PART 1.3 – NARRATIVE OF EVENTS

1.3.1. All times local (Zulu plus 4.5 hours). Of note, the Ground Control Station (GCS) clock time, as shown on the GCS screen-shots, is 7 minutes ahead of the actual time.

Introduction

Figure 1 – ZK515 at Bastion Airfield

1.3.2. At 0945L on 2 Oct 11, a Royal Artillery (RA) Unmanned Air System (UAS) Hermes 450, ZK515, call sign **(S26)** , crashed at Bastion Airfield, Afghanistan. The crew consisted of a Bombardier UAS-commander, a Lance Bombardier UAS-pilot and a Sergeant Mission Commander. The Staff Sergeant Senior Operator was also present within the GCS to oversee the crew's GPS Take Off and Landing System (GTOLS) procedures.[1] 57 Battery, 32 Regiment RA, were 5 months into a 6 month tour in support of Op HERRICK 14.

[1] **(S26)**

Pre-Accident Events

Crew Composition

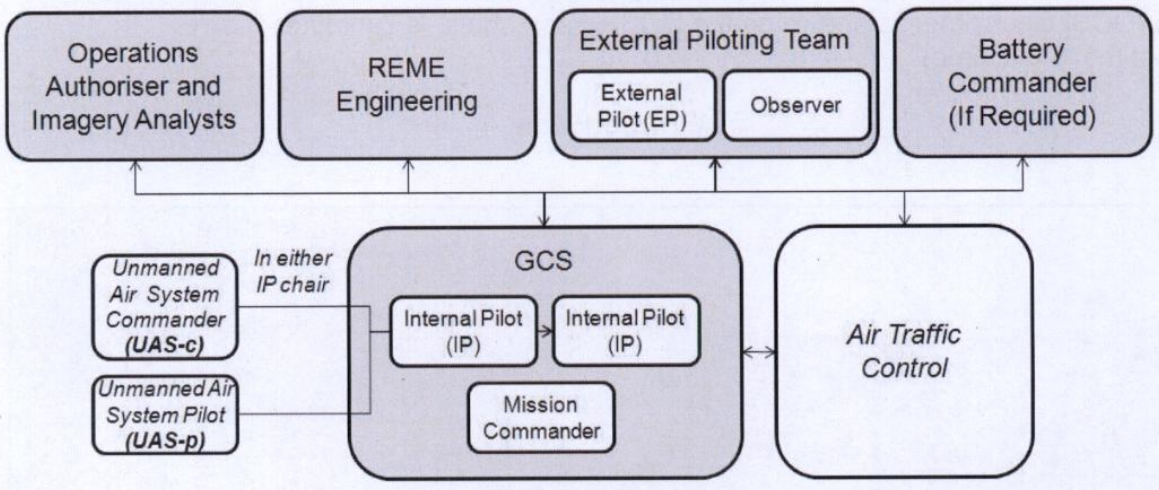

Figure 2 – Schematic of H450 Operations Network
(diagram reproduced from Exhibit 16)

1.3.3. **UAS-commander.** The UAS-commander (UAS-c) was 5 months into her first operational tour on the H450. She had flown 515 hours on H450, approximately 500 of which were as a UAS-c. Her H450 Certificate of Competence had been awarded in Mar 11 and she passed to a high average standard. Her previous aviation experience was one operational tour on Desert Hawk. — Exhibits 92, 93

1.3.4. **UAS-pilot.** The UAS-pilot (UAS-p) was in his second operational tour on the H450; the previous tour was in 2008/2009. He had flown 1141 hours on the H450, all as a UAS-p. He had qualified on type in Aug 08 and his most recent Certificate of Competence had been carried out in Mar 11 to an average standard. He had not managed to meet the simulator currency requirements between operational tours. Prior to H450 qualification, he had previous Phoenix UAV experience, though not on operations. — Exhibits 94, 95; Exhibit 26

1.3.5. **Mission Commander.** The Mission Commander (MxC) had been qualified as a H450 MxC since 2007 and had completed 3 previous H450 MxC operational tours. Previous aviation experience was as a Phoenix Detachment Launch and Recovery commander. He was not, and was not required to be, qualified as a UAS-p or UAS-c. — Witness 11

1.3.6. **External Pilot.** The External Pilot (EP) was employed by the contractor, UAV Tactical Systems (U-TaCs), and had been qualified on this project for one year. He had completed numerous 4 week periods in theatre and accumulated approximately 110 hours flying UK H450. He had previous experience working as an H450 EP with other nations before joining the U-TacS Lydian[2] programme. — Witness 1

1.3.7. **GTOLS Observer.** The GTOLS Observer in the Flight Authorisation sheet for ZK515's flight carried out this function for the departure. — Exhibit 51, 97

[2] Lydian is the name used by Thales and U-TacS for the UK H450 programme.

