SECTION 1.4.5 – COLLISION, AFTERMATH AND FOLLOW ON ACTION

1.4.5.1 The accident involved two aircraft from different formations. Together, the formations numbered four aircraft and eight crewmembers. The actions of the eight crewmembers, interwoven with the maintenance and Flypro of the four aircraft create a complex picture. Further complication was added by personnel performing multiple supervisory duties due to half of the Sqn having deployed to Cyprus on exercise. The similarity of the formation callsigns, ASTON and ABBOT, can create confusion.

1.4.5.2 The crews were allocated as follows. The descriptors in the left hand column will be used to describe each crewmember throughout the report:

a. **ASTON 1 – ZD743**
   (1) Pilot: Student Pilot. (Deceased)
   (2) WSO: OC B Flight (Programming), Stand in OC XV(R) Sqn, Qualified Tactics Instructor (QTI). (Deceased)

b. **ASTON 2**
   (1) Pilot: Student Pilot.
   (2) WSO: Sqn WSO, QTI. Set the scenario for ASTON sortie.

c. **ABBOT 1**
   (1) FS Pilot: Student Pilot.
   (2) RS Pilot: Supernumerary Sqn Ldr on XV(R) Sqn, Qualified Weapons Instructor (QWI), was 1st Duty Authoriser, gave phase brief to student pilot before going flying.

d. **ABBOT 2 – ZD812**
   (1) FS Pilot: Student Pilot. (Deceased)
   (2) RS Pilot: STANEVAL(Synthetic). QWI. Led the plan for ABBOT sortie. (Survived)

Introduction

1.4.5.3 This section covers the collision, its aftermath, and follow on action. It is divided into the following sub-sections:

a. Collision Sequence of Events

b. Separation from Aircraft/Ejection

c. Search and Rescue (SAR) Action

d. Post Crash Management

Collision Sequence of Events

1.4.5.4 This section describes how the aircraft collided, the resulting damage to each aircraft, and how each aircraft crashed into the sea. The separation of the crew from the aircraft is excluded. This section is divided into the following sub sections: Exhibit 15

a. Point of Impact

b. Post Collision

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(1) ASTON 1

(2) ABBOT 2

Point of Impact

1.4.5.5 The first physical contact between the two aircraft occurred when the nose of the right underwing fuel tank of ABBOT 2 collided with the right engine air intake cowling of ASTON 1 (Figure 49). Exhibit 15

Exhibit 15

ABBOT 2 – Green
ASTON 1 – Blue

Figure 49. Computer Generated Collision Model

1.4.5.6 As the two aircraft moved together, the leading edge of the right wing of ABBOT 2 collided with the rear of the cockpit of ASTON 1. Both the wing of ABBOT 2 and the rear cockpit of ASTON 1 broke up as they collided with each other. Approximately one third of the right wing of ABBOT 2 was lost and the remaining wing section was forced back to a nominal Wing Sweep Angle (WSA) of 67°, fracturing the wing sweep actuator. As the rear of the cockpit of ASTON 1 broke up, the front of the cockpit became separated from the fuselage. Exhibit 15

Post Collision – ASTON 1

1.4.5.7 ASTON 1 lost electrical power at the point of separation of the fuselage and the cockpit. The Replacement Air Data Recorder (RADR) recorded no voice or data from the point of collision onwards. Exhibit 15

1.4.5.8 The front cockpit section (Figure 50), having become detached from the fuselage, underwent a ballistic descent into the sea. Exhibit 15

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Figure 50. ASTON 1 Wreckage Viewed from Front Left

1.4.5.9 With the cockpit removed, the fuselage (Figure 51) became unbalanced between the front and rear and as a result, pitched upwards. The engines RPM slowed, the wing section stalled and lost lift. The fuselage began a ballistic descent into the sea. Exhibit 15

Figure 51. ASTON 1 Rear Fuselage Viewed from Above

1.4.5.10 In the collision, a fire had broken out on the upper surface of the fuselage. The source of fuel for the fire could have been either the ruptured underwing fuel tank of ABBOT 2 or one or more of ASTON 1's internal fuel tanks having been ruptured when the rear of the cockpit broke up. There are numerous potential sources of ignition. The increased angle of attack produced an area of recirculating air which provided the fire with the environment necessary to sustain itself until entry into the sea. Exhibit 15

1.4.5.11 ASTON 1 entered the water at a considerably lower airspeed than it had been flying at prior to collision. The engines were running slowly or had stopped and the fuselage created a lot of drag due to its attitude, slowing its forward speed. As a result, significant elements of the fuselage and the engines were intact and easily identifiable following entry into the sea. Exhibit 15

Post Collision – ABBOT 2

1.4.5.12 The forward motion of ASTON 1 forced the right wing of ABBOT 2 upwards in addition to rearwards. The result was that ABBOT 2 initially rolled anticlockwise and gained height following the collision. Exhibit 15

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1.4.5.13 The anticlockwise roll was opposed by the imbalance of lift now being produced across the wings. The left wing was producing the expected amount of lift, but the right wing had lost one third of its section and had been swept back. The left side of the aircraft was producing more lift than the right, inducing a clockwise roll. Yaw is produced as a secondary effect of roll; the yaw rate increased to approximately 24° per second. The resultant flight profile was a corkscrew style positively accelerated (+5.5 g) spiral descent. Exhibit 15

