. Additionally, the JHC CI (designed to provide JHF COs with a summary of crew experience) was not completed by 654 Sqn or chased by JHC. The Board believes the process of crew selection delivered a poorly constituted crew without the chain of command fully recognising the associated risks.

The Board concluded that the AH crewing (Force Generation) process, culminated in the selection of a poorly constituted crew without suitable mitigation for their recognised inexperience and is considered a contributory factor in this accident.

g. **Detachment Experience.** In the course of this investigation it has become apparent that the chain of command recognised a fall in the levels of experience across the AH Force due largely to the increased number of *ab initio* aircrew and the outflow of experience. 4 Regt AAC recognised the issue and invested considerable time and effort to re-balance the FET, reaching across to 3 Regt AAC for support to mitigate the problem. Upwards of 7 FETs were created to try and deploy the most balanced detachments. The chain of command acknowledged Tranches 2 & 3 represented the least experience, with Tranche 3 being the weakest. On arrival in theatre the JHF(A) Fwd chain of command considered Tranche 2 to be worse than expected, requiring regular guidance and re-briefs and culminating in a crew change. The Board believes that the experience levels in Tranche 2 were even worse than that perceived by the chain of command and represented considerable risk when pairing the crew of ZJ177 without suitable mitigation. To support this view the Board commissioned an objective analysis of Tranches 1 to 4 in order to justify the chain of command's perception and fully investigate actual experience levels in lieu of the JHC CI. The analysis reinforced the general view that Tranches 2 and 3 were the least experienced with Tranche 3 marginally the weakest. However, the purely statistical approach masks key weaknesses in Tranche 2 which the Board believes represented the greatest risk when operating in Afghanistan. For example, comparing Tranches 2 and 3, the former has the least hrs on type by 100 hrs mean (av) per person (314 compared to 407) and half the Op HERRICK experience i.e. few hours on type and limited specific op experience. Finally, the Board believes that the perception of experience when compared with previous AH iterations and other BH forces has eroded to the extent that a 600(+) hr, recently qualified Ac Comd with a single previous op tour and minimal broader avn knowledge is considered experienced. This distorted view of experience had significant impact on the selection of crews and in this case resulted in two *ab initio* pilots of the same rank, similar experience, hours and ability being crewed together without the chain of command appreciating and mitigating the associated risk.

Witness 4-2, 6-2 & 23
Exhibit G

The Board considers that the reduction in AH experience

was not fully understood, was greater than anticipated and **with no formal mitigation implemented was a contributory factor in this accident.**

h. **JHC Command Instruction (CI).** The board has discovered that JHC CI J3/CI/14 (Statement of Deployed Aircrew Qualification) was not completed for either Tranche 1 or 2 AH Aircrew. Completion of this CI would have provided Comds JHF(A) Fwd and Main with a detailed objective assessment of Tranche 2's ability, experience and competency; prompting further assessment of the crewing regime or the introduction of mitigation to limit AH operational activity in line with assessed individual ability. **Witness 3-2, 4-2, 7-2 & 25**

The Board considers the lack of a completed JHC CI for consideration by the chain of command was a contributory factor in this accident.

5. **Training.**

a. **EQ.** At the time of the accident environmental training during Ex CRIMSON EAGLE (Arizona) did not include specific instruction, demonstration or practice of transition techniques to be used when operating from dust suppressed areas with limited power. The crew of ZJ177 therefore had to rely on the advance transition techniques taught on CTT & CTR, and anecdotal experience from other crews leading to a degree of ambiguity when trying to decide on an acceptable technique to be used in the circumstances they faced. The rotate about the nose technique is now taught and demonstrated during environmental training supported by guidance to avoid down wind departures. **Witness 1-1, 1-3, 2-1 & 20**

The Board concluded the lack of formally taught, specific environmental, power limited techniques to be a contributory factor in this accident.

b. **General Handling Competency.** Subjective evidence suggests that throughout AH training, crews are not given sufficient opportunity to consolidate GH techniques. Furthermore, the Board considered there to be a lack of specific direction/supervision on the individual exercises to be practised in order to ensure GH competency across the spectrum of techniques included in the Aircrew Training Manual (ATM). It is a Sqn responsibility to monitor and maintain GH currencies but again the Board believes that it is largely ineffective and much of the GH is not focused on limited power or environmental advanced transition techniques. Specifically for the crew of ZJ177, a review of their log books highlighted a lack of recorded and dedicated GH sorties in the preceding 6 months (therefore conceptually uncurrent). Both crew members stated they were current but that the GH elements were gained in 10 – 15 minute slots grabbed at the end of tactical/weapon sorties focused predominantly on Op HERRICK and not across the spectrum of techniques included in the ATM. Little GH was recorded for either member of the crew after the end of CTT, the only notable exception being the HP's pre-Ac Comd check **Witness 1-3 & 20 Exhibit H, I & T**

remains a concern and when questioned a third time (6 months after the accident) the HP was still unable to accurately state the minimum power margin required prior to commencing a down wind transition. Whilst investigating the lack of tangible GH currency, the review of the crew's FRFs identified missing flying check report forms (HP – 6 monthly on 2 May 08 & AFSSI Form 3 on 17 Jun 08 / CPG – CTR Form 1 & EQ Form 3) and significant discrepancies between hours recorded on check ride forms and individual log books. Had the FRFs and log books been reviewed as part of the crewing for Tranche 2 the chain of command would have been denied valuable information on aircraft handling, experience and competency owing to the lack of accurate recording of GH and missing report forms. The Board also identified a number of issues raised in the Jan 08 AFSSI visit to Wattisham relating to the poor administration of FRFs, training records and log books, and a lack of resource impacting on the opportunity to consolidate GH. There is no evidence of action by the chain of command to rectify the issues and the Board believes this to be a contributory factor in this accident.

The Board concluded that the lack of training focus and consolidation of GH techniques (specifically those directly related to limited power/environmental operations) was a contributory factor in this accident.

c. **Theatre Reception Staging and Onward Integration (RSOI) Briefs.** The Board reviewed the briefs given during RSOI and believed them to be comprehensive and detailed, containing specific direction on take-off and landing including 'Never attempt take-off down wind'. The Board believes that the volume of information passed during an intense period of ground instruction during the very early stages of a tour may have obscured critical elements. Crews were not encouraged to take notes or provided with handouts containing the critical information for reference during the early stages of the tour. However, despite missing the specific FOB EDI deliberate ops brief, the Board believes that the crew of ZJ177 had numerous informal opportunities to assimilate adequate personal experience to ensure safe operations from FOB EDI, although no formal process existed to confirm this assumption. Furthermore, the airmanship and performance details are taught throughout pilot training, pre-deployment training and in-theatre qualifications (APC, CTT, EQ and TQ) and the pitfalls of operating limited power, in re-circulating dust or down wind should have been well known to the crew of ZJ177.

Witness 1-3, 5-2, 7-2, 20 & 21
Exhibit J

The Board concluded that the crew did not assimilate the critical information to never attempt down wind transitions which was a contributory factor in this accident.

OPERATING AND NATURAL RISK

6. **Hostile Action.** The Board considered hostile action as a possible cause of the accident. The site of the accident, whilst located in a relatively benign area within Helmand Province,

Annex E – AIEFSO Report

Nothing within witness interviews or other evidence indicated that hostile action had been a causal factor in the accident. The Board concluded that Hostile Action was <u>not</u> contributory.

7. **Local Area.** The Board considered that the immediate area bounding FOB EDI was inherently hazardous and encapsulated all the issues related to operations from austere FOBs in a desert environment. The terrain on the departure route of ZJ177 (between the compacted mud HLS and the crash site) presented a number of physical obstacles. The compacted mud HLS is immediately bounded by a number of mounds of loose soil, stones and dust approx 0.5m high. There is an area of flat ground to the north of the compacted mud HLS crossed left to right by minor, dusty tracks before a man made berm (approx 1m high) that runs around the perimeter of the FOB. The berm is broken close to the compacted mud HLS to provide the main FOB entry/exit point (approx 15m wide). Beyond this there is an area of flat ground that falls away into a crater (up to 1.5m deep at its lowest point). Both the crater and flat area are covered by approx 6" of fine dust. There are also a number of mounds of dust on what is otherwise a large, open and flat expanse of desert. The JHF(A) chain of command acknowledged the requirement to scrutinise the use of austere FOBs (specifically DWYER, ROBINSON and EDI) in preparation for deliberate operations, aware of the increased risk caused by the natural hazards in comparison with routine operations from prepared surfaces (HALS/runway) at Main Operating Bases. There are a number of fixed and mobile obstacles in and around FOB EDI. The obstacles influence available departure options and the selection of suitable transition techniques. The variable nature of the some of these hazards requires crews to regularly reassess their departure route and technique. The Board considered the following local area hazards:

Witness 1-1 & 2-1
Annex D – Photographs
Annex E – AIEFSO Report
Exhibit D, K & L

a. **Fixed.** The fixed obstacles around FOB EDI are those that cannot reasonably be moved. The Board identified 3 main fixed obstacles; the dust on the manmade tracks, the berm surrounding the FOB and the Hesco Bastion.

(1) **Dust.** The surface area in the immediate vicinity of FOB EDI is very fine and powdery (similar to talcum powder). The Board walked the approximate route from the departure point to the crash site. The dust became progressively deeper beyond the berm, likely to cause significant, heavy re-circulation and brown out. The crew of ZJ177 encountered the dust and having lost all visual references became disorientated and crashed. The Board believes the dust to have been a major causal factor.

(2) **Manmade Tracks.** There are a number of tracks immediately surrounding the compacted mud HLS which culminate at the main entry/exit point to FOB EDI (approx 50m from the edge of the HLS). The tracks have been created by the movement of large, heavy military vehicles (wheeled and tracked), resulting in a large

quantity of fine dust (similar to talcum powder) to a depth of approx 5". The tracks significantly increase the volume of dust and their proximity to the HLS radically increase the likelihood of encountering heavy recirculation immediately on leaving the compacted mud HLS. The Board believes that the proximity of the tracks to the HLS is a significant contributory factor to the cause of this accident.

(3) **Hesco Bastion Walls.** The FOB is enclosed by a 3m high Hesco Bastion wall. The northern wall of the FOB is approximately 50m to the south of the compacted mud HLS. The Board believes that the Hecso walls were neither a causal nor contributory factor but the location and proximity to the compacted mud HLS reduces the options available, preventing transitions directly into the prevailing wind and complicates the decision process to select an appropriate departure route and technique.

b. **Mobile.** FOB EDI is a home to an Armoured Coy, GMLRS Bty and a major administrative node for the 'Northern' BG and consequently is extremely busy with a wide variety of mobile obstructions. At the time of the accident there were 4 SH parked on their designated spots to the west of the compacted mud HLS, 2 SH had recently departed from the fuel spots to the SW, GMLRS and Warrior AFVs parked to the east and numerous personnel moving throughout the location. Although not a causal nor a contributory factor the Board believes these mobile obstructions complicated the decision making process, influenced the final route selection and distracted the crew.

The Board concluded that the large volume of dust in the immediate vicinity of the compacted mud HLS was a significant causal factor in this accident. Additionally, the proximity of both fixed and mobile obstructions complicated the decision process and distracted the crew.

8. **Aircraft Performance.** AH performance does not constrain operations at MOBs where runways or HALS are available and crews can conduct a running take off or landing. However, performance does become a significant constraint when operating from austere FOBs on dusty, semi-prepared surfaces that preclude running take offs. In a desert environment aircrew are taught a vertical outside ground effect (VOGE) technique to depart from an HLS which requires a 5% thrust margin (TM) [redacted] When mission configured OGE performance is not available, operating at FOB EDI necessitates the use of limited power techniques not formally recognised or taught during EQ. After an initial recce by the RHQI it was recommended that crews adopted an in to wind cushion creep technique, using the maximum available distance on the compacted mud HLS, maximum power to accelerate in order to reach sufficient speed and translational lift to avoid brown out on reaching the edge of the HLS. This was underpinned by the recommendation of a minimum inside ground effect (IGE) power margin (PM) of 5%. The technique and performance requirements were briefed to the AH

Witness 1-1, 2-1, 5-1, 5-2 & 20
Annex A – Particulars
Exhibit M

[redacted] for deliberate operations at FOB EDI. At the time of the crash the aircraft weighed approx 18,770lbs (standard weapon load + additiona[redacted]HELLFIRE missiles and approx 2830lbs fuel). The performance page displayed the IGE power required as 92% (93%) representing an 8% (7%) PM. For a variety of reasons the crew ended up conducting a transition down wind without the mandated 10% IGE PM. The Board has assessed that the only viable technique to enable a safe departure to the north whilst down wind would have been a VOGE which requires a minimum performance of 5%(+) OGE TM (unachievable with the aircraft configuration at the time).

The Board concluded that the performance of the aircraft was a causal factor in this accident but only because of the type and direction of the technique conducted.

9. **Meteorological Conditions.** At the time of the accident the weather at BSN was recorded as 240º magnetic at 6kts, CAVOK, +35º C. The exact direction and strength of the wind at FOB EDI was not recorded but witness statements and the EVADR data from the aircraft provided a range of estimates between 165º - 240º magnetic and 6 – 15 (G20) kts. The weather was entirely normal, within limits and regularly encountered by the crew of ZJ177.

Witness 4-1, 7-1, 11, 12 & 13
Annex E – AIEFSO Report
Exhibit L, N & O

The Board concluded that the meteorological conditions were entirely normal and not a causal or contributory factor in this accident. However, by transitioning downwind the direction and strength of the wind exacerbated the limited performance of the aircraft and increased the duration and intensity of brown out.

TECHNICAL FAILURE

10. The Board considered technical failure as a possible cause or contributory factor to the accident. The technical and site investigation by AIEFSO have shown there to be nothing to indicate that a technical fault or failure contributed to the crash of ZJ177.

Annex E – AIEFSO Report

The Board concluded that nothing within witness interviews, other evidence or the technical investigation indicated that a technical failure had been a causal factor in the accident. The Board concluded that Technical Failure was <u>not</u> contributory.

HUMAN FACTORS (AIRCREW)

11. In assessing the impact of Human Factors (Aircrew) as either causal or contributory factors the Board considered each of the following in detail:

a. Situational Awareness (SA).

b. Spatial Disorientation.

c. Crew Experience.

d. Departure Technique.

e. Individual Performance.

f. Fatigue / Arousal Levels.

g. Focus.

h. Medical Fitness.

12. **Situational Awareness (SA).** The Board considered the following factors and their impact on the crew's situational awareness:

a. **Perceived Space Available.** The crew of ZJ177's perception of physical obstacles and inadequate space [redacted] led them to choose the final direction of departure and discount all other options. The Board has established that it was an accepted norm for AH to transition into wind to the west between SH parked on dedicated spots and the inner wall of the FOB. The crew had not been present at the FOB EDI brief and previous experience of operations at EDI had not involved other parked aircraft on the spots to the west of the compacted mud HLS, leading them to discard it as an option due to the proximity of the SH and passengers. The inner Hesco wall of the FOB presented a barrier to the south and the crew considered the route to the east inappropriate (implied by the HP on the CVR) due to the presence of ground vehicles (GMLRS & Warrior AFVs). Facing an unfamiliar situation the inexperience of the crew led them to elect a northerly departure, down wind and over an area of heavy re-circulating dust rather than waiting for the SH to depart to allow them to use their usual departure route. A review of the HP's flying training records highlighted an aversion to operating in close proximity to other aircraft which influenced his decision to dismiss the route as a departure option, not a common perception amongst other aircrew. The Board believes this mis-perception to be a contributory factor in the crash of ZJ177.

Witness 1-1, 1-3, 2-1 & 7-2
Annex G – HF Report
Exhibit E, N & P

b. **Wind.** As already discussed above the strength and direction of the wind was not recorded at the time of the accident and estimates vary between 165º - 240º magnetic and 6 – 15 (G20) kts. [redacted] clearly depicts the dust cloud from both ZJ177 and the camera aircraft moving to the NE and wind strength in excess of 10 kts. The crew perception of the wind was south westerly less than 5 kts (as briefed at BSN that morning), despite the indications in the cockpit and other multiple cues (eg dust from other aircraft, flag on inner FOB wall, dust from vehicles). At interview the crew of ZJ177 believed they were departing crosswind, despite verbalising the intent to transition down wind on the CVR. The Board concluded that the crew departed with a significant down wind component and this when allied to the performance of the aircraft and the environmental conditions the exacerbated the situation and was a contributory factor in the crash.

Witness 1-1, 1-3, 4-1, 7-1, 11, 12 & 13
Annex E – AIEFSO Report
Exhibit L, N & O

c. **Route Selection / Mental Model.** The crew of ZJ177 did not attend the brief on operating from FOB EDI, which

Witness 1-1, 2-1, 7-2
Annex G – HF Report

included details on performance, routes in and out, refuelling, parking, obstacles, comms and aids to landing [redacted]. However, despite not attending the brief the crew had flown into FOB EDI during their TQ famil sortie, were briefed on the layout and facilities during the RSOI package and had operated from EDI on 31 Aug 08 conducting 4 landings onto the compacted mud HLS in light recirculation, never losing reference to the horizon at any stage. On the day of the accident the crew also spent a considerable period of time on the ground in the vicinity of the compacted mud HLS and would have been exposed to the multiple cues of dust and wind. As a result the Board believes the crew should have had sufficient opportunity to develop a detailed working knowledge of the FOB and should have been aware of the environmental and physical obstacles associated with the location. However, from the evidence on the CVR and through subsequent questioning the Board has established that the crew were not fully aware of the performance issues and risks associated with operating from FOB EDI. When faced with an unfamiliar and complex scenario the crew perceived that only a northerly departure direction was available and failed to fully appreciate the dangers and performance limitations. It appears that at no stage did the crew formally consider the wind, transition technique, associated performance or route. The Board believes that had they done so, the crew should have discounted the chosen route due to the likelihood of heavy re-circulating dust, down wind component and associated power limitations. The inappropriate route selection is deemed a causal factor in this accident.

Exhibit A, E & P

The Board concluded that the crew of ZJ177 lacked suitable situational awareness caused by the mis-interpretation and perception of the obstacles, the wind and the associated additional performance requirements. This led to the inappropriate route selection and is a causal factor in the crash.

13. **Spatial Disorientation (SD).** The Board believes that as soon as the crew left the relative safety of the compacted mud HLS, re-circulating dust engulfed the aircraft and the crew suffered varying levels of disorientation. The HP suffered Type 1 Disorientation (unrecognised disorientation). The CPG suffered Type 2 Disorientation (recognised) and called heights, Tq and provided prompts to the HP. The Board believes that the CPG would not have considered taking control owing to his lack of experience. There was no evidence on the CVR that the crew conducted an internal brief on the departure, potential hazards or emergency procedures and as a result were not expecting to encounter total brown out and were not prepared to react accordingly.

Annex F – Avn Med Report
Annex G – HF Report
Exhibit N

<u>The Board concluded spatial disorientation to be the major causal factor in the crash</u>.

14. **Crew Experience.** (as at time of accident)

Exhibit A, H, I, Q & R

HP

- *Ab initio* (first flying tour)

- Total Hrs 688:29 hrs (from log book – disagrees with Form 3s)
- Hrs on type 422:29 hrs
- Simulator hrs 139:10 hrs
- Hrs in Comd 117:20 hrs
- Awarded LCR Jun 07
- Hrs on previous op tour approx 140 hrs
- Hrs on current op tour 51:50 hrs
- Non-op/CTT/CTR AH hrs approx 100 hrs (development/experience)
- Previous op tour Feb – mid May (rwy/HALS only)

CPG

- *Ab initio* (first flying tour)
- Total Hrs 618:23
- Hrs on type 257:58 hrs
- Simulator hrs 160:55 hrs
- Hrs in Comd 42:40 hrs (25 hrs pre-service)
- Awarded LCR Mar 08
- Non-military flying approx 148 hrs
- Hrs on current op tour 50:50 hrs
- Non-op/CTT/CTR AH hrs approx 51 hrs (development/experience)

The Board considered it necessary to assess the crew experience of ZJ177 and analysis of the figures above shows the relative inexperience of both the HP & CPG (both *ab intio*). The HP is only 14 months out of training (qualified LCR), qualified as an Ac Comd in Dec 07 but not used in that role during his first deployment (a winter tour) and whilst flying as a Rear Seat HP did not operate from austere FOBs. Outside training and his first op tour he only flew 100 hrs consolidation (after the end of CTR) which were primarily operationally focused (sights, sensors & weapons not GH). He was a very inexperienced Ac Comd at the time of the accident and his general avn experience lacked breadth and depth. The CPG qualified in Mar 08 and only flew 50 hrs consolidation which was largely Op HERRICK focused. The Board assessed that individually and collectively they [redacted] The lack of experience contributed to the crew of ZJ177 failing to maintain a satisfactory level of professionalism and allow themselves to 'switch off' for what was a simple transit back to BSN and meant that the crew failed to assimilate/appreciate the risks associated with a limited power transition.

Witness 1-3

a. **CRM / Cockpit Gradient.** The Board considered the CRM cockpit gradient between the crew to be flat. Both individuals had a similar number of total flying hours at the time of the crash and although they were not direct peers they were on consecutive CTT courses, both relatively inexperienced (in their first flying tour) and both the same rank (junior Capts). Evidence gleaned from the CVR and HP/CPG witness statements suggested that the CRM gradient had developed into a 'respectful collaborate dynamic' (HF(A) report)

Witness 4-2, 5-2 & 6-2
Annex G – HF Report
Exhibit N & P

(democracy) and resulted in a significant lack of professionalism as highlighted by the failure to conduct all mandated checks, no weapon ops checks, no discussion of departure route or selection and inappropriate radio call during the reorganisation of the SH passengers. The Board considers the lack of a cockpit CRM gradient to be a contributory factor in the crash.

b. **Verbal Communication (Checks & Crew Brief).** There is clear evidence of the lack of communication between the HP and CPG. The short period prior to the crash was one of high workload as the crew started the aircraft and prepared for departure. Despite the workload there was a significant amount of non-flying related conversation and most notably little verbalisation of the mandated challenge and response checks in accordance with the Flight Reference Cards (FRCs), no post take off checks, no formal assessment of the departure heading, route selection or performance considerations and no consideration of potential emergencies between the crew. At no stage did either member of the crew raise any concerns about the departure route. The HP initiated the lift to the hover without verbalising his intentions and without the knowledge of the CPG who queried the HP's intentions. Though the HP claims to have done the mandated checks in his head, the Board believes many of the post take off checks could not be completed fully or accurately in the time between lifting and departure and more broadly, were not completed due to the level of fatigue, arousal and distraction. The Board considers the lack of verbal communication to be a contributory factor in the crash.

Exhibit N & P

c. **Use of Symbology.** The Board believes that the relative inexperience, work load and arousal level of the HP caused him to initiate the transition visually (at no stage did the HP register or correct the aircraft drift, attitude or height without prompts from the CPG) and on encountering brown out prevented an immediate reversion to symbology to attempt a recovery. At the time of the crash there was no formal direction on environmental techniques in the ATM and specifically no direction to revert to symbology and to pull to maximum available power in the event of brown out in an attempt to avoid an accident. The Board believes this to be a major contributory factor in the accident.

Annex F – Avn Med Report
Annex G – HF Report
Exhibit N

d. **No SD Sortie.** Neither member of the crew of ZJ177 had conducted the mandated Spatial Disorientation sortie during the APC or subsequent training. The Board believes this to have been a minor contributory factor in the crash.

Exhibit H & I

e. **Complacency.** The Board believes that there are a number of verbal cues that indicate a significant level of complacency in the cockpit of ZJ177. Though the Board accepts 'banter' within the cockpit, it should not interfere with mandated checks. The crew failed to articulate pre and post take off checks in accordance with the FRCs, failed to brief the departure technique, route or associated performance criteria and as a result were poorly placed at the time of the accident.

Annex F – Avn Med Report
Exhibit P

The Board has articulated elsewhere the impact of fatigue, arousal levels and a poor CRM gradient but believes that inexperience allowed the crew to become complacent which became a contributory factor in the crash.

f. **Traits.** Error rate profiles highlight weak traits for both members of the crew. The HP had a recurring problem with 'visualisation' throughout training which was not addressed or recognised. There is no evidence that individual training plans exist for either member of the crew to address weaker traits identified during training. The Board believes that the HP's visualisation problem may have contributed to his spatial disorientation and poor route selection. The CPG has ongoing CRM problems (crew co-op) which the Board believes is a contributory factor in the accident.

Annex G – HF Report
Exhibit Q & R

The Board concluded that the lack of individual and collective experience within the crew of ZJ177 was a major contributory factor in the cause of the accident.

15. **Departure Technique.** The Board believes the crew of ZJ177 attempted an inappropriate transition down wind having failed to fully appreciate the dangers of the environment (dust and wind) or the lack of aircraft performance. The crew were trained to select and conduct appropriate transition techniques dependent on the operating environment with due consideration of the airmanship and handling aspects, including downwind departures. These techniques are taught during Basic and Advanced Rotary, during the AH CTT and fully articulated in the AH ATM. The Board believes that the crew understood that they were downwind but then did not consider the requirement for a 10% PM as mandated in the ATM and taught throughout the APC. Had the crew fully considered the departure technique they should have disregarded the northerly option.

Exhibit M

The Board concluded that the crew selected an inappropriate departure route and technique which was a major causal factor in this accident.

16. **Individual Performance.** The Board believes that the procedures and techniques for downwind departures should be well understood. The assessment of risk associated with more complex situations caused by environmental conditions and limited power relies heavily on experience. As already discussed the crew of ZJ177 were 'inexperienced', did not recognise their state of low arousal or fatigue, allowed themselves to be distracted (visitors, photos, aircraft movements, dinner, COS presentation), which resulted in a poor performance. Owing to the established respectful collaborate dynamic the Board believes that neither member of the crew confronted the poor or inappropriate decisions made prior to departure and the 'democracy' that had developed, was not beneficial or a good dynamic.

Annex F – Avn Med Report
Annex G – HF Report
Exhibit P

The Board concluded that poor individual performance was a major causal factor in the crash.

17. **Fatigue / Arousal Levels.** The Board identified a number of verbal clues that when allied to the lack of pre-take off and post take

Annex F – Avn Med Report

are a good barometer of the low level of arousal and considerable fatigue. The crew failed to conduct the mandated challenge and response pre-take off checks in accorndance with the FRCs and HP elected not to verbalise either a departure brief or the post take off checks. The crew did verbalise their intent to "[redacted]". The Board also noted that the HP verbalised a confused statement relating aircraft performance to the outside air temperature ("the performance has dropped a bit as well cause the temperature has ramped off a lot"), which was not countered by the CPG, also highlighting the low level of arousal in the cockpit. The Board believes that the CVR and lack of verbal checks are an indication of the level of arousal. The Board considered the following causal factors impacting on the crew's arousal and fatigue:

Annex G – HF Report
Exhibit P

a. **Working Hours.** The crew were initially woken at 0430L for the first VHR sortie of the day, breaking their circadian rhythm. They subsequently received [redacted] at around midday. The mission launched during the afternoon but was aborted and finally stood down at 1830 hrs; the accident occurred shortly afterwards at the end of a 14hr day. The Board believes this would have caused significant levels of fatigue that may not have been apparent to the crew and was not considered by either the Authoriser or the supervisory chain of command. The long day and an early start undoubtedly caused considerable fatigue which the Board believes was a significant causal factor in the poor performance of the crew immediately prior to the accident.

Witness 1-1 & 2-1

b. **Rest.** During a long working day (0430L – 1830L) of continuous activity the opportunity for effective rest was limited by the lack of facilities (shade) and the environmental conditions (38ºC) the Board believes compounded the level of fatigue immediately prior to the accident.

Witness 1-1 & 2-1
Exhibit O

c. **Cumulative fatigue.** AH crews operate a 12 day cycle (broken down into 3 day elements of air test, duty ops, delib ops and VHR) which does not include a stand down recovery period. The Board believes this increases the risk of cumulative fatigue developing after protracted periods in theatre, particularly with no compulsory rest day built into the tasking regime. However, the crew of ZJ177 had only been deployed in theatre for 4 weeks and the Board has no concrete evidence to indicate cumulative fatigue was a factor in this accident.

d. **Hunger.** Though the crew have stated that they do not recall being hungry they do discuss getting back in time for supper and to "[redacted]". Lunch had been provided between 1300 – 1400L along with liquid refreshment but it was approx 4 - 5.5 hrs before the accident. The Board believes that though the crew may not have been consciously hungry, their level of fatigue will have been affected by the lack of food or drink and exacerbated by the local environmental conditions.

Witness 1-1 & 2-1
Annex F – Avn Med Report

The Board concluded that a number of elements contributed to

the crew's fatigue and low level of arousal which were significant contributory factors in the poor professional performance of the crew and a contributory factor in this accident.

18. **Focus.** The Board believes that the crew were unconsciously distracted by external influences that impaired their decision making process and professional performance: — **Annex G – HF Report**

a. **Camera.** During the post start checks there were several references to the use of a camera (" [redacted] ?", [redacted] "). Both crew members were clearly distracted by something external to the aircraft (" [redacted] "), which the Board believes to have been a departing CH-47. The Board believes that the discussion about the use of a camera and the external activity were distractions during a critical period of pre-flight checks. — **Exhibit P**

b. **Comms.** During the start sequence prior to departure, the CPG selected the BLOS comms in order to make a satellite phone call to his girlfriend but did not return the switch to the FM2 selection (common air to ground), rendering FM 2 inoperative. As a result the Board believes the crew became engrossed in the requirement to conduct a blind call prior to departure, distracting them and absorbing a large element of focus at a critical juncture. — **Witness 2-1** **Exhibit P**

c. **Visitors.** During the afternoon at FOB EDI the crew received a number of visitors wanting to view ZJ177 (including Ross Kemp, [redacted] and Medics). Whilst not a distraction at the time of the accident the Board believes it was a contributory factor to the overall focus of the crew. — **Witness 1-1 & 2-1**

d. **Disappointment.** Prior to the operation at FOB EDI the crew had not been involved in enemy engagements and believed the duty would provide a suitable opportunity. When the day passed without incident it is evident the crew of ZJ177 were disappointed (" [redacted] "). The Board believes the disappointment contributed to a lack of focus during the start and preparation for departure. — **Witness 1-1 & 2-1** **Exhibit P**

e. **Evening meal.** Although neither member of crew remembers being hungry at the time of departure it had been approx 5 hours since their last meal and conversation in the cockpit alludes to getting back to BSN to avoid missing evening meal (" [redacted] "). The Board believes that hunger blurred the focus and added a perceived pressure to expedite their departure. — **Witness 1-1 & 2-1** **Exhibit P**

f. **COS presentation.** The HP was distracted by work he had been asked to produce for the JHF(A) Fwd COS. During the aircraft start and pre-take off checks he suddenly remembered the work was not complete and discussed the issue with the CPG (' [redacted] — **Witness 1-1 & 2-1** **Exhibit P**

today), adding to the distraction from the job at hand.

The Board concluded the combination of the distractions listed above contributed to a significant lack of focus immediately prior to departure and was a contributory factor in this accident.

19. **Medical Fitness.** Both aircrew held current aircrew medicals (CPG currency not recorded in his log book) and were fit for duty. However, the heat, lack of shade, long day, early start, distractions, no food for over 4 hrs and false starts led to high levels of fatigue and a low state of arousal which was a major contributory factor in the crash. **Annex F** – Avn Med Report

The Board concluded that though medically fit the crew were poorly placed to conduct an unusual and complex departure due to fatigue and low arousal.

SUMMARY

20. In the course of this investigation the Board has identified a number of factors that directly contributed to the crash of ZJ177. The accident occurred in a highly complex and dynamic operational theatre against a backdrop of an AH Force in a continual state of flux and not at steady state or full maturity. The Board identified the following causal factors:

a. Type 1 Spatial Disorientation experienced by the HP.

b. The crew selected an inappropriate departure route and did not conduct the correct transition technique.

c. The large volume of dust in the immediate vicinity of the compacted mud HLS complicated by the proximity of both fixed and mobile obstructions.

d. Lack of situational awareness caused by the mis-interpretation and perception of the obstacles, the wind and the associated additional performance requirements.

e. The performance of the aircraft but only because of the type and direction of the technique conducted.

f. Poor individual performance.

21. The Board also identified a significant number of contributory factors that formed part of the chain of events leading up to the accident:

a. AH Sqn HQ & Aircrew de-synchronisation resulted in the inability of the chain of command to influence PDT, a lack of knowledge of individual aircrew and a supervisory philosophy based on a previous and more capable detachment.

b. The use of individual augmentees from other Sqns (Regt) without early, formal and detailed handover.

c. The disjointed supervision and focus on gunnery resulted

implications of operating at FOB EDI and subsequent inadequate supervision of the task.

d. [redacted]

e. Single aircraft operations and the subsequent reduction in supervision, increase in cockpit workload and responsibility was beyond the training, experience and ability of the crew of ZJ177.

f. The AH crewing (Force Generation) process, culminated in the selection of a poorly constituted crew without suitable mitigation for their recognised inexperience.

g. The reduction in experience between Tranches 1 & 2 was not fully understood, was greater than anticipated and no formal mitigation was implemented.

h. The lack of a completed JHC CI for consideration by the chain of command.

i. The lack of formally taught, specific environmental, power limited techniques.

j. The lack of training focus and consolidation of GH techniques (specifically those directly related to limited power/environmental operations).

k. The crew did not assimilate the critical information to never attempt down wind transitions.

l. The lack of individual and collective experience within the crew of ZJ177.

m. A number of elements contributed to the crew's fatigue and low level of arousal underpinning a poor professional performance.

n. A combination of distractions contributed to a significant lack of focus.

22. In summary, it is clear to the Board that this accident was caused by the disorientation of the HP when conducting a poorly executed transition downwind, with inadequate aircraft performance and engulfed in heavy recirculation. The Board believes that the crew lacked sufficient experience for the complex, high end, unsupervised operation, had become fatigued and were distracted at a critical juncture.

23. The Board recognises there were a number of systemic issues that significantly increased the likelihood of this accident, stretching as far back as the crew's training, the original force generation of the FET and culminating with the disjointed authorisation and supervision of a poorly constituted crew on the day of the accident.

The Board considers these organisational factors to be mitigating circumstances beyond the control of the crew of ZJ177.

PART 5

FINDINGS OF THE BOARD OF INQUIRY	SUPPORTING DOCUMENTATION
1. **Cause or causes of the accident.**	
a. The evidence indicates the HP (Ac Comd) elected to conduct a transition down wind with insufficient power and without due consideration of the nature of the departure route. The Board consider that crew inexperience led to the inappropriate selection and conduct of the transition which resulted in the HP becoming disorientated in heavy re-circulation and allowing the aircraft to impact the ground.	**Exhibit P**
b. The Board acknowledges that 'operating and natural hazards' (close proximity of a GMLRS vehicle, the accommodation area of the FOB, other aircraft and pax) limited the crew's perception of available departure options. However, compounded by a number of HFs (Aircrew) (fatigue, distraction, low arousal and complacency) the crew failed to perform the required checks, brief a departure plan or actions in the event of an emergency. A poor CRM gradient, allied with a lack of experience, fatigue and low arousal underpinned the failure to recognise the dangers of departing down wind (power limited) through heavy recirculation and contributed to the lack of discussion or action to prevent what the Board considered to be an irrecoverable situation for this particular crew. Neither member of the crew had completed a spatial disorientation sortie and the HP had little opportunity to consolidate GH techniques after the completion of CTR (focus on weapons, sights & sensors) all of which the Board believe contributed to the crash.	**Witness 1-1, 2-1, 4-2, 5-2 & 6-2** **Exhibit P**
c. The accident occurred in a highly complex and dynamic operational theatre against a backdrop of an AH Force in a continual state of flux and not fully mature. The Board acknowledges that there were a number of systemic, organisational and chain of command factors that exposed an inexperienced crew to unnecessary risk. As far back as the construction of the FET there was recognition that Tranches 2 – 4 were significantly less experienced than previous AH detachments, diluted by the increase in *ab initio* aircrew and an outflow of experienced AH crews. However, the potential risks were not formally highlighted to the chain of command and the final crewing decisions left to a separate Sqn HQ with little/no intimate knowledge of the incoming aircrew. On the day of the accident the crew operated as a single aircraft, [redacted] and focused entirely on the weapon aspects of the sortie. Despite the complexities of the 'high end' task and utilising a high risk crew, the mission was not supervised once ZJ177 departed BSN;.	**Witness 3-1, 4-2, 5-2, 6-2 & 25** **Exhibit G**
2. **Degree of injury.** The extent of injury sustained is as follows:	
a. [redacted]	**Annex F** – Avn Med

[redacted]

Report
Exhibit AD

b. [redacted]

Annex F – Avn Med Report
Exhibit AD

3. **Personnel on duty.** The Board found both [redacted] and [redacted] were on duty at the time of the accident. | **Exhibit A**

4. **Compliance of relevant orders and instructions.** The Board established a number of areas where the crew failed to follow relevant orders or instructions:

a. **Aircrew Training Manual (ATM).** The ATM clearly articulates the technique to be employed for a down wind transition and states that is must not be attempted when power limited and requires a mandatory 10% power margin (PM) when established in the down wind hover. Had the crew of ZJ177 complied with the ATM they would not have committed to a transition down wind and the accident may have been avoided. | **Exhibit M**

b. **Flight Reference Cards (FRCs).** The crew failed to conduct the mandated challenge and response pre-take-off checks in accordance with the FRCs. The CPG questioned the HP on the requirement to conduct other weapons operational pre-flight checks but allowed himself to be overruled and did not take issue with the failure to satisfactorily conduct the mandated checks. Had they conducted the checks in a more diligent and thorough manner, as dictated by the FRCs, the crew of ZJ177 would have conducted a more thorough analysis of aircraft performance, achievable departure techniques and the accident may have been avoided. | **Exhibit AB**

c. **RSOI/TQ briefs.** The crew of ZJ177 were subject to a detailed and thorough aircraft operating brief from the RQHI which included a slide on take off and landings stipulating 'never attempt take-off down wind'. The crew of ZJ177 attended the brief approximately 1 month before the accident; however, neither member of the crew could recollect the instruction and do not remember taking notes at the time of the briefings. Had the crew complied with this explicit instruction the accident may have been avoided. | **Witness 5-1, 5-2 & 7-2**
Exhibit J

d. **JHC FOB.** The crew did not get the 8 hours rest mandated in the JHC FOB (went into rest at 2130L and were aroused at 0430L). | **Exhibit AC**

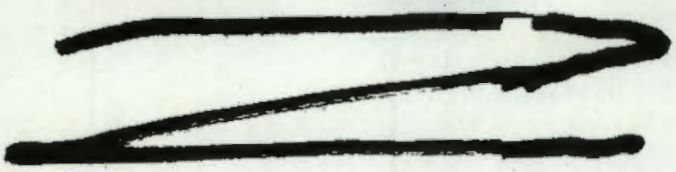
e. **JSP 550 Reg 301 – Duties of an Authoriser.** The Authorising Officer on the day of the accident did not fully comply with the duties laid down in JSP 550, particularly failing to ensure adequate supervision. f. **JHC CI/J7/14.** 4 Regt AAC failed to provide CO JHF(A) with the mandated crew experience information as per JHC CI/J7/14.	**Exhibit AG**
5. **Extent of damage to aircraft.** The aircraft is believed to have impacted the ground at low G, resulting in the aircraft being categorised as CAT 4 (PROV) - beyond economic repair, in accordance with Joint Air Publication 100A-01, Military Aviation Engineering Policy and Regulation, Chapter 9.13.1, Assessment, Categorisation and Repair of Aircraft and Aircraft Structural Components. It is clear that there was considerable confusion between AIEFSO, JHC and JHF(A) during PCM which led to issues with the recovery of the aircraft, preservation of evidence and associated legal ramifications.	**Annex E** – AIEFSO Report **Annex I** – Recovery Reports
6. **Extent of damage to removable role equipment.** Much of the role equipment appears to have sustained only minor damage and is considered salvageable at this stage.	**Annex E** – AIEFSO Report
7. **Extent of damage to property.** Due to the location of the crash, the Board found no damage to either Service or Civilian property other than the aircraft.	
8. **Crash survival.** The cockpit area of the aircraft was entirely intact and both crew members of ZJ177 were able to walk away from the crash with only very minor injuries. In this instance the Board consider the aircraft to be crashworthy although it must be made clear that the accident occurred from low height (approx 10'), at low speed (10kts) and resulted in a low G impact.	**Annex E** – AIEFSO Report

RECOMMENDATIONS OF THE BOARD OF INQUIRY	SUPPORTING DOCUMENTATION
1. **AH Health Check**. During the conduct of this investigation the Board has identified distinct similarities with other platform issues. It is recommended that a JHC coordinated review utilises organisations already in existence to conduct an AH Force Health Check to establish if any of the following recommendations have already been set in train. It is recommended that the TORs, coordination and oversight are delegated to a senior member of JHC and cover the following areas:	**Part 4**
a. **Force Structure.** Empower the AH Force HQ (J1-9) (Wattisham Stn HQ) with greater capacity to enable greater emphasis on J3, 5 & 7. Review the employment of current Sqn structures to focus on the delivery of coherent AH detachments for HERRICK until AH reaches steady state.	**Part 4, Para 3, Sect b & Para 4 Sect f**
b. **Training** (CTT, CTR, EQ, PDT, TQ, (SIM)). It is recommended that with the continued development of AH employment in theatre, CTT, CTR, EQ, PDT and TQ (inc ground school & SIM) are reviewed to provide greater opportunity to consolidate GH techniques (ltd power, environmental & advanced transitions), deliver broader avn experience and attain competency rather than simply currency. The output must focus on continuity, consolidation, development (individually focused for roles eg Flt Comd, Msn Comd), greater dynamic evolution in line with op tasking, quantify and acknowledge broader avn experience deficits and include a post tour 'reset'/'back to basics'. Development must be Force-wide and reflected in a formal training directive for trained AH crews. Lastly, if AH continues to be employed on single aircraft ops, CTR must be amended to reflect the required output.	**Part 4, Para 5**
c. **Experience**. Recognition of the dilution of experience and articulation of minimum requirements for specified tasks/roles. Anecdotally, AH experience is being eroded by increased numbers of *ab initio* aircrew. Current 'Experience' is HERRICK focused, relatively narrow and not fully understood. It is recommended that JHC confirm and recognise the dilution in AH experience caused by the increased numbers of *ab initio* aircrew and take steps to mitigate against the associated risks (particularly in op theatres) by developing a formal experience metric against which to force generate detachments. Whilst this cannot replace the requirement for detailed knowledge of crews it will inform the force generation and crew constitution process, providing basic information for scrutiny in theatre. All detachments should be mandated to compile a risk table highlighting individual weaknesses & strengths to underpin mitigation.	**Part 4, Para 3, Sect b & Para 4, Sect g**
d. **Training Documentation**. Re-evaluate the contents and	**Part 4, Para 4, Sect f & g,**

format of FRFs to better provide value to the chain of command when force generating detachments. Bland reports fail to highlight areas for development or inform continuation/consolidation training (box ticking). Additionally, the management of FRFs must to be reviewed to ensure the timely completion and administration of reports. Consider a standardised Tri-Service FRF and report format to improve chain of command interpretation ability, training and experience and implementation of suitable supervision. It is also recommended that individual training development plans are produced for all aircrew to address areas of weakness and Training Record Folders (TRFs) are mandated to be held at sqn level and include post sortie reports as a matter of course.	Para 5, Sect b
e. **Incident Records.** Greater use of Form 5s to capture details of previous incidents and better inform Force Generation. It is also recommended that human factors related incident signals are included in either FRFs or TRFs.	**Part 4, Para 4, Sect f**
f. **Supervision**. Formalise the roles & responsibilities of the supervisory chain of command on ops and re-educate supervisors. Supervisors must be dedicated, focused, empowered (mitigation) and accountable.	**Part 4, Para 4**
g. **Operational risk management**. Formal balancing (constraining) of operational capability against experience, ability and training of the deployed detachment.	**Part 4, Paras 3 & 4**
h. **Administration of records & documentation**. Ensure the standard, accurate and timely completion of formal documentation (Log Books, FRFs, Auth Sheets, Incident Signals, TRFs) and guarantee appropriate scrutiny and oversight by the chain of command.	**Part 4, Paras 3, 4, & 5**
i. **Ethos**. Moderate the "Wilco" attitude to balance ability and experience against operational tasking [redacted]	**Part 4, Para 4, Sect b**
j. **Manning**. Retention of experienced cohort at front line.	**Part 4, Para 4, Sect f**
2. The BOI recommends the following issues are addressed in light of investigations into the crash of ZJ177:	
a. **SD Training**. A review of the requirement and delivery of SD training & currency. Establish a Tri-Service policy.	**Part 4, Para 13**
b. **GH Currency**. Review GH currency/competency requirements to ensure AH aircrew get sufficient GH as mandated by the JHC FOB, that it is of sufficient quality, directed and dedicated training which is then accurately recorded.	**Part 4, Para 5, Sect b**
c. **EQ**. Review EQ training package & currencies with greater emphasis on techniques for ops at austere FOBs (eg EQ qualify or refresher within 6 months of deployment). Formalise rotate about the nose (RAN) and overshoot/miss-	**Part 4, Paras 5 & 8**

briefs to include wind direction and suitable techniques. Consider introducing standardised WARPLL checks. Allow AH crews the opportunity to practise full brownout dust landings and departures (currently AH Force consider light recirculation with no loss of reference to the horizon to be a dust landing). This should include investigating feasibility of enhancing AH simulator environmental and handling fidelity to enable realistic revision of dust landing/take-off techniques immediately prior to deployment.	
d. **Currencies**. EQ training related currencies are too lenient for the most challenging scenarios (high temp & DA, heavy recirculation and power limitation). The accuracy and recording of currencies needs to be re-iterated to the chain of command to improve standards. The focus must be competency not just currency and individually focused.	**Part 4, Para 5**
e. [redacted]	**Part 4, Para 4, Sect b**
f. **Supervision**. Review the formal supervision of individual continuation training and development based on an AH Force Trg Directive.	**Part 4, Para 4**
g. **Sub unit cohesion**. Review the requirement for sub unit cohesion to ensure aircrew deploy with their regular chain of command to guarantee optimal crewing through an intimate knowledge of ability, experience and training.	**Part 4, Para 3**
h. **Individual Augmentees**. Review and formalise the process of the timely hand over of individual augmentees between Sqns/Regts.	**Part 4, Para 3, Sect b**
i. **Supervisor's Course**. Review the currency and content of supervisor's/authoriser's courses to ensure the detail on roles, responsibilities and conduct is operations focused.	**Part 4, Para 4**
j. **'Guest Lines' (additional AH aircrew from external units (AMTAT/AFSSI/SAAvn)**. Formalise the TORs for 'guest lines' to include oversight/governance of avn standards/practices until experience levels increase	**Part 4, Para 3, Sect a**
k. **TQ**. Re-evaluate TQ in light of the evolving operational requirement and experience dilution. Consider external (AFSSI/AMTAT) validation during TQ to confirm experience, ability and weaknesses, refresh EQ, ensure consistency and highlight risks for mitigation.	**Part 4, Para 5, Sect c**
l. **RSOI Briefs**. Review the delivery of RSOI to ensure maximum impact – consider handouts, deliver elements in UK prior to deployment, encourage note taking and follow up with update briefs at a later date. It is also recommended that all briefs are archived as part of the Operational Record Keeping (either on a monthly basis or when updated/amended) to allow future BOIs access to detail	**Part 4, Para 5, Sect c**

correct as at the time of any accident/incident.

m. 	**Part 4, Para 4, Sect b**
n. **Single Aircraft Ops**. Review the requirement for single aircraft operations and provide guidance on risk assessment and mitigation where appropriate.	**Part 4, Para 4, Sect c**
o. **JHC CI 14**. Review the content of JHC CI 14 and enforce the implementation, management and use to underpin supervision and crewing regimes. This will expose experience, ability, training and CRM gradients to the chain of command to allow for risk assessment and mitigation where appropriate.	**Part 4, Para 4, Sect h**
p. **Force Generation**. Formalise the process to constitute FETs and optimise crew constitution (review FRFs, TrgRFs, CRM gradient), quantify risks and implement formal mitigation. Review the possible instigation of crew rotation (a balance of continuity, experience exchange and over-familiarity). CO to declare his squadron fit to deploy.	**Part 4, Para 4, Sect f**
q. **Manning**. Current manning issues within Squadrons are clearly proving a barrier to optimal crew constitution. This is an issue that should be addressed by the consideration of a long-term strategy to take AH Force through to steady state. In the meantime it is recommended that formal measures are put in place to mitigate the risks that arise from low experience levels. These should include: i. Placing emphasis on the importance of effective CRM to mitigate potential problems with aircraft role configuration. ii. Limiting less experienced aircrew tasking. iii. A formalised process to manage consolidation and development of aircrew. iv. Retain experience within the front line AH Sqn, including Officers accepting the impact on traditional career structures.	**Part 4, Para 3, Sect b & Para 4, Sect f**
r. **Management of Formal Documentation**. Review the management process and governance of formal documentation (FRFs, log books and training RFs). Missing detail (reports, currencies, log book entries etc) undermines the contribution documentation can make to force generation and crew constitution.	**Part 4, Paras 3, 4 & 5**
s. **AFSSI Audits**. Review the AFSSI audit process to add gravitas and enhance the respect in which the organisation is held (it should be a "knee-knocking experience" as recommended in the Puma Review). Visits should be tied to the Form cycle and aimed at sub-unit level to ensure maximum impact and value.	**Part 4, Para 5, Sect b**

t. **Aircrew Duty Period**. Review of the current rules governing aircrew rest (16 hours aircrew duty period), particularly for those crews operating in an austere environment. Current JHC FOB allows a maximum crew duty period of 16 hours which is based on operating in a peacetime environment and does not adequately reflect the tempo, conditions or protracted period of duty encountered on operations. More than 12 hours doubles the likelihood of mishap and greater than 14 hours trebles the likelihood of mishap. Consideration should be given to the level of authority required to extend crew duty (to allow an objective, external review) and guidance provided on the mitigation and impact of cumulative fatigue and low arousal over more regular periods than the current monthly guidelines. Consideration should be given to the crew duty cycle and the inclusion of a recovery period during protracted operational deployments. It is also recommended that there is a greater study in to the effects of cumulative fatigue over an op tour (and consecutive op tours) in association with tasking routine. It is clear that a dedicated recovery period at the end of a crew cycle is important to recharge the batteries and combat cumulative fatigue and needs to include sufficient spare capacity to allow the chain of command element to step out of the crew cycle to deliver against non-flying deadlines.	**Part 4, Para 17**
u. **Crew Fatigue**. Re-educate aircrew on risks and symptoms associated with fatigue, cumulative fatigue and the appropriate mitigation. As a particular issue associated with operating in austere environments (lack of facilities etc) the currency of education should be reviewed and aligned with another regular event eg AFSSI flight safety roadshow)	**Part 4, Para 17**
v. **Orders/regs**. Review the procedures and standardisation related to the use, administration, update and distribution of information to aircrew to ensure the latest documents are available at all times and in all locations whilst allowing dynamic evolvement in light of new thinking. Associated with this JHC must provide direction on the mandated documentation to be held at all avn locations (operational or non-operational) (ATM, JSP 550 series, JHC FOB, PCM SOPs, TTPs, etc) and standardisation across all rotary assets to minimise confusion.	**Part 4, Para 4, Sect a**
w. **Dust suppressant**. The Board believes the requirement for AH to operate at austere FOBs is likely to remain and a review of the best method to simply suppress dust and create safe HLSs is conducted ASAP (use of 'Harrier matting', 'DURASOIL', or other suitable suppressant).	**Part 4, Para 4, Sect d**
x. **Wind socks**. All outlying FOBs with an HLS must have wind sock as a bare minimum to provide at least a rudimentary wind direction and strength indication.	**Part 4, Para 4, Sect d**
y. **Inter-detachment co-op**. Review the independent operation of JHC assets in the same theatre to maximise access to shared knowledge, experience and information and	**Part 4, Para 4, Sect a**

minimise risk. There appears to be a current tendency to work as independent Dets – [redacted]

[redacted]

3. **AIEFSO.** AIEFSO has recommended further investigation into the following: **Annex E**

a. **Aircraft Details.** Logged weight and balance details for ZJ177 were inaccurate. It is recommended that the administration and governance of F700s and WRAM are reviewed.

b. **Aircraft door opening mechanism.** AIEFSO confirmed that the door opening mechanism for the front cockpit of ZJ177 does not function correctly. It is recommended that there is an investigation into the door opening mechanism.

4. **PCM.** Formalisation (operationally focused AIEFSO guide to support JSP 551) of post crash management aircraft handling (stripping, movement & recovery of aircraft (post accident)) as a function of AIEFSO and not the AOA to ensure appropriate investigation & independence. It is also suggested that a review of post crash storage is conducted to formalise the requirement and logging of detail (particularly of removable role equipment). It is clear that current PCMIO courses focus on accidents in benign environments. It is recommended that in consultation with the accident investigation branches of all 3 Services, direction is produced on operational post crash procedures (flexibility), including the formation of a Post Accident/Incident Follow Up (PA/IFU) organisation. **Annex E & Part 7**

PART 7

OBSERVATIONS OF THE BOARD OF INQUIRY

1. **BOI Administration.** The Board faced a number of administrative challenges that made the process unnecessarily difficult. It is recommended that the following be set in place ASAP:

a. The BOI members must be wholly dedicated to the BOI and JHC must be responsible for informing the chain of command of members' involvement and likely time away from work. Ideally the BOI should be a standing team (preferably with an SO1 lead) with previous experience, briefed and on standby to deploy. It is recommended that JHC J7 Flight safety own this responsibility. If an ad hoc BOI is raised then there must be a process in place to provide an in-depth brief and some 'tactical' advice (do's & don'ts, how to create suitable questions, submission of evidence etc).

b. The BOI members should be geographically collocated (where possible).

c. AIEFSO must be informed immediately (as per JSP 551) of any accident/incident and deployed ASAP. It might be considered that AIEFSO should conduct an initial assessment to inform the convening authority's decision on calling a full BOI.

d. Ideally an Human Factors (HF) expert must be informed immediately of any incident/accident. Where possible they should deploy with the BOI to the crash site to provide early advice on questioning. Failing this there must be an opportunity to meet with an HF expert prior to deployment or at the very least a guide/check list providing advice on collating/asking suitable questions. An HF(A) SME is **essential** on all BOIs.

e. It is essential that clerical support is provided to the BOI from the outset (to deploy if necessary) to log/submit evidence, type up transcripts etc. If possible the clerk should be adept at shorthand.

f. A second BOI box is included to contain additional consumables (specifically multimedia eg).

g. Provision of spare IT consumables (re-writable CDs essential to impex work to DII, printer cartridges, paper).

h. Require at least 2x digital recorders for interviews (redundancy & issue of sound quality across desks etc).

i. The laptop is cleared of previous, unrelated data.

j. A hard copy of the BOI précis and full JSP 551 guide are included in the BOI box.

2. **Aircrew Training Manual.** All Sqn QHIs should hold an ATM to allow aircrew easy access by all aircrew for revision of flying techniques.

3. **PCM:**

a. BOI deployment rushed.

b. Initial PCM confused (poor quality SOP, no reference to JSP), items to be quarantined missed (SES docs, AH gun tape) **(see Exhibit AF)** and PCMIO not trained to deal with operational scenario.

c. Individuals left theatre or hurried process of BOI – priority on getting home rather than

d. Not all required documents were impounded (SES).

e. Review of JSP 551 procedures to better reflect the plethora of mediums used in an operational theatre (e.g. MiRC, JCHAT, AH Gun Tape, ISTAR footage, electronic logs, digital photos etc).

f. Specific action to ensure all JHFs have a dedicated crash box that remains in theatre (including relevant publications/guides).

g. AIEFSO:

i. No depth ICP with comms at BSN or KAF to co-ordinate and offload the high volume comms to AIEFSO at the site.

ii. Aircraft equipment removed before AIEFSO's arrival compromising evidence gathering

iii. Removed aircraft components stored at BSN/KAF not protected from the elements (stored in the open next to their STCs) in any way so re-usable components damaged (engines etc)

iv. AIEFSO not called out by JHF(A) as per SOI. AIEFSO heard about accident through casual conversation with SO1 AFSSI.

v. Decision to strip aircraft and transport made by JHC – should be an AIEFSO decision to avoid a conflict of interest/legal issues.

vi. Transport of aircraft to BSN not fully explored resulting in the requirement to further strip aircraft and cause unnecessary damage and impinge on the engineering investigation.

vii. AIEFSO's equipment lost/delayed during deployment to theatre delaying and hampering the investigation.

viii. JHF SOPs do not include detail on recovery procedures.

ix. No control of the return of aircraft components to UK. As a result the aircraft and components were not fumigated for foreign bodies and were returned containing live insects. Additionally, there was no inventory made and dangerous items were not correctly packaged. As a result it is unclear if items are missing.

h. Process to test urine samples in accordance with 2006DIN02-030 (PIDAT) not followed by Field Hospital (no blood samples taken).

i. No debrief or PCM lessons learned account.

j. No PCM rehearsals – should be mandated.

k. Must have fully qualified Buzzards at FOB HLSs in order to coord ac movements, react accordingly to incidents, provide wind direction and strength info and coordination of the pax & loads. A graduated Buzzard ops dependent on scale of ops.

l. Where possible BOIs to be allowed to continue in parallel with RMP investigations to ensure rapid feedback and prevent repeat incidents accidents.

4. [redacted]

5. **BOI Interim Report.** Limited action and not focused on the main issue which was that downwind, limited performance transitions in a dusty environment must not be attempted. No feedback to the BOI on convening authority action.

6. **AEA.** The Board observed that the crew of ZJ177 were not wearing the mandated second layer of AEA. There is no excuse in an air-conditioned AH cockpit for not wearing the correct flying clothing which is an essential element of survival in the event of fire. This is very much a supervision issue but needs to be re-iterated to the avn community.

7. **Pre-BOI finding discussions/briefings.** It must be reiterated to the avn community that the any public discussion or briefing on an incident pre-BOI completion is unacceptable, unhelpful and cannot be productive (eg DARS).

8. **HLS directories.** Greater resource to produce, maintain and update directories in liaison with aircrew. Minimum level & quality of info (freqs, obstacles, dangers (dust), markers [redacted], best approach heading etc). To include standardised operating procedures (SOPs) for all Forward Operating Bases

Signatures of Board Members: **Date:**

President: [redacted] 22 OCT 09.
Cdr C Slocombe OBE RN

Member: [redacted] 22 OCT 09

Member: [redacted] 22 OCT 09

PART 8

AIRCRAFT OPERATING AUTHORITY'S COMMENTS

FINDINGS

1. I agree with the findings of the Board. The major causal factor of the accident was the Spatial Disorientation experienced by the HP when he entered a dust cloud during a transition. I also agree with the further causal and contributory factors which the Board identified explaining why the crew selected an inappropriate departure route and, having done so, did not conduct the correct transition technique and found themselves in a thick dust cloud.

2. The Board identified poor individual performance as a contributory factor. The comprehensive analysis of the Human Factors involved in this accident has identified that the aircraft commander believed that the departure that he initiated was within his own capabilities and the performance capabilities of the aircraft. In addition the downwind component contributed to the aircraft entering a significant dust cloud which the crew had not anticipated. The crew found themselves in an unfamiliar environment at a critical stage of flight and did not react to the situation correctly.

3. **Supervisory Issues**. In addition to poor individual performance, the breakdown of supervision processes is deeply worrying. The lack of co-ordination of the Sqn HQ and the Aircrew resulted in a chain of command that lacked the required knowledge of the individual aircrew. This, coupled with the poor handover of squadron augmentees, meant that the chain of supervision was effectively broken. Crew composition decisions were made in these circumstances resulting in a constituted crew that had a poor cockpit gradient being put in a situation that was at the very edge of their collective capability.

4. **Training Issues**. The Board identified that a lack of training focus and lack of consolidation of General Handling (GH) techniques (relating to limited power in demanding environmental operations) were contributory factors. They also identified that when the aircraft is mission configured, operating at FOB Edinburgh necessitates the use of limited power techniques not formally recognised or taught during EQ. Whilst the chain of command established a local departure technique, the overall lack of training focus did not allow for either the consolidation of GH techniques or the accumulation of basic airmanship experience. The crew involved in this accident did not recognise the complexity and difficulty of the situation in which they found themselves - a significant indicator of a degree of failure in the training process.

5. **Professionalism**. The Board has articulated several individual failings of the crew involved in this accident. In addition to not complying with specific orders formally laid down in Aircrew Publications and explicit instructions during RSOI/TQ briefs, the Board identified a number of issues which call into question the professionalism of the crew, particularly within the cockpit. I am concerned that a frontline crew on high end operations had such disregard for established procedures that firstly, they did not perform post-take off checks. Secondly, they failed to make formal assessments of the departure heading and route selection and thirdly, they did not consider the performance of the aircraft or potential emergencies. The Board also identified that the crew had been given several cues regarding the wind direction and strength over the course of the day, and yet they failed to apply any knowledge they had gained. The crew demonstrated a distinct lack of focus on the job at hand and, whilst I understand that the crew was likely fatigued, this is another clear indicator of a less than professional approach. It is clear that the flat cockpit gradient was a significant factor that could have been negated by the supervisors in the chain of command at the outset. However, this lack of gradient resulted in a lapse of professionalism by both aircrew which is unacceptable.

5. I fully support the significant number of recommendations that the Board have made which should greatly reduce the chance of a reoccurrence. I am pleased to note that the Environmental Training Command Instruction (JHC/J7/CI/04) has provided a robust framework for EQ which has already resolved a number of training, planning and supervision issues. As the AH Force continues to operate in the most demanding conditions and with limited numbers of personnel I am concerned about sub-unit cohesion, optimal crewing and manning and welcome the Board's recommendations 2g, 2h, 2k and 2q which will go some way to provide greater supervisory oversight.

6. Due to the significant number of contributory factors involving training and supervision that were identified, a Health Check of the AH Force, as recommended by the Board (part 6 para 1), will be carried out by AD Doctrine and Strategic Plans [redacted] at this Headquarters. I will write the Terms of Reference for the Health Check taking into account the findings, recommendations and observations of the Board.

SUMMARY

6. The adoption of correct transition techniques is an established method of reducing exposure to the risks inherent in Brownout conditions and it is vital that our crews are adequately trained and prepared for the situations that they are likely to encounter. In addressing the wide-ranging training and supervision issues highlighted by the Board I anticipate that the likelihood of a reoccurrence will reduce significantly.

C A JOHNSTONE-BURT
R Adm
Comd JHC

25 Jun 10