For the return, another GTOLS Observer who was not annotated in the auth sheets, carried out this task. Both Observers had completed the Lydian GTOLS Observer course prior to the operational tour.

1.3.8. **57 Battery Senior Operator.** The Senior Operator (SO) was a qualified H450 MxC and had been appointed as SO immediately prior to 57 Battery's operational tour on HERRICK 14. As SO, in addition to the role of MxC, he had flown several operational sorties as an H450 UAS-c during the tour, though the Panel has found he was not fully qualified, competent and current as a UAS-c in accordance with the regulations[3]; he had not flown H450 for 2 years prior to the HERRICK14 tour or completed the necessary training and checks required. The SO had previously been qualified as a UAS-c, originally qualifying on type in 2007 and at the time of the accident had 800 total H450 hours. Before joining 57 Battery (Bty) he was a member of the Operating Standards Cell (OSC) within 32 Regiment (Regt) RA, a unit responsible for assuring the standardisation of all UAS operators. As such, he had conducted Theatre Qualification (ThQ) checks of 32 Regt H450 operators in both Iraq and Afghanistan. Prior to his time on H450, he was a Phoenix operator.

Exhibit 8

Witness 12

Previous 24 Hours

1.3.9. As a constituted crew, the day before the accident the UAS-c and UAS-p conducted a routine H450 flight, reporting for work at 0400L and finishing at 1015L. Following work the UAS-c went to the gym, had some food and then went to bed, waking at 0315L and reporting for work at 0335L on 2 Oct. The UAS-p carried out some admin after work on 1 Oct 11, had some food and went to bed before reporting for work at 0335L on 2 Oct 11. Both assert they had sufficient rest prior to duty on 2 Oct 11, in accordance with the Fatigue Management orders in force at the time.

Witness 9, 10

Exhibit 47

1.3.10. The MxC also had an uneventful day's operational tasking the day before the accident, though he flew with a different crew on 1 Oct to the crew he was with on 2 Oct. He finished his working routine at 1300L, went to the gym, had some food and went to bed at approx 2200L, waking at 0430L on 2 Oct and reporting for duty.

Witness 11

1.3.11. The EP and GTOLS Observer both had a normal routine the day before the accident and had sufficient rest in accordance with the regulations before reporting for work on 2 Oct.

Witness 1, 23
Exhibit 47

1.3.12. For the week preceding the accident the SO had been very busy as he was the only person in the Bty who could be present in the GCS to oversee every crew's GTOLS take-off and landing procedure as part of the **(S26)** . This routine involved him reporting for work in time to observe the first take-off at 0300L, then 0315L, 0600L and 0615L take-offs followed by an 0800L landing. He then remained at the Bty for approximately an hour and a half before leaving the Bty and returning to the accommodation for between 3-4 hours rest. He reported back to work in time to observe a landing at approx 1700L, another at 1715L followed by a take-off at 1800L, a landing at 2000L and another at 2015L. He left the Bty for the accommodation and got to bed by approx 2100L before waking at 0200L to return to the Bty in time to observe the 0300L take-off. This cycle continued at approximately the

Witness 12

[3] 1 Artillery Brigade Flying Order Book issue 5.

same times, every day, for the week preceding the accident. Of note, as SO he was not required to abide by the Fatigue Management regulations in force at the time. He estimates he had approximately 6-7 hours sleep per 24 hour period, split between 2 periods of rest for the week prior to the accident. The day before the accident followed this pattern and on 2 Oct he woke at 0200L and had been at work observing GTOLS events until the accident occurred at 0945L. Exhibit 47

Sortie Details and Preparation

1.3.13. On arrival at the Bty on 2 Oct 11, the UAS-p and UAS-c as operating crew began their normal pre-flight planning and preparation. The task was a routine Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) sortie in a familiar area; the mission was the same as one they had conducted 2 days earlier. Take-off was planned for 0600L with a flight duration of 14 hours. Owing to planned sortie length, the crew were scheduled to hand-over to another crew after 8 hours and were therefore not expecting to conduct the recovery or landing, planned for 2000L. There was no meteorological data forecast to affect the task and there was nothing significant in the SPINS[4] to affect the flight. The Unmanned Air Vehicle (UA) ZK515 had sufficient airframe and engine hours available to conduct the sortie and there were no Acceptable Deferred Faults or Limitations to affect the flight. During the crew's planning they noticed a hand written statement on the whiteboard in Operations limiting use of GTOLS on runway 01 due to airfield work in progress (WIP). Following the standard back-brief the AO authorised the sortie, but the back-brief did not include any limitations the WIP might place on H450 operations. Witness 9, 10 / Exhibit 28 / Exhibit 50 / Witness 10 / Witness 13 / Exhibit 28

1.3.14. The SO had no involvement in the sortie preparation or authorisation. Witness 12

Sortie Execution

1.3.15. ZK515 departed Bastion Airfield at 0600L. The GTOLS take-off, departure and initial climb to **(S26)** and towards the operating area were flown without incident, though it was noted at 0609L that the indicated engine air temperature was higher than expected during the initial climb, reaching 124°C. The engine air temperature stabilised at around 108°C once operating altitude was achieved and consistently noted as being higher than would normally be expected, although within limits. There were no other abnormal indications. To meet a currency requirement, the UAS-c flew the UA in 'Sticks mode'[6] for 20 minutes during the transit as per the flight authorisation. Exhibit 4 / Witness 10 / Annex A / Annex A / Witness 10 / Exhibit 51

1.3.16. After two hours of the mission at 0803L the engine air temperature began to gradually increase. When the engine air temperature reached 114°C the UAS-c informed the Ops Officer and sought advice from the Royal Electrical and Mechanical Engineers (REME); the advice was to continue monitoring the air temperature for 30 minutes as it was still within limits. The UAS-c also checked the current engine parameters against those recorded during ZK515's previous day's flight and noted the engine air temperature was running about 10°C hotter. The SO entered the GCS at this stage to monitor Exhibit 4 / Annex A / Witness 9, 10

[4] Special Instructions for all flying activity within the Joint Area of Operations, issued by the Combined Air Ops Centre in Al Udeid.
[5] **(S26)**

[6] The UAS-p will take control of the UA manually and fly it by using the Flight Control Unit 'sticks' within the GCS.

what was happening. At approximately 0855L, following a Spec-C command[7], the engine air temperature reached 123°C; this temperature was now within the yellow sector of the gauge. At 0858L the UAS-c decided to terminate the mission early and return to base. The SO agreed with the UAS-c's decision and left the GCS to inform Bty Operations.

Witness 10, 12

Witness 9, 12

Accident Events

1.3.17. The transit back to **(S26)** was completed without incident. When the UA was within the vicinity of **(S26)** the SO re-entered the GCS. At this time the UAS-c informed the EP that they were returning and, according to the operating crew, the EP refused to take the UA for a manual landing due to the WIP vehicles, positioned to the south of the H450 runway, posing an obstruction. Without the option of an EP landing, the crew of ZK515 still had the option of a GTOLS landing. Following de-confliction with another H450, **(S26)** , that was initially returning ahead of them, ZK515 routed towards ECHO Hold whilst descending from **(S26)** above mean sea level (amsl). ZK515 reached **(S26)** hold at 0924L at **(S26)**, now below **(S26)** and in front of it for recovery. Once established in **(S26)** Hold, a descent to 4500' was requested from Air Traffic Control (ATC) in an attempt to cool the engine; at 0927L, a descent to 5000' was approved by ATC in order to de-conflict from inbound fixed-wing traffic. At 0932L the engine air temperature entered the red section of the gauge at 136°C.[8] A request was made at this time by the crew to ATC to move the WIP vehicles, but ATC informed them it would take 30 minutes to clear the people and vehicles. The UAS-c asked the GTOLS observer if the vehicles presented an obstruction and the observer stated there was not a problem as the vehicles were further than 20 meters from the end of the arrestor cables. The UAS-c then elected to conduct a GTOLS landing immediately owing to the high air temperature and requested the SO remain in the GCS to oversee the procedure as this was to be the UAS-c's first GTOLS landing in 5 months.

Exhibit 4
Witness 10, 12

Witness 9, 10
Witness 1

Witness 9

Annex A

Witness 10

Witness 10

1.3.18. The UA engine air temperature remained in the red until 0936L when ZK515 was cleared by ATC for a descent to 4000' and a GTOLS approach to PAPA 01 (P01) taxiway.[9] There was negligible surface wind, but P01 was the landing runway in use for H450 at the time as the arrestor cables had already been set by the Lydian Field Service Rep (FSR) in preparation for **(S26)** landing. The ATC clearance to make an approach to P01 was not acknowledged by the crew and they instead prepared for a P19 GTOLS approach. As the UA descended at idle power the engine air temperature reduced back to the green sector of the gauge.

Annex A

Exhibit 4

Witness 7

Exhibit 4
Annex A

1.3.19. At 0939L, shortly after the GTOLS P19 approach was initiated by the crew, the UA self-aborted the approach; ZK515 was at 3558' altitude, approximately 500' above ground level (agl). The self-abort was due to an incorrect parameter in the GTOLS set-up form loaded by the crew[10] resulting in failure of the GTOLS approach validation check. Concurrently, the FSR and EP noticed the UA was not flying in the direction they would have expected for an approach to P01 and asked the UAS-c which runway had been selected. Some confusion followed over which runway could be used to make a GTOLS landing as the crew did not think a GTOLS landing was possible on P01 owing

Annex A

Witness 10, 12
Witness 7, 9

Witness 9, 10, 12

[7] Spec-C is a wide-open throttle command periodically carried out to prevent carburettor icing, with a duration of 30 seconds.
[8] The H450 Quick Reference Handbook (Exhibit 46) warns that with an engine air temperature above 140°C engine failure might occur.
[9] Taxiway Papa 01/19 is the main runway for H450 operations at Bastion. It is the Papa parallel taxiway to the west of the main runway 01/19.
[10] Entrance Way Point was selected as 'Directly' rather than 'WP1' to begin the GTOLS approach from the correct waypoint.

to the WIP. The SO also believed this to be the case. The SO then asked the Operations Room if it was possible to make a GTOLS approach to P01 and he was informed this was possible. Witness 12

1.3.20. Moments after the self-abort, recognising the urgency of the situation and the additional strain placed on the engine by the go-around, at 0940L the UAS-c abbreviated the pre-programmed go-around GTOLS route by sending the UA straight back to the **(S26)** hold with a 'Fly To Coordinate' command. The UA was at 3600' altitude at this point, approximately 550' agl. The UAS-c rapidly prepared for a GTOLS approach to P01. As the UA was climbing towards **(S26)** hold the engine air temperature rapidly rose again into the red sector and as it reached 138°C, at 0943L the UA engine failed. ZK515 was at 3926' altitude, approximately **(S26)** . Witness 10 Annex A Annex A Exhibit 4

(S26)

Figure 3 – ZK515 GCS Display screenshot shortly after engine failure

1.3.21. An emergency 'Pan' transmission was made by the UAS-p on Tower frequency to ATC as the crew carried out the Quick Reference Handbook (QRH) drills for an engine failure and the UAS-c attempted to upload an Emergency Landing Site (ELS) to ZK515 that was within glide range of its current position. Prior to receiving the updated ELS, the UA adopted the 'No-Comms GTOL 01' route as per the H450 system logic. Coincidentally, the UA initially headed towards the position of the ELS, but at 0944L the UA turned left, back towards the airfield, as observed by the EP and SO. This was not what the crew were expecting, so the UAS-c attempted to command the UA back towards the ELS. At 0944L the UA received the command, but by this time it was only approximately **(S26)** and too late to make a difference to the flight Witness 9 Exhibit 96 Witness 10 Annex A Exhibit 13 Witness 1, 12 Witness 9,10 Annex A

path.

1.3.22. ZK515 initially impacted a new, unoccupied, United States Marine Corps hangar on the North East corner of Bastion Airfield, which broke off the UA's port wing, before striking the ground upside down and sliding approximately 100m and coming to rest on a newly constructed, but empty, aircraft dispersal pan. Exhibit 2

(S26)

Figure 4 – ZK515 flight path prior to crash

Post-Accident Events

1.3.23. Shortly after the crash 57 Bty Post Crash Management (PCM) personnel were paged and informed of **(S26)** .[11] ATC initiated an Emergency State 1 and tasked the crash and rescue services. There was a slight delay as the exact location of the crash was not initially known and ATC were not sure if the UA had crashed inside or outside the perimeter fence. There was no impact to air operations and the airfield remained open throughout the PCM process. After initial briefing from the Bty Captain (BK), the Artificer and Equipment Manager (EM) were deployed immediately to the crash site to take charge of the scene and were soon after assisted by Sqn Ldr Operations from 903 EAW. The Theatre UAS Bty Ops Officer informed all the relevant personnel identified in the **(S26)** . All equipment and documentation involved in the accident was placed under quarantine with hot statements taken from all involved. Quarantine was only broken with the authority from the relevant agencies. Immediately upon arrival at the crash site the EM set up a Cordon to control access to the site. The Artificer was granted permission by the Brigade Aviation Role Office (BARO) on 2 Oct 11 to remove the Flight Data Recorder (FDR) from the aircraft to preserve evidence. On 4 Oct, the Head of the Military Air Accident Investigation Branch (MilAAIB)

Exhibit 67

Exhibit 66

Exhibit 68
Exhibit 69

[11] **(S26)**

granted permission to remove the emergency battery due to a significant fire risk; this was supervised and recorded by the Military Police. The crash site then remained under cordon with a 24 hr guard until the Service Inquiry (SI) Panel arrived.