1.4.5.14 Immediately following the collision, the aircraft control column was moved to the fully forward and fully left position and 10° left rudder was applied. Damping of the yaw rate, in response to the rudder input, was evident for a very short period. There was no discernable aircraft response to the control column inputs. Exhibit 15

1.4.5.15 The throttle control was moved to max reheat at the same time as the control column movement. The engine output increased accordingly. The airspeed did not increase as a result of drag induced by the manoeuvres being performed. Exhibit 15

1.4.5.16 Within one second of the collision, the Command and Stability Augmentation System (CSAS) reverted to mechanical mode. This was as a result of system failures in the pitch and roll controls. Reversion to mechanical mode reduces the amount of control authority available and CSAS ceases to provide control assistance. Exhibit 15

1.4.5.17 Whilst the aircraft was still in aerodynamic flight throughout its descent into the sea, it was not possible to bring that flight under control. Exhibit 15

1.4.5.18 ABBOT 2 flew into the sea approximately 5 secs after colliding with ASTON 1 at an approximate speed of 360 kts. The aircraft disintegrated as it entered the water (Figure 52). Exhibit 15

Figure 52. ABBOT 2 Wreckage Viewed from the Front

Separation from Aircraft/Ejection

1.4.5.19 This sub-section describes how the aircrew became separated from their aircraft. It is divided as follows:

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a. ABBOT 2

b. ABBOT 2 RS Pilot (Survived)

c. ABBOT 2 FS Pilot (Deceased)

d. ASTON 1 WSO (Deceased)

e. ASTON 1 Pilot (Deceased)

ABBOT 2

1.4.5.20 Approximately 2 secs after the collision, the call *"EJECT, EJECT, EJECT"* was made. It is not possible to determine which pilot gave the call and the surviving crew member has no recollection of the event. Inspection of the Pilot's seats found that both Seat Pan Firing Handles (SPFHs) had been fully withdrawn, and the cartridges had fired. It is likely that both Pilots pulled their SPFHs during or shortly after the eject call. Exhibit 7 Witness 16 Exhibit 15

1.4.5.21 Approximately 3 secs after the collision, the RADR recorded a loss of cabin pressure. The first step of the ejection sequence is the jettison of the cockpit canopy. The timing at which pressure loss occurs fits with the anticipated ejection sequence timings had ejection been initiated as the call of *"EJECT, EJECT, EJECT"* was made. The cockpit canopy was not found within the aircraft wreckage trail which suggests that the canopy did not enter the sea at the same time and place as the rest of the aircraft. The absence of the cockpit canopy can be explained by it having been jettisoned prior to the aircraft's impact with the sea. Exhibit 78 Exhibit 446 Exhibit 15

1.4.5.22 In the Before Take-Off Checks, ABBOT 2 RS Pilot confirmed to the FS Pilot that "BOTH" was selected on the Command Ejection Selector. In this configuration, if either Pilot initiated ejection, both Pilots would be ejected. The RS Pilot would be ejected first, followed by the FS Pilot. With "BOTH" selected, the canopy is jettisoned first, followed by the rear seat approximately 0.3 secs later, and the front seat 0.4 secs after the rear seat. Exhibit 7 Exhibit 446 Exhibit 15

1.4.5.23 The ejections of the RS and FS Pilots were modelled by Martin Baker Aircraft Company (MBA) and the Centre for Aviation Medicine (CAM). The models are purely mathematical and simplified from reality, taking no account of weather (wind) or temperature (air pressure) conditions. The start point of the models is defined by the change in cockpit pressure, which was assumed to signify the jettison of the cockpit canopy. Very small alterations in input data can have large effects on the result of simulations, and therefore great efforts were made to ensure the most appropriate parameters were used, and their limitations acknowledged. Exhibit 15 Exhibit 462

1.4.5.24 The cockpit pressure is recorded at one second intervals on the Tornado RADR. The change in pressure could have occurred at any time in the one second period since it was last recorded, so a range of start conditions was considered. Exhibit 78 Exhibit 15

1.4.5.25 For each time at which the canopy could have been jettisoned, there is a corresponding set of flight data with its own variations to be applied. The airspeed, altitude and roll angle all varied with time and are sampled at differing rates. The roll angle feed was lost following the collision; roll angles were therefore derived from the recorded rate of roll. Exhibit 15 Exhibit 462

1.4.5.26 In sum, there is a margin of error in the models. The models are useful in providing a range of possible outcomes, but are in no way definitive. The limitations described above apply to all figures used to describe the ejections below. Exhibit 15

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ABBOT 2 RS Pilot (Survived)

1.4.5.27 ABBOT 2 RS Pilot was found in the sea wearing his helmet and was still attached to his fully extended parachute. He was wearing his inflated Life Preserver Aircrew (LPA) and was in the sea holding onto the side of his inflated liferaft. He was attached to his liferaft via the Personal Survival Pack (PSP) lowering line. He had not been able to climb into his liferaft or extract the FastFind beacon from his Combat Survival Waistcoat (CSW) and operate it. Exhibit 42 Exhibit 15

1.4.5.28 The state in which the RS Pilot, his Aircrew Equipment Assembly (AEA), and Survival Equipment (SE) were found, suggests that he entered the sea having undergone the full ejection sequence. The only contra-indication was that the PSP lowering line had not deployed fully from its beckets on the Survival Aids Container (SAC). The PSP is expected to deploy within 4 secs of man-seat separation. Either there had been a fault with the PSP lowering fully or the RS Pilot entered the sea within 4 secs of separating from his seat. Exhibit 15 Exhibit 446

1.4.5.29 The models predict that the RS Pilot entered the sea at a rate of descent of up to 8.3 m/s. Table 5 details the results of MBA and CAM ejection modelling. This rate of descent at landing is considered to be on the edge of the designed maximum safe speeds for a successful landing following an ejection. The design safe speeds are based upon the requirement not to sustain life threatening injuries in a worst case scenario of landing on hard ground. A landing on any more favourable surface which reduces the rate at which deceleration occurs, increases the chance of survival and decreases the risk of injury. In design terms, 9 m/s is on the edge of the envelope but, into the sea, it can be an easily survivable landing. Exhibit 15

	Altitude on Ejection (m)	129	139
CAM	Time from initiation to impact (secs)	4.1	6.6
	Impact Velocity (m/sec)	**8.1**	**6.6**
	Ejection Gun Acceleration (g)	15.7	15.7
	Parachute Opening Shock Acceleration (g)	15.5	15.5
MBA	Time from initiation to impact (secs)	3.33	4.67
	Impact Velocity (m/sec)	**8.3**	**6.1**

Table 5. MBA and CAM Ejection Modelling for the RS Pilot.

1.4.5.30 The RS Pilot had been unable to complete his survival drills as a result of a [redacted] When rescued, he was [redacted] Exhibit 15 Exhibit 44 Exhibit 42

[redacted] Exhibit 15

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[redacted] Exhibit 15

ABBOT 2 FS Pilot (Deceased)

1.4.5.33 The ABBOT 2 FS Pilot was recovered from the sea bed eight days after the accident. He was still attached to his deployed parachute and the CO_2 bottle of his liferaft was attached to the fully deployed PSP lowering line. The remainder of his liferaft was recovered on the day of the accident by R138, the SAR helicopter. It was found partially inflated, held in place in the water by an unknown submerged load. Exhibit 15 Exhibit 43

1.4.5.34 The deployment of his parachute and the distance he was found from his ejection seat suggest that some elements of the ejection sequence were successful.

[redacted]

1.4.5.36 The altitude, airspeed, bank angle, rate of roll and pitch angle of the aircraft at which the FS Pilot ejected were significantly different to those when the RS Pilot ejected. This is a result of the time delay between operation of the seats which prevents the seats colliding in mid air. Modelling of the FS Pilot's ejection gave very different results to that of the RS Pilot's ejection. MBA and CAM predicted that the FS Pilot entered the sea at high speed, although the magnitude of that speed varies dramatically as shown in Table 6. The injuries sustained by the FS Pilot are not consistent with the highest predicted entry speeds (80 m/sec), and are more complex in nature than would be expected purely from a high speed entry into water. A Federal Aviation Administration report into fatal injuries resulting from extreme water impact at velocities between 32 and 33 m/sec reported significant trauma, which were not present in this case, and allowed the Panel to discount extreme entry speeds. Exhibit 459

1.4.5.37 The start point data for the modelling contains margins of error as a result of the sampling rate and resolution of the recorded data. Running the same models with very slightly different start point data produced impact velocities as low as 6.9 m/sec, which are not recorded in the table below. Impact at 6.9 m/sec in this configuration would most likely be survivable and injury free. This was not the case for the FS Pilot, so such low velocities are also ruled out. Exhibit 462 Exhibit 50

	Altitude on Ejection (m)	94	103
CAM	Time from initiation to impact (secs)	1.99	2.3
CAM	Impact Velocity (m/sec)	**80**	**50**
CAM	Ejection Gun Acceleration (g)	14.6	14.6
CAM	Parachute Opening Shock Acceleration (g)	-	-
MBA	Time from initiation to impact (secs)	2.09	2.53
MBA	Impact Velocity (m/sec)	**71.8**	**27.8**

Table 6. MBA and CAM Ejection Modelling for the FS Pilot. Exhibit 15

1.4.5.38 There was not sufficient time for the full ejection sequence to have taken place before the FS Pilot entered the sea. Given that the shortest predicted length of time available was 1.99 secs, man-seat separation is expected to have commenced. The FS Exhibit 15

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Pilot would have been released from the seat, but may not have achieved significant clearance from it. Clearance from the seat is achieved as the main parachute deploys. The pilot slows under retardation from the parachute, whilst the seat continues unretarded. The models put entry into the sea at a point where the main parachute was still deploying.

1.4.5.39 Examination of the ejection seat, AEA and SE of the FS Pilot revealed several corresponding sets of damage which indicate that the seat and FS Pilot collided on entry into the sea. It is likely that entry into the sea at high speed was exacerbated by collision with and disruption by his ejection seat. The FS Pilot was killed instantly as he and his ejection seat entered the sea. Exhibit 15

ASTON 1 WSO (Deceased)

1.4.5.40 ASTON 1 WSO was killed instantly as the right wing of ABBOT 2 and the rear of the cockpit of ASTON 1 collided. The WSO did not have sufficient time to initiate ejection. His ejection seat was broken into fragments. Few components of his seat were recovered; it was not possible to ascertain which, if any, components had operated. The seat could not have operated as designed as a consequence of the degree to which it was damaged and fragmented. Exhibit 50 Exhibit 15

ASTON 1 Pilot (Deceased)

1.4.5.41 ASTON 1 Pilot was found deceased in the sea, attached to both his parachute and his inflated liferaft. His LPA had operated automatically, but the inflatable stole was punctured. He was found 1.186 km away from where his ejection seat was retrieved on the sea bed. This is a significant distance and will be explained in para 1.4.5.50. Witness 18 Exhibit 42 Exhibit 15

1.4.5.42 Inspection of the ejection seat of the ASTON 1 Pilot revealed that he had not initiated ejection. The Seat Pan Firing Handle (SPFH) was dislodged from its stowed position, but had not moved far enough to initiate ejection. Exhibit 15

1.4.5.43 Although the SPFH had not been pulled, elements of the ejection system had operated. They were: Exhibit 15

a. Rocket Motor

b. Drogue Gun

c. Barostatic Time Release Unit (BTRU)

d. Parachute

e. PSP ADU and deployment of PSP lowering line

1.4.5.44 The following items did not/were not operated:

a. SPFH

b. Harness Power Retraction Unit (HPRU)

c. Breech Type Time Delay Firing Unit (BTTDFU)

d. Ejection Gun Cartridges

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1.4.5.45 That only the components listed at 1.4.5.43 operated indicates that an ejection was not initiated by the WSO pulling his SPFH. It is normal practice for Tornado OCU crews to select the "BOTH" position on the Command Ejection Controller. In this position, pulling either SPFH initiates ejection for both occupants. Had the WSO pulled his SPFH, it would have initiated the ejection seat of the Pilot as well as his own, and vice versa. If initiation had occurred in this manner, the HPRU, BTTDFU and ejection gun cartridges would have fired. Exhibit 15 Exhibit 7 Exhibit 446

1.4.5.46 The rocket motor is fired by a static line which is attached to the airframe. The motor is triggered when the seat achieves sufficient clearance from the airframe to place the static line under tension. Exhibit 446 Exhibit 15

1.4.5.47 The drogue gun and BTRU are triggered by static rods which are attached to the airframe. They are triggered as the ejection seat is fired out of the aircraft by the ejection gun and the seat is displaced relative to the airframe. Exhibit 446 Exhibit 15

1.4.5.48 It is not possible to ascertain the order in which the rocket motor, drogue gun and BTRU were initiated. All three components can be initiated through the seat becoming displaced relative to the airframe, thus applying tension to the static lines and rods. Exhibit 15

1.4.5.49 Displacement of the seat relative to the airframe could have been caused by: Exhibit 15

a. the airframe being disrupted as forces from the collision were transmitted forwards from the point of impact.

b. the ejection seat having been struck on the side by components displaced in the collision i.e. refuelling probe or cockpit canopy.

c. a combination of a and b.

d. the airframe continuing to break up as it descended following the collision.

e. the airframe breaking up on entry into the sea.

1.4.5.50 There is a significant difference in the distance between the locations in which the ASTON 1 Pilot and his seat were found (1.186 km), compared to the same metric for both ABBOT 2 Pilots (0.224 km and 0.307 km), illustrated in Figure 53. It is known that the ABBOT 2 Pilots spent a very short period of time descending under parachute. Therefore, the distance they were found from their seats is attributable to a few secs of descent followed by approximately 70 mins of sea drift. The time difference in locating each of the pilots was small. Had ASTON 1 Pilot and ABBOT 2 Pilots entered the water in a similar fashion, they would have been separated by only 0.8 km, where sea drift would not vary considerably over this distance. The three locations would not be expected to be very far different from the 0.8 km entry locations. Hence, it is most likely that the ASTON 1 Pilot and his ejection seat became separated from the forward fuselage at altitude and the excess displacement from his start point is due to wind drift whilst descending under parachute. It follows that the disruption and initiation of elements of the ejection sequence would have occurred at, or shortly after, the point of collision, as described in options a through d in para 1.4.5.49, prior to the cockpit entering the sea. Exhibit 42 Exhibit 43 Exhibit 15

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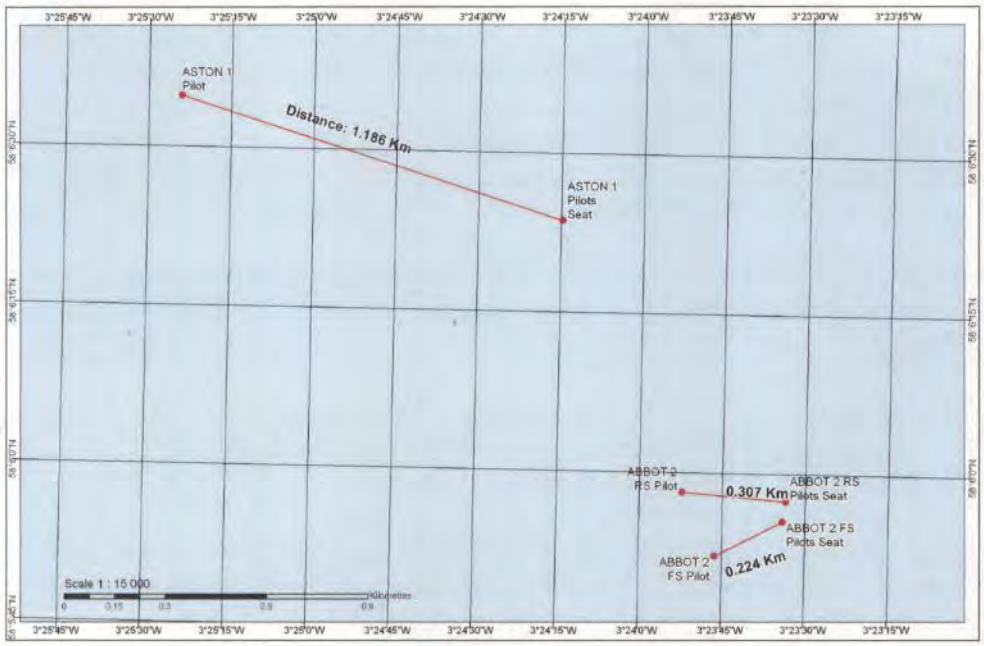

Figure 53. Seat vs Aircrew Found Positions Plot.

1.4.5.51 Both the collision and separation from the cockpit were violent. The ejection sequence, when operating normally, has delays (based either upon time or forces due to acceleration) between each step in order, in part, to prevent excessive forces being applied to the occupant. ASTON 1 Pilot did not have the benefit of these delays as those items that operated, did so independently. Exhibit 446 Exhibit 15

1.4.5.52 It is not possible to discern which injuries sustained by the ASTON 1 Pilot were a direct result of the collision and which were a result of his separation from the aircraft and operation of elements of his ejection seat. The Pilot did not pull his SPFH; therefore, if he did survive the collision, he did not have enough time to act before elements of his ejection seat functioned. Exhibit 50 Exhibit 15

1.4.5.53 It is believed that ASTON 1 Pilot's descent under parachute, once separated from the cockpit, was benign. His PSP deployed beneath him to the full extent of the PSP lowering line, and his liferaft inflated automatically upon entry into the sea. The Automatic Life Preserver Inflation Unit (ALPIU) operated automatically on entry into the sea and the life preserver stole deployed from its cover. The stole was punctured adjacent to the ALPIU operating head. It is most likely that the damage was sustained during the collision and separation from the aircraft, and that pressure was lost as the stole inflated and folded out to expose the puncture. Exhibit 15

Identification of the Emergency

1.4.5.54 This sub-section covers the means available to identify an emergency and how they performed in this accident. It is subdivided as follows:

a. How this Emergency was Identified

b. Beacons – Auto-Initiated

c. Beacons – 406 MHz

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d. Beacons – 121.5/243 MHz

How this Emergency was Identified

1.4.5.55 The first indication that an incident might have occurred became apparent to the Tain Air Weapons Range Controllers (AWRCs). They acted quickly in seeking assistance from RAF Lossiemouth Air Traffic Control (ATC) to try and re-establish communication with the aircraft and to communicate their own concern that a collision may have occurred. Witness 1 Witness 3 Exhibit 4 Exhibit 5

1.4.5.56 The Supervisor at RAF Lossiemouth ATC was careful not to overreact, whilst taking the concerns raised by the Tain AWRCs seriously. She initiated additional attempts to communicate with the aircraft from RAF Lossiemouth ATC and enlisted the assistance of Distress & Diversion (D&D) in attempting to raise them on the Guard frequency. D&D could communicate over much greater distances than RAF Lossiemouth, thus widening the search area. Witness 20 Witness 21 Exhibit 4 Exhibit 5 Exhibit 41

1.4.5.57 The RAF Lossiemouth ATC Supervisor made a telephone call to D&D again immediately after ABBOT 1 reported hearing a beacon. The D&D controller asked what kind of beacon ABBOT 1 was hearing in order to confirm whether or not there might be a link with two reports of Emergency Location Transmitters (ELTs) which had been received shortly beforehand. ABBOT 1 was correct in its response that the beacon was a Personal Locator Beacon (PLB); however, there is no audible way to distinguish between an ELT and a PLB heard on a radio. An ELT is usually a larger emergency beacon that is fitted to an aircraft (which can be automatically or manually operated) a PLB is usually a smaller, handheld device for personal use to indicate a person in distress. Exhibit 4 Exhibit 41

1.4.5.58 The IFF transponder of Tornado aircraft is set to switch to the emergency code 7700 on initiation of ejection. Aircraft squawking 7700 are automatically highlighted on ATC screens. There was no detection of aircraft squawking 7700 by any air traffic agency. The accident may have occurred at too low an altitude to have been detected and for too short a time. The separate beacon reports received did not constitute sufficient evidence because: Witness 57 Exhibit 418

a. the reports of emergency beacons (specifically ELTs, although they are indiscernible to PLBs) had been received from Commercial Air Traffic (CAT). They were flying at FL 115 ivo Wick and FL 340 ivo Stornoway. It was not possible to identify an approximate location of the ELT(s) from these reports because line of sight from the reporting aircraft gave range rings of 131.3 nm and 225.8 nm; Exhibit 447 Exhibit 41

b. it was not possible to determine whether the CAT were reporting the same single, or two unique beacons. 121.5/243 MHz beacons do not transmit unique identifiers;

c. the proliferation of 121.5/243 MHz beacons results in significant numbers of false alarms per year. Incidents are not routinely initiated solely on the basis of a 121.5/243 MHz beacon being heard. Reports of a beacon being heard usually result in phone calls being made to likely agencies that may have personnel using such beacons in order to confirm whether or not an emergency exists. Witness 57 Exhibit 418

1.4.5.59 There was insufficient evidence for the D&D controller to identify an emergency and report it to the Aeronautical Rescue Coordination Centre (ARCC).

1.4.5.60 The act of distinguishing the two sets of reports from each other by identification of the beacon type may have delayed the identification of an emergency by the D&D controller. Linking the reports with the emerging RAF Lossiemouth based incident may have been sufficient to initiate a response.

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1.4.5.61 The ATC Supervisor decided to request that D Flight launch an aircraft based on the reports of beacons heard, the concerns of the Tain AWRCs, the lack of response from ASTON 1 and ABBOT 2, and a request for the launch of SAR by ABBOT 1. The ATC Supervisor was aware that she did not have the authority to direct the launch of SAR, but telephoned direct to D Flight in the interests of expediency. Witness 20 Witness 21 Exhibit 4 Witness 5

1.4.5.62 The ARCC received no notifications other than from RAF Lossiemouth ATC and D Flight because:

a. no 406 MHz beacon was activated by the aircrew; Exhibit 15

b. the auto activated Search And Rescue Beacon (SARBE) 7 beacons, operating on 121.5/243 MHz were not detected by satellite. Beacons operating on these frequencies are no longer monitored by the Cosmicheskaya Sistyema Poiska Avariynich Sudov – Search and Rescue Satellite-aided Tracking (COSPAS-SARSAT) network; Witness 58

c. the land based Transmitter/Receiver (TX/RX) network and Direction Finding sites did not detect the SARBE 7 beacon transmissions on 121.5/243 MHz; Exhibit 450

d. no beacons could be heard on Guard through the land based TX/RX network; Exhibit 41

e. neither aircraft had made contact with D&D. Exhibit 41

Summary

1.4.5.63 There was insufficient evidence for the D&D controller to define an incident and initiate a response by reporting it to the ARCC. The frequent false alarms, lack of positive confirmatory information such as a mayday call or 7700 squawk and vague positional information (including the confusing use of ELT within the reporting) did not give sufficient evidence to raise an alarm. The ATC Supervisor, in contrast, had more specific information with which to react and launch the SAR aircraft.

1.4.5.64 The air traffic controller on duty in D&D did not have sufficient knowledge or experience of distress beacons to understand the limitations of the information being reported to him.

1.4.5.65 The actions of the AWRCs and the ATC Supervisor led to the normal SAR deployment cycle being bypassed and the SAR assets being deployed more quickly than might have occurred otherwise. It is likely that the next trigger for action would have been overdue action when the aircraft did not return to RAF Lossiemouth as scheduled.

Beacons – Auto-Initiated

1.4.5.66 UK MoD Fast Jet (FJ) aircrew are not equipped with 406 MHz beacons which operate automatically upon ejection. The RAF holds limited numbers of 406 MHz beacons capable of operating automatically on contact with salt water (SARBE G2R). These beacons are reserved for aircraft operating more than 50 nm from land or long distance flights overseas and are not issued for local sorties.

1.4.5.67 UK MoD FJ aircrew are equipped with SARBE 7 beacons which operate automatically during the ejection sequence and are also fitted with a pull toggle for manual activation. SARBE 7 beacons operate on 121.5/243 MHz.

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1.4.5.68 The COSPAS-SARSAT network monitored 121.5/243 MHz up until 1 Feb 09. COSPAS-SARSAT had always monitored 406 MHz as well as 121.5/243 MHz, but 406 MHz became the sole frequency monitored from 1 Feb 09. The cessation of 121.5/243 MHz monitoring by COSPAS-SARSAT was announced in Oct 00. Exhibit 293

1.4.5.69 On 24 Sep 08, Signature Industries, a subsidiary of Digital Angel Corporation, was awarded the contract to supply the MoD with the Personal Emergency Locator System (PELS). PELS was to replace the SARBE 7 beacon. Delivery was scheduled to take place between Quarter 4 of 2009 and Quarter 1 of 2010. The PELS project failed to deliver. The contract was cancelled with mutual agreement between the MoD and Digital Angel Corporation in Apr 12. The procurement of PELS is covered in Section 1.4.6. Exhibit 448

1.4.5.70 FastFind beacons, which are not auto-initiated in the event of aircrew being incapacitated, were procured by Front Line Commands (FLCs) as an interim measure to restore a limited capability for detection by COSPAS-SARSAT. For Tornado pilots, the FastFind beacon is stowed in the CSW which is worn beneath the LPA. The location in which it is stowed is not easily accessible. Other military aircraft operators, such as the SAR Force, have integrated the FastFind into their LPAs improving ease of access.

Summary.

1.4.5.71 There was no automatically generated notification of the incident to the ARCC because the crew were not equipped with auto-initiated beacons operating on the COSPAS-SARSAT monitored frequency.

1.4.5.72 The MoD did not procure a replacement auto-initiated beacon prior to satellite monitoring of the in service auto-initiated beacon ceasing. This was due in part to not commencing procurement in a timely manner and in part due to the subsequent failure of the project. COSPAS-SARSAT gave eight years notice of the change in operating frequencies. The MoD awarded the contract to replace the beacon four months before the change was scheduled to occur. The subsequent failure of the project lengthened the period for which crews do not have an adequate beacon.

1.4.5.73 The FastFind beacon was procured to partially mitigate the capability gap left by the failure of the PELS project. Had the beacon been auto-initiating, it would have been sufficient to mitigate the failure of the PELS project in the interim. Operation of the beacon is made more difficult by its stowage location in the CSW underneath the LPA. This is discussed in more detail in Sea Survival, Aircrew Survival Training and UK SAR, SOPs, PELS in Section 1.4.6.

Beacons – 406 MHz

1.4.5.74 The only member of aircrew to survive the collision and subsequent impact with water was not capable of accessing and operating his FastFind beacon. He used both hands to hold onto his liferaft. Two free hands are required to operate this beacon. Exhibit 15

1.4.5.75 Two FastFind beacons were recovered with the ASTON 1 Pilot and ABBOT 2 RS Pilot on 3 Jul 12. Both beacons were still stowed in their CSWs with zips tied closed with thread. They were subsequently tested and functioned correctly. A third beacon was recovered with the ABBOT 2 FS Pilot, having been submerged for eight days. It was also still stowed, zipped and tied off in the CSW. Water ingress caused the unit to malfunction under testing. Exhibit 15

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1.4.5.76 The Service Inquiry report from ZG792 recommended that the practise of tying the FastFind pocket closed with thread be ceased because of the impediment it caused aircrew attempting to access the FastFind in an emergency. The instruction for installing the FastFind had subsequently been rewritten to remove the requirement for pockets to be tied closed with thread, however, all of the FastFind pockets examined in this incident were tied closed. Further random checks of CSWs at RAF Lossiemouth were made and it was discovered that pockets were still routinely being tied closed. Exhibit 451 Exhibit 457

1.4.5.77 An urgent safety recommendation was issued via a progress report from this inquiry. The instruction for the installation of the FastFind in the CSW was rewritten and issued again, specifically stating that the pockets must not be tied off. Exhibit 449

Summary

1.4.5.78 There was no aircrew generated notification of the incident to the ARCC via COSPAS-SARSAT because the aircrew did not operate their 406 MHz beacons (FastFind).

1.4.5.79 None of the aircrew was capable of accessing or operating their FastFind beacons following the accident/ejection sequence. Subsequent testing indicated that the beacons would have operated as designed, had they been used.

1.4.5.80 Had the aircrew attempted to use their FastFind beacon, they would have had additional difficulty in doing so due to the pockets being tied off with thread. Action taken following a previous incident failed to resolve this issue.

Beacons – 121.5/243 MHz

1.4.5.81 UK MoD FJ aircrew are equipped with SARBE 7 121.5/243 MHz beacons. The SARBE 7 is integrated into the LPA such that it is automatically initiated in the ejection sequence. It is initiated at the point at which the PSP descends from the pilot/WSO on its lowering line. The force of the PSP weight on the lowering line pulls an inhibiting pin out of the SARBE 7 beacon, activating the transmitter.

1.4.5.82 The land based TX/RX network and DF sites are made up of a network of transmitters and receivers operating on the frequencies of 121.5/243 MHz. The purpose of the TX/RX network is to transmit and receive voice transmissions on 121.5/243 MHz, the DF sites locate the bearing of the transmission. In the Scottish Flight Information Region (FIR), the network feeds D&D at Scottish Air Traffic Control Centre (Military) (ScATCC (Mil)).

1.4.5.83 The number of DF sites is greater than the number of TX/RX sites because signals must be received at more than one DF station in order to determine the direction of the transmitter. Reception at three sites allows true triangulation to be carried out. To minimise false alarms from the DF network, DF plots are only displayed at D&D if there is an accompanying reception of an audio signal through the TX/RX network. Analysis of the DF network log shows that no audio or DF signals were detected at the time of this incident.

1.4.5.84 The assessed performance of the TX/RX network in the vicinity of this incident, based on line of sight to antennas, is that it can operate down to 300 ft AMSL; however, a range of factors, including weather, can adversely affect this performance. No beacon audio transmissions were recorded by D&D, ScATCC (Mil) at the time of the incident. On the assumption that network performance was roughly in the predicted region on the day of the incident, this suggests that no beacons were initiated significantly above 300 ft AMSL. Exhibit 450 Exhibit 41

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1.4.5.85 High flying[1] CAT reported beacons being heard on the 121.5/243 MHz Guard frequencies. It is not possible to be certain that the transmissions they received were related to this incident, however, radio wave propagation predictions based upon the height of the aircraft show that the CAT was in a position in which they could have received a signal from a beacon transmitting in the Moray Firth (Figure 54). Exhibit 1 Exhibit 41

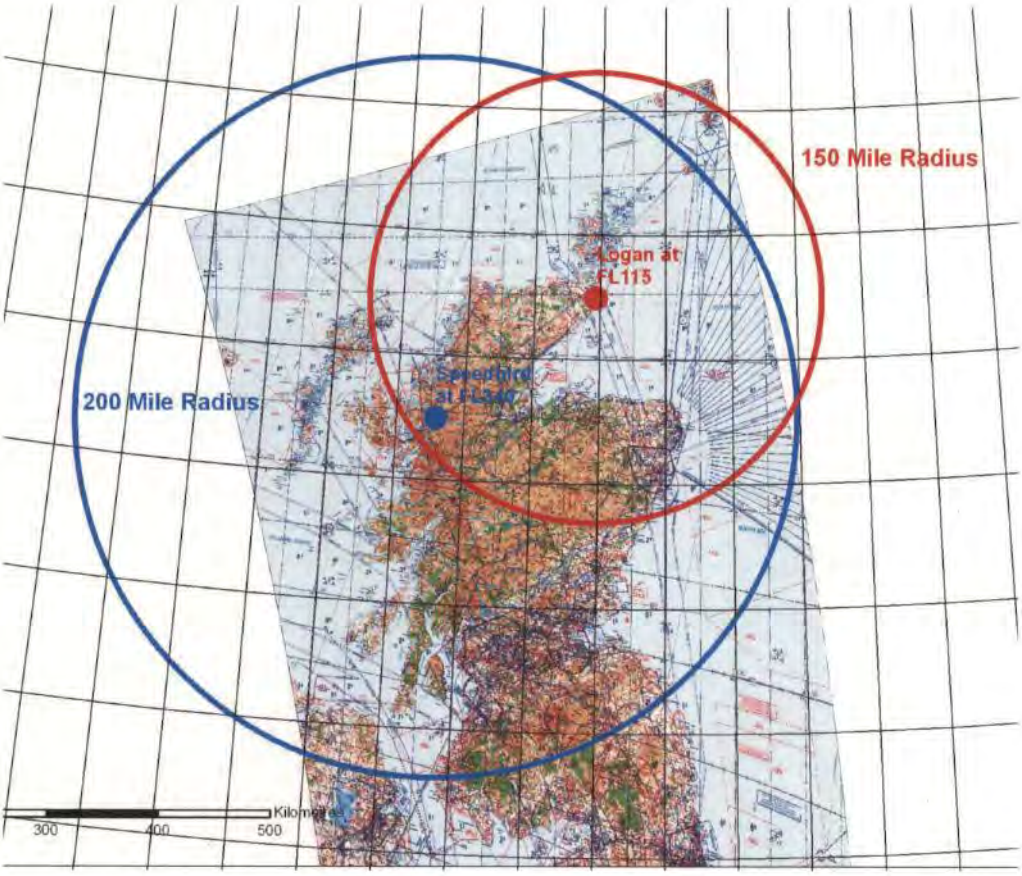

Figure 54. Potential Beacon Reception Range of reporting CAT.

1.4.5.86 ABBOT 1 and R137 both received beacon transmissions in the Moray Firth and R137 was able to home on a signal to find the aircrew. During the recovery of the ASTON 1 Pilot, two distinct beacon signals could be heard on the aircraft radio. This reduced to a single audio signal when the crew reported switching off ASTON 1 Pilot's beacon. Exhibit 1 Witness 4 Exhibit 10 Exhibit 4 Exhibit 42 Witness 6 Witness 18

1.4.5.87 The SARBE 7 beacon of the ABBOT 2 RS Pilot was not switched off until R137 delivered him to Raigmore Hospital, Inverness. Once R137 had departed from the scene of the incident, no further beacons were reported or identified transmitting in that vicinity. Exhibit 42

1.4.5.88 The auto initiation mechanism was found to have operated on all three SARBE 7 beacons recovered. The two SARBE 7 beacons recovered on 03 Jul 12 were subsequently tested and found to operate as designed. The SARBE 7 beacon recovered eight days later with ABBOT 2 FS Pilot failed testing due to corrosion of components due to water ingress. Exhibit 15

[1] FL 340 and FL 115

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Summary

1.4.5.89 The SARBE 7 beacons initiated automatically as designed. The SARBE 7 beacons of the ASTON 1 Pilot and the ABBOT 2 RS Pilot operated as designed following initiation. The SARBE 7 beacon of the ABBOT 2 FS Pilot failed under test due to water ingress. Exhibit 42 Exhibit 15

1.4.5.90 The beacons were not detected by the land based TX/RX network and could not be heard by D&D. It is assessed that they were initiated at an altitude below that which the network could detect.

1.4.5.91 It is likely that the beacons heard and reported to D&D by CAT were related to this incident. Analysis of the D&D and ARCC logs shows there were no other aircraft incidents reported at that time which would have resulted in similar beacons being heard.

1.4.5.92 The Panel **observed** that ASTON's sortie took place over remote sections of NW Scotland, where, had the accident occurred in similar circumstances with no beacon location, DF, squawk or radio alert, it could have resulted in extended detection times. The ambiguity of CAT notification and lack of precise location beacons relying on line of sight homing rather than auto-initiation satellite detection, coupled with the SAR footprint, would delay location considerably and could create an aggravating factor in a future accident.

1.4.5.93 Automated means did not alert D&D to the incident.

1.4.5.94 The aircrew of the aircraft involved in the collision were unable to identify the emergency to D&D due to the sudden nature of its occurrence and limited time to act following the collision.

1.4.5.95 The information available to the D&D controller through reports from CAT and discussions with the RAF Lossiemouth ATC Supervisor was not sufficient to define an emergency.

Conclusions

1.4.5.96 The ARCC was not notified of the emergency when it occurred because:

a. the aircrew were not capable of operating the supplied manually operated 406 MHz beacon;

b. the auto initiated beacons supplied to the aircrew operated on frequencies not monitored by COