PART 1.4 – FINDINGS

W – Witness
E - Exhibit

All times are LOCAL (GMT -7 / Pacific Daylight Time)

AVAILABLE EVIDENCE

1. The following evidence was available to the Panel:

   a. The accident aircraft ZA 671.

   b. Witness Statements from the operating crew.

   c. Witness Statements from the passengers.

   d. Witness Statements from the Chain of Command from the Detachment Flight Commander to the Operation Authority, JHC, at OF5 level.

   e. Witness Statements from personnel involved with the Post Crash Management of ZA 671.

   f. Post-accident photographs.

   g. MilAAIB Technical Report.

   h. Aircraft Documentation including MF700.

   i. STARs Aircrew Currency Data.

   j. Human Factors Report by RAFCAM.

   k. Ex VM12 Planning Documents.

   l. 27C Flight Training Records.

   m. Chinook DDH / ODH Aviation Documentation.

   n. Previous Military Accident Reports.

   o. All Aviation Orders Applicable to Chinook Force.

   p. ASIMS Database.

   q. Cockpit Voice and Flight Data Recorder for ZA671.

   r. NAF El Centro Base Ops Briefing Information.

SERVICES

2. The following Services were available to the Panel:

   a. MilAAIB Service Inquiry Advisor.

   b. 1710 NAS Material Integrity Group (MIG).

   c. MilAAIB Technical Investigation Team.

d. MAA Legal Advisor.

e. RAF Centre for Aviation Medicine (RAFCAM) Human Factors (HF) Advisor.

f. Joint Aircraft Recovery and Transportation Squadron (JARTS).

g. Chinook Project Team.

h. Joint Helicopter Command (JHC).

i. QinetiQ – Accident Data Recorder Systems Department.

j. Standards and Evaluation Unit (STANEVAL) – RAF Benson

FACTORS CONSIDERED BY THE PANEL

3. The following factors were considered by the Panel:

a. Technical Factors.

b. Events on 7 Apr 12 / ZA671 Flight.

(1) Execution of the Sortie.

(2) Physiological Human Factors Analysis.

(3) Environmental Factors.

c. ZA671 Aircrew Background and Training.

d. Sortie Planning and Preparation.

e. The Accident Site.

f. ZA671 Flight Authorization.

g. Squadron level Supervision.

(1) 27 C Flight Commander Supervision.

(2) Key 27 C Flight Personnel – Training.

(3) Officer Commanding 27 Squadron.

h. Exercise VENTUS MAGNUS 12 Organization and Planning.

i. Broader Organisational Factors.

(1) Duty Delivery Holder Oversight.

(2) Operating Authority – Joint Helicopter Command.

j. Dust Landing Technique Analysis.

k. Additional Observations from the Inquiry.

SUMMARY

4. Summary of Causal, Contributory and Aggravating Factors Leading to ZA671 Accident and Other Findings.

ANALYSIS OF FACTORS

TECHNICAL FACTORS

5. **ZA671 Aircraft Serviceability and Technical Performance**. The serviceability of ZA671 including full HUMS download was investigated by the MilAAIB, General Electric (GE) and 1710 NAS, and reported at Annex A. Although some HUMS parameters were exceeded and recorded in the lead up to the accident, with the exception of 2 minor events which occurred between last servicing and accident impact these were all investigated and sentenced by the HUMS maintenance staff. On balance of evidence the Panel was able to discount technical systems failure, structural damage, and engineering or maintenance issues as contributory factors. Annex A

The Panel concluded that the serviceability and technical performance of the aircraft was not a factor.

6. **ZA 671 – Internal DAPU Clock Time Discrepancy**. There was a 10 minute discrepancy between the DAPU internal clock and the reported time of the accident due to internal clock drift. A non-safety recommendation is to be taken forward to ensure that the internal DAPU time clock is regularly updated to prevent incorrect UTC time being recorded on the CVFDR and HUMS. Annex A

The Panel concluded that the discrepancy with the DAPU clock was not a factor in this accident but a recommendation is required to rectify the fault to support future accident investigations.

7. **Aircraft Documentation.** A review of the F700 has been completed by the Quality Assurance (QA) Department RAF Odiham, on behalf of the MilAAIB and the Panel. The results are reported at Annex D. A number of anomalies were found commensurate with a typical F700 review and unrelated to the accident. These included incorrect amendment state of forms, incorrect coordination of Maintenance Work Orders, and incorrect recording and description of some aircraft component series numbers within LITS. A small number of non-critical aircraft components were lifex (e.g. hand held fire extinguisher). These observations were passed to 18/27 Eng Sqn for rectification. Annex D

The Panel concluded that the aircraft documentation was not a factor.

EVENTS ON 7 APR 12 / ZA671 FLIGHT

Execution of the Sortie

8. **Conduct during the Flight**. The Panel reviewed the CVFDR evidence from the flight. The Panel assessed that, with the exception of passenger management, the crew displayed the best possible levels of professional attitude and conduct throughout, which is to be commended. E44d

The Panel concluded that the conduct and attitude of the crew during the flight was totally professional and not a factor.

9. **Landing at PB PIMON**. Before the accident landing, the crew carried out a DL at PB PIMON. The crew had previously been conducting some simulated IF and descended the aircraft to 100 ft with approximately 6 miles to run to the IP, a distinctive mound in a relatively flat area. The IP to Target run was uneventful and the crew identified the landing site through use of the HLS directory and due to the fact that Acmn 1 had previously landed at the site. An orbit was set up, Acmn 2 gave his brief, and the landing checks were carried out. The aircraft's circuit was adapted slightly due to the proximity of the Mexican border but lined up on finals within parameters outlined in SOP 21[1]. A summary of the landing parameters from the CVFDR is shown at Figure 1. The Panel noted that although the approach was steeper than that normally expected, and the ROD averaged just over 500 fpm, the correct control inputs were applied (cyclic moved aft on rear wheels touching down). On touchdown the aircraft ran on 6-8m which would have been caused by the HP not fully developing the second stage flare. This could also have been compounded by the slightly inaccurate talk down given by Acmn 2. Acmn 1 reported feeling it was a heavier than normal landing. The Panel noted that the dust level at PB Pimon was low and the surface was made from gravel and sand. This made the surface solid and firm to land on. Although this would have compounded a firm landing, it would have allowed the aircraft to run on, unlike a landing on a softer de-accelerative surface. W1-3, 5 E19a E13

The Panel concluded that although the crew executed a firm landing at PB PIMON, it was within the safe operating limits of the aircraft and they conducted a crew debrief. The crew's judgement to continue with the flight as planned was reasonable and was not a factor.

10. **Carriage of Passengers**. Three military personnel (the RAF Ops Sergeant (Passenger 1) and two Air troopers (Passengers 2/3)) were authorized to take part in the flight to gain a better understanding of flying operations and a familiarization with the training areas. The regulations[2] associated with the carriage and care of passengers during flight are listed in MAA RAs, JHC and Odiham FOB, and are detailed at Appendix B. The carriage of the passengers was correctly authorized by the 27C Flt Comd, in line with the guidance for the carriage of passengers on training sorties JHC FOB[3] The authorization paperwork was found to be correct. The passengers were initially all seated in the rear of the aircraft. W1-3, 5, 8, 10-12

a. **Passenger One**. Post initial take off, Passenger 1 was escorted to the jump seat by Acmn 2 and remained seated in the jump seat for the duration of the flight. This meets the regulations stipulated in Odiham FOB[4]. W3,10-12

b. **Passengers 2 and 3**. Passengers 2/3 were permitted to sit on the ramp together, secured with dispatcher harness during transits between landing sites. This is in contravention of JHC FOB[5], which states that "the aircrewman may permit *one* passenger at a time to leave his seat". During both landings at PB PIMON and PB5, Passenger 2/3 were returned to their seats; however, they were permitted to remain on the dispatcher harnesses and were not restrained by the seat-belts attached to the seats. JHC FOB[6] states "Passengers and troops are to be strapped in at all times when the aircraft is moving" (except for some operational exceptions that do not apply in this case). Guidance associated with the use of the dispatcher harness in the JHC W10,12

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[1] Chinook Force Standard Operating Procedure 21 – Operating in Desert and Dusty Conditions.(Exhibit 26)

[2] MAA RA 2340 (Exhibit 45), JHC FOB 2340 (Exhibit 46) and Odiham FOB 2340 (Exhibit 47). See Appendix B.

[3] JHC FOB 2340.140.(Exhibit 46) See Appendix B.

[4] Odiham FOB 2315.100.1 (Exhibit 47) See Appendix B

[5] JHC FOB 2315.130.9 (Exhibit 46) See Appendix B

[6] JHC FOB 2340.130.9 (Exhibit 46) See Appendix B

FOB[7] states that "The dispatcher harness, whilst preventing the wearer from inadvertent exit from the aircraft, does not provide the same degree of restraint or protection as the seat harness." Acmn 1 was delegated the task of ensuring the safety of the passengers, although the ultimate responsibility of the safety of passengers lies with the Ac Capt[8]. As an experienced crewman instructor, he would have been fully aware of both the regulations and the associated risk to passenger safety. There was no operational reason why the passengers could not be restrained correctly. Fortunately, neither passenger sustained any significant injuries during the accident but the risk to the passengers was not as low as reasonably practicable. E3 Annex B

The Panel concluded that the carriage of passengers was not a factor in the accident. However, the safety of the passengers in the rear of the aircraft was not ALARP during the flight and during the landings.

11. **Accident Landing Site Selection.** During the flight the crew misidentified the crash site[9] as PB5. They elected to land next to a large bush/small tree, which is 368m East of PB5 HLS box. The HLS Directory includes a photo of the landing site and does not show any bush / tree. Whilst airborne the landing site was initially identified by Acmn 2. This was verified by the NHP who believed it matched the location indicated by the CDNU. The crew believed that they had landed at the site indicated within the HLS directory. Due to the Acmn 1 having been to the HLS previously the Panel felt that this could have incorrectly influenced the NHP into accepting his landing site selection rather than trying to find the exact grid. Surface conditions at the accident site were very similar to those at PB5. W1-3,5 E6, 48 W3,5

The Panel concluded that mis-identification of the LS by the crew was not a factor.

12. **Accident Approach and Landing**. A normal DL approach from 100' agl takes between 15 and 18 seconds to complete. A graphical representation of the aircraft landing sequence parameters and voice record from the CVFDR is shown at Figure 2. The human factors analysis of the accident was conducted on behalf of the Panel by RAFCAM and is at Annex E. The crew selected an into wind approach direction as per the SOP. The terrain was relatively flat apart from a small raised ridge (berm) approximately 3m high that was positioned approximately 200m to the left of the approach path. The accident LS itself was clear of obstructions with a clearly defined landing position marker; a small tree. However, it was impossible to gauge its size accurately due to the lack of other visual clues. The descent was started at 1306 hours at the correct SOP initial "gate" but it was initiated late (nearly 3 seconds after calling "starting approach"). This meant the approach was already going to be steeper than normal if the aircraft was going to land alongside the chosen marker. E19b W2 E23,33-35 Annex E W1-3,5

a. **Human Factors – Pressure from Previous Heavy Landing**. The HP was a self confessed perfectionist; his previous landing at PB Pimon had not been perfect and evidence suggests the approach was steeper than detailed in the SOP. HF analysis of his behaviour, given that he had only recently passed out of the OCF, would indicate that he might have been placed into a frame of mind where he perceived pressure to perform well from other crew members and wanted to ensure the next landing was good; to satisfy not only himself of his capabilities but also that of the MACM, an instructor, who had just negatively evaluated his previous DL. W1-3,5 E1,19a W10,12

[7] JHC FOB 2130.106.1 (Exhibit 46) See Appendix B

[8] JHC FOB J2115.100.1 (Exhibit 46) See Appendix B

[9] PB5: 32° 51 77N / 114° 27.99W and Crash Site: 32° 51.47N /114 27.46 W.

b. **Human Factors – Risky Shift**[10]. The aircraft did not meet the second 75'/25kts DL approach "gate", being 4 kts too slow, because the HP had flared too much during the first stage flare. The NHP called "75 slow", and the HP attempted to correct by applying a forward cyclic correction. The 50'/20kts gate call was missed by the NHP, probably because of the very compressed timeframe due to the steep approach. At this point the NHP should have called for an overshoot, but did not. He states that he did consider it as they were touching down, but didn't act. HF analysis suggests that a potentially significant factor of "risky shift" could have had a part in this split second decision. In effect a flat gradient front seat crew is susceptible to accepting more risk; expect the other member to act, and hence put off acting to curtail a risky evolution until too late.

W2,5
E19b

Para 26

c. **Human Factors – Visual Disorientation**. The radar altimeter correctly gave a warning at 40'agl. At this point the Rate of Decent (ROD) had increased to approximately 800ft/min. The crew faced unfamiliar and unusual surface conditions at the LS which provided few visual clues during the final stages of the descent, effectively presenting the HP and NHP with a form of visual disorientation, and a lack of realisation of the true rate of descent. Although the ROD then reduced due to the final flare and building ground cushion, as the rear wheels impacted the surface they very quickly sank into the soft sand to a depth of 28cm, resulting in minimal / no compression of the rear undercarriage, insufficient to operate the WOW micro-switches. Sand built up in front of the wheels effectively increasing braking effect, decelerating the aircraft at a higher rate than normal.

E19b
Para 34

E23

Annex A

d. **Human Factors – Overshoot Call**. At the point of rear wheel impact, Acmn 1 called "overshoot" having felt that something wasn't quite right; simultaneously the cyclic stick was moved forward (See Figure 2). HF analysis of the impact of the overshoot call points convincingly to there being very little likelihood of the overshoot call having any effect on the rapidly evolving scenario. The time taken to hear the call, understand what it meant, and then act upon it by moving the cyclic forward and increasing power is estimated at 1.5 seconds[11] as an absolute minimum. The CVFDR recorder and engineering tests conducted by the MilAAIB on the movement of the cyclic show that the cyclic was physically pushed one inch (2.5 cm) forward of the central sprung neutral position within 0.25 second of the overshoot call. Analysis of the CVFDR data shown that the HP did not initiate a collective input, therefore the HP could not have responded to the "overshoot" call.

W1-3,5,10,12
E19b

Annex A

e. **Human Factors – Handling Response of the HP on Impact.** Analysis of the CVFDR data shown that the HP physically pushed the cyclic forward on impact (Figure 2), either inadvertently or as an incorrectly applied post wheels-on procedure. The combination of the forward cyclic movement (which decreases the pitch on the forward rotor and increases it on the rear) and the rapid deceleration of the aircraft resulted in the aircraft very quickly pitching nose down. The forward undercarriage then impacted the desert surface, sinking into the soft sand further slowing the

W2
E19b
Annex A

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[10] There is a phenomenon well known in the aviation environment called "risky shift". First highlighted 1961 by Stoner, it was further discussed by Shaw in 1976 and Forsyth in 1990, and more recently by Conrad Anker in 1998. In layman's terms and how it may have presented with ZA671 crew, it is a phenomenon that occurs amongst groups of like minded individuals who are also risk takers. Aircrew are risk takers. This doesn't mean that they are willing to take stupid risks, but means that they will weigh up a situation and take a risk if it weighs in their favour or the situation or operational need requires them to do so. But it also means that they will take more risk as part of a uniform group than they would as an individual. A group of likeminded individuals (in this case risk takers) form the front seat crew of ZA671. When groups work together where no one is clearly in charge/more experienced/more capable/ or dominant then group think such as Risky Shift is easily succumbed to. What does it mean at the most basic level? As individuals undertaking a flying manoeuvre (for example a solo pilot in a gazelle, or a lynx pilot flying with a crewman instead of another pilot) then the pilot carries all the risk for the manoeuvre him/herself and therefore may be more cautious and less willing to push on when things aren't quite right (gate speeds/heights/ROD etc). In a crew of equally qualified, equally competent and experienced (or inexperienced) pilots, they may push on further than they would individually because they have effectively shifted or shared the risk (and responsibility) that would normally limit behaviour onto the other pilot. Basically when things start to go wrong, one of the crew is waiting for the other to take charge or say stop, and vice versa. What actually happens is that they push on to such an extent that neither is capable of recovering the situation.

[11] I. Thackray, Ph.D Paper: Response/Recovery of Continuous Psychomotor Performance Following Startle: "Since the reflex muscle response to startle, depending upon the Intensity of the reaction, may last from .3 to 1.5 sec (Landis and Hunt, 1939), it is evident that a major portion of the time required to complete a voluntary response following startle is a direct result of this reflex interference."

aircraft, whilst the pitching motion lifted the rear undercarriage clear of the sand. The pitching moment continued to a 10 degrees nose down attitude causing the cockpit floor structure to impact the desert surface. This overloaded aircraft structure Station 120, which supports the forward transmission rear mounts, causing the forward transmission to move rearwards and down into the cabin. This deformation of the cockpit and forward cabin caused the troop commander's seat to collapse as the transmission moved rearwards and down. The No1 sync shaft failed, followed by the No 2 sync shaft which was forced upwards and out through the No1 drive shaft tunnel cover.

f. **Human Factors – Adherence to SOP21**[12]. Eight control sorties were flown in the UK (on Chinook ZH777 and ZA778) in order to ascertain the ROD and time taken to achieve the accepted SOP 21 DL profile. They were performed by a B1 QHI (Chinook Wing Standards Officer) and OCF QHI/SI Panel Pilot. Figure 3 compares the landing profile flown during the accident (ZA671) with data gathered during the control sortie that most accurately represents a DL approach flown in accordance with SOP 21. Two significant deviations are noted: E49c

(1) **Time Compression**: The radar altimeter plot shows that the two approaches are quite different in approach angle and ROD. The time between starting the approach at 100' and the aft wheels touching down on the accurately flown sortie was 16 seconds. This compared with the 8 seconds it took ZA 671 to complete the accident approach. The accurately flown sortie had an approximate ROD of 400 fpm in comparison with the accident approach ROD averaged approximately 750 fpm. In accordance with the SOP21, had the excessive ROD been observed by the HP/NHP it should have resulted in "overshoot" actions being taken during the descent and before touching the ground. E49c

(2) **Difference in Cyclic Input**: The graph shows the difference in cyclic stick inputs. The data gathering sortie shows the progressive rearwards movement of the cyclic and the rear wheels touch the ground, which counteracts the rotation of the aircraft around the aft wheels on touch down. It can been seen from the accident data that ZA671's cyclic stick moves initially aft but on touchdown the cyclic moves to 1 inch (LPI) forward. This caused the accident sequence as described in Para 10e resulting in the nose of the aircraft impacting the ground. Annex A

The Panel concluded that the aircraft was mishandled during the final DL approach. A high rate of descent, with subsequent application of forward cyclic on touchdown, was the <u>cause</u> of the accident. This was assessed to be a skill based error (slip)[13],[14].

The Panel concluded that HF played a significant part in the mis-handling of the aircraft during its final DL. Significant factors include "risky shift", visual disorientation and a pressure to improve upon the performance of the HP/NHP in their previous DL.

The Panel concluded that the "overshoot" call made by Acmn 1 was not a factor in the accident sequence, as it was given too late to affect the flight profile.

[12] Chinook Force Standard Operating Procedure 21 – Operating in Desert and Dusty Conditions. Issue 6, AL8 (Exhibit 26)
[13] MAA Manual of Air Safety Issue 2 Chapter 3 Annex B Para 4: "Error: An error is an action that does not go according to plan. Errors can either be due to an individual doing something other than what they intended to do (error of commission) or failing to do something because of an issue with concentration or memory (error of omission)."

[14] CAA CAP 737 Appendix 5 Para 2.7. Skill Based Error/Action Slip: An action not carried out as intended.

Physiological Human Factors Analysis

13. **Medical Fitness to Fly**. An assessment of all the crew's previous medical history (FMed4) has been conducted by JHC SO1 J1 Aviation Medicine (Annex B) on behalf of the Panel. This report concluded that all 4 crew were officially medically fit to fly on the day of the accident. During interviews the crew did not reveal any emergent medical issues to prevent them from flying on 7 Apr 12. Annex B E 50

The Panel concluded that the crew were medically fit to fly and this was not a factor.

14. **Fatigue.** Events during the previous day and hours prior to the flight differed for each crew member. Both crewmen had completed a gunnery sortie the previous night between 1900-2210. Although this sortie was 3 hours in duration, each crewman had only operated for a short time, in order to pass their M60 and M134 shoot iaw the Operational Shooting Policy. Both crewmen were back at the hotel in El Centro and at rest at 2300. They both had an uninterrupted nights sleep, awoke and attended breakfast between 0800 and 0830. The pilots had last flown on the night of the 3 Apr 12, conducting night DL's at Holtville airfield with a Training Captain (TC). The previous day to the accident had been spent in ground briefings; both pilots were well rested. None of the crew had consumed alcohol in the previous 24 hrs and food was readily available for the crew. W1-3, 5, 8 E8 E 51, 52

The Panel concluded that fatigue did not contribute.

15. **Post Accident Egress and Survivability.** The impact forces were modest and the crash was clearly well within the survivable range with maximum vertical triangular pulse estimated at 2.62G, and maximum horizontal triangular pulse being estimated at 1.07G. All crew and passengers were able to egress the aircraft easily and safely using the designated emergency exits. This is detailed further at Annex A. Annex A W1-3,5,10-12

The Panel concluded that the accident was survivable and the safety equipment within the aircraft was adequate.

Environmental Factors

16. **Meteorological Conditions – Wind / Temperature / Density Altitude.** The detachments utilized weather reports from two different sources. Marine Corps Air Station Yuma provided detailed reports and forecasts throughout the sortie times on local weather, and the crews also used the internet to gather data from a NOAA (National Oceanic and Atmospheric Administration) approved site. During the sortie times both reports correlate and describe the cloud levels as "Few: above 12,000ft with 10km or greater visibility", Winds: "Northerly between 6-8 Kts" and Temperature: "28°C". None of the crew reported that the weather played any part in the accident. E14 W1-3,5

The Panel concluded that meteorological conditions were not factors during the accident.

17. **Airborne Dust Environment**. The dust conditions at the LS were variable due to the unusual nature of the surface at the site (see Para 34 for detailed description). Although PB5 landing site surface was described as "dusty and soft" in the MAOT approved Helicopter Landing Site (HLS) Directory, the NHP stated during interview that the airborne dust was light and at no point were references lost. This is confirmed by Acmn 2, who described very little dust cloud and stated that he expected far more. Wind speeds of 6-8 kts would have also delayed the onset of any the dust cloud. None of the crew reported that the airborne dust played any part in the accident. E6 W3,5 E14

The Panel concluded that airborne dust was not a factor during the accident. Utilizing a dust landing technique was a suitable evolution to land the aircraft, but the dust did not cause visual references to be lost at any time during the landing sequence.

ZA 671 AIRCREW BACKGROUND AND TRAINING

18. **ZA 671 Crew Composition**. The crew comprised an LCR Ac Capt (410 hrs total flight time, approx 166 on type and 7 Ac Capt hours) and an LCR HP (480 hrs total flight time, approx 167 on type). Both held a Limited Desert Environmental Qualification (Lim EQ), gained in Oct 11 but had not conducted any further environmental training prior to the beginning of Ex VM12. The rear-crew consisted of 2 CR crewmen who each held a full Desert EQ qualification and had previous operational experience in HERRICK. Acmn 1 was a MACM Instructor[15] with 3300+ hrs. The composition of the front crew was approved by 27 C Flt Comd primarily to develop and consolidate captaincy skills. To note, the NHP and DA believed the crew had been composed to consolidate dust landing techniques, not specifically captaincy skills. The aircrewmen were selected by the Flt MACM, sometime after the sortie was generated on STARS, and the sortie tasking was not a deciding factor for their selection. The choice of Ac Capt (NHP) was made by the front crew themselves and was approved by the DA. During post accident interviews neither the 27C Flt Comd, DA/QHI, Flt 2IC nor the TC had any particular concerns regarding the crewing of this front crew in principle.

E1-4
W1-5,7,8

E 53, 54

W 5, 8

The Panel concluded that the crew composition was a contributing factor.

19. **Crew Currency.** Flying currency is primarily the responsibility of individual aircrew. The management and monitoring of flying currencies is listed in the terms of reference of 27C Flt Deputy Comd and Flt Training Officer, who both acknowledged during interview that they understood this responsibility. Considerable effort had been made prior to deployment by the 27C Flt training staff to identify currency shortfalls and ensure all personnel were current for the duration of Ex VM12. However, following a review of STARS data, aircrew log books, flight authorization sheet and witness interviews, the Panel has confirmed the following currency shortfalls for the accident crew at the point of the flight authorization on 7 Apr 12:

W 2,4,5 7, 8,24
E1-4,18, 53-55

a. **Handling Pilot**: Deficient by 1x RNF landing and 5 minutes IF Hours. The HP attributed this to be the result of on-paper recording and calculations mistakes, confusion related to the accuracy of the STARS data available to the Detachment members and the wider misrepresentation of IF simulator currency in STARS as a white rated pilot (see Para 87). However, the STARS download available to the Panel on 13 Apr 12 in El Centro, clearly indicated that the HP was un-current on 7 Apr 12. To note: His night flying currency was also being maintained by 5 minutes of P2 hours.

W2

E18, 127

E128,

b. **Non-Handling Pilot / Aircraft Capt**: Human Factors / Crew Resource Management (CRM) training lapsed on 30 Mar 11. The lack of HF training received by the NHP was a result of confusion in the validity of his HF training received during initial pilot training (recorded as being valid for 5 years in JPA) and the lack of awareness that consolidation training is now required every 2 years iaw JHC FOB.[16] There had been opportunity for the NHP to receive HF training over the preceding 6 months as training occurred at RAF Odiham every Tuesday.

W5, E 56

E57

[15] The MACM is a previously qualified QHCI on the Chinook. However, his Endorsement of Category was out of date as he was employed in the role of Senior Crewman on 27C Flt and not the QHCI.

[16] JHC FOB J2103.000.6. (Exhibit 46) See Appendix B

c. **Rear Crewman** - Both rear crewmen were fully current iaw JHC FOB. E3,4, 56

20. Whist both the HP and NHP were un-current iaw JHC FOB, the HP's deficiencies were not related to skillsets required during DL, day flying or any aspect of the authorized sortie profile. The NHP's lack of CRM / HF training currency may have impacted his ability to recognise the signs of an approaching accident during the DL.

The Panel concluded that the overall management of currencies prior to and during Ex VM12 by 27C Flt was not sufficiently robust enough to prevent uncurrent personnel from flying. The HP's handling specific currency shortfalls did not contribute to the actual handling errors made during the accident, however, the NHP's non currency in HF / CRM continuation training may have been a contributory factor.

21. **Flying Training Post OCF for HP / NHP**. Neither HP nor NHP received a formal progressive flying induction to 27 Sqn following completion of OCF. They both executed a number of sorties in the interim period ranging from LCR/LCR trips, through airtests, IF and some tasking including participation in MRX. A squadron acceptance check was conducted by the HP and assessed by a TC immediately on joining as required by JHC FOB[17]. However, the NHP was only assessed more than a month after joining, by the Flt Comd, in the simulator. His airborne captaincy skills had not been formally assessed and recorded since joining 27 Squadron. Neither pilot had flown any airborne sorties with the QHI during their time on 27 Squadron. The NHP's entries for LCR and NVD Level B qualifications on joining 27 Squadron are unsigned in his log book. Formal flying training sorties by both HP and NHP since leaving OCF can be seen at Figure 4 and 5. E1,2, 51, 52, 58, 59

The Panel concluded that both the HP/NHP would have benefitted from a formal induction package on arrival in 27 Sqn, to include more flying with QHI and TC, to build experience and captaincy before being exposed to EQ training at El Centro; and that the lack of such structured package may have been a contributory factor in the accident.

The Panel concluded that 27 C Flt had only given the NHP a simulator Squadron Acceptance Flight rather than a flying Acceptance Flight as required by JHC FOB, which would have given the unit authorizing officers an indication of his ability. This may have been contributory factor in the accident.

22. **Flying Practice of the HP during Previous 6 Months**. As detailed in Figure 6, the HP had not achieved 15 hours per month in any of the previous 6 months and had not achieved 45 hours in the previous quarter as required by the JHC FOB[18], despite including his P2 flying time[19]. Approximately half of his flying time post OCF was as part of LCR only crews, lacking exposure to QHI/TC or other CR crew. This lack of quality flying hours may have prevented the HP from fully consolidating his aircraft handling and operating skills, learnt during flying training. This dilution of flying exposure meant he would not have been considered fully competent in accordance with the JHC FOB. E2,18, 53

The Panel concluded that the HP had not achieved sufficient flying hours in the previous quarter to be considered fully competent to operate iaw JHC FOB[16] and that dilution of exposure to quality flying was a contributing factor.

[17] JHC FOB J2101.101.2 (Exhibit 46). To note, this reference does not indicate when the Squadron Acceptance Flight is to be carried out. See Appendix B

[18] JHC FOB 2102.100.1 (Exhibit 46) See Appendix B.

[19] P2 flying time refers to time logged whilst sitting in the jump seat, supposedly taking an active part in the management of flying functions.

23. **Flying Practice of the NHP/Ac Capt during Previous 6 Months**. As detailed in Figure 7, the NHP had not consistently achieved 15 hours per month in the previous 6 months and had only achieved over 15 hours in one previous month (Mar 12). He had achieved 45 hours in the quarter prior to the accident, but only by including P2 hours logged in the jump seat. This lack of flying hours, particularly in Dec 11 / Jan 12, may have prevented the NHP from fully consolidating his flying skills, learnt during flying training (OCF). Approximately a third of his flying time post OCF was in LCR only crews, lacking guidance from QHI/TC or other CR crew. Only 7:10 hours were conducted assuming the role of the Ac Capt since OCF. The NHP would have been considered competent iaw JHC FOB. E1,18, 54

The Panel concluded the NHP had not had achieved sufficient flying hours in the previous 6 months to fully consolidate his flying skills learnt during OCF, including the hours spent as the Ac Capt. This was a contributing factor.

24. **Flying Practice of Rear Crew during Previous 6 Months.** The flying hours achieved by the rear crew are noted in Figures 8 and 9. Both had achieved 15 hours in the previous month and both had flown over 45 hours in the previous quarter, indicating a suitable flying rate prior to deploying on Ex VM 12. E3,4,18

The Panel concluded that the currency of the rear crew was not a factor.

25. **Initial EQ award for HP / NHP**. Initial EQ training for both ZA671 front seat crew was conducted on the OCF during a deployment to Jordan in Oct 11. Both pilots had completed all serials as stated in the Chinook Training Directive[20]. The Panel reviewed all their training reports throughout this phase and found neither had shown any concern throughout these serials. The HP gained his Lim EQ status on 21 Oct 11 and the NHP on 17 Oct 11. E1,2, 60, 61

The Panel concluded that the initial EQ training syllabus and qualification was not a factor.

26. **HP/NHP EQ Consolidation Training and Re-Evaluation**. Neither pilot participated in any additional EQ training between gaining their initial Lim EQ status in Oct 11 and the beginning of Ex VM 12 in Mar 12. They did not conduct any flying training or dust landings with a QHI during Ex VM 12. Only one day training sortie and one night training sortie were flown with a TC. Their training reports highlight that a level of expected skill fade had taken place since the Lim EQ award in Jordan, but by the end of the sorties both pilots were operating to a safe standard. The TC did not stipulate within the reports whether the HP/NHP would be capable of operating solely in an LCR crew to conduct desert landings but he did state during interview he thought they were safe. The NHP had conducted no dust landings in the LHS during Ex VM12 prior to the accident sortie. During Ex VM 12, the pilots participated in the following sorties prior to the accident: E8, 51- 54 W6

a. **HP:** W2 E8, 52

26 Mar 12: Day area familiarization sortie with Flt Comd. One dust landing (DL) was executed, but the evolution was conducted solely by the Flt Comd. The ZA 671 HP was sitting at the controls but did not handle the aircraft. W8

29 Mar 12[21]: Day sortie including DLs with the Training Captain (TC) and ZA671 NHP[22] at Holtville. This sortie was a formally recorded assessment. The ZA671 HP performance was graded "B". W6

[20] Joint Helicopter Command Support Helicopter Training and Standardisation Instructions Issue 4 AL 2 (Exhibit 62)

[21] An ASIMS report was submitted for a day training flight on 29 Mar 12. The occurrence describes multiple worn/scored patches - scoring worn through to the tyre thread with a couple of small patches and one long (approx 30cm) found on the tyres. A wheel change was required but no

1 Apr 12: Day gunnery sortie with LCR Aircraft Capt. W9

3 Apr 12: Night sortie including DLs with the TC / ZA671NHP at Holtville. This sortie was a formally recorded assessment. His performance was graded 'B'. W6

b. **NHP**: W5 E8, 51

26 Mar 12: Day area familiarization sortie with Flt Comd / ZA671 HP. DLs were not conducted. The NHP sat in the jump seat throughout the sortie, only logged P2 hours and did not operate the ac. W8

29 Mar 12[16]: Day sortie including DLs with the TC / ZA671 HP at Holtville. This sortie was a formally recorded assessment. His captaincy skills were not assessed during this sortie. His performance was assessed as "B". W6

31 Mar 12: Day sortie including DLs with LCR Aircraft Capt in the vicinity of the accident location. E54

2 Apr 12: Day consolidation inc DLs in Holtville area and PB PIMON with experienced LCR pilot (with extensive previous Puma experience). The sortie was cancelled whilst airborne due to unserviceability and DLs were not achieved.

3 Apr 12: Night sortie including DLs with the TC / ZA671 HP at Holtville. This sortie was a formally recorded assessment. His captaincy skills were not assessed. His performance was assessed as "B+". W6

The Panel concluded that both HP/NHP would have benefited from further consolidation DL training sorties with a TC, QHI or a CR Ac Capt during EQ training, before being permitted to fly as an LCR crew. The limited levels of training and lack of consolidation flying with more experienced aircrew since arrival on 27C Flt is considered a contributory factor.

27. **EQ Qualification of the Aircrewman**. Acmn 1 most recently re-qualified for his EQ on 26 Jun 11 and Acmn 2 on 10 Jun 11. E3,4

The Panel concluded that the EQ qualification of the aircrewmen was not a factor.

28. **Crew Resource Management**. The crew's relative inexperience and dynamics resulted in a flat cockpit gradient, and a negative gradient between the front and rear crew. Other CRM factors include:

a. The HP and NHP were close friends. They had passed through Officer and Flying Training in very close proximity. E1, 2, 58, 59

b. This was the first task that the front crew had undertaken together without on-board supervision (QHI or TC) during Ex VM12, albeit they had flown together on a number of sorties in the UK. E8

c. The scope of the sortie, including transition at low level along the Colorado E8, 51, 52

damage was found to the brakes. The cause was attributed to natural operating factors; damage to tyre through running landings to rough ground. Whilst noteworthy, no further evidence was available therefore the Panel could not undertake any further analysis of the execution of this training flight. (ASMIS Reference: RAF/27Sqn/Chinook/12/12838 – Exhibit 143)

[22] For both this and the 3 Apr 12 sortie, the front seat crew alternated between ZA671 HP and NHP roughly half way through the sortie.

River, DLs and rear wheels-on pinnacle landing, was significantly different to that conducted during the previous Ex VM 12 supervised training sorties, but was perceived as a 'benign' task by both crew and DA.

29. **CRM – Behaviours**. The Panel concluded that CRM issues may have resulted in the following behaviours:

a. An Ac Capt who may have been capacity limited due to lack of Captaincy experience, not fully in command of the aircraft as detailed in JHC FOB[23], and not sufficiently experienced to recognise and respond to handling errors made by the HP. E2

b. An Ac Capt who had overconfidence in the handling abilities of the HP, and may have been reticent to take control as the situation deteriorated. This is supported by his own testimony that he considered making an "overshoot" call in the later stages of the landing but did not. He didn't follow through with the controls during the later stages of the landing and assumed the brace position on impact. W5

c. A HP who may not have had the capacity to appreciate and monitor the Ac Capt's lack of actions during the approach flight (including failing to make the 50 ft gate call). E19b

d. A HP who may have become more tense during the second landing as a result of the debrief given by Acmn 1 after the first landing, leading to overcompensation in the air rather than take appropriate early "overshoot" actions. Evidence to support this conclusion is that he was too slow at the 75ft gate, and then increased airspeed which would have contributed to increased rate of descent. W1-3,5,6, 10 E19b

30. **CRM – Other Examples**. Other examples which support these conclusions include:

a. The Acmn 1 (MACM) immediately took charge of all the post-accident actions including making the initial emergency calls back to the unit, communicating with the unit during the recovery phase, and directing initial PCM activity of the crew and passengers. W1,3,5

b. The Ac Capt did not confirm for himself Acmn 2's identification of landing site PB5 (despite the HLS Directory card clearly showing a different location). The aircraft landed approx 368m from the recced and authorized PB5 site. W3

c. Although customary for the Ac Capt to lead a debrief of any significant serials during the flight, prompting was required by Acmn 1 at the end of the first landing at PB PIMON. W1-3,5,10-12

The Panel concluded that the composition of the crew, the flat cockpit gradient and the negative gradient between the front and rear crew were contributing factors.

SORTIE PLANNING AND PREPARATION

31. **ZA671 / 7 Apr 11 Sortie Generation**. The sortie was generated the previous day by the HP/NHP who noticed a space in the flying programme and approached the Flt Comd and 2IC to gain permission. Guidance was given by the Flt Comd on the areas that he wanted them to concentrate on, focusing on development of their captaincy skills. The Flt 2IC initially created the flight on STARS. Crewmen were added to the sortie at a later time. The originally allocated crewman required a mountain training sortie and was subsequently W2,4,5,8 W1

[23] JHC FOB 2115.100.2 (Exhibit 46) See Appendix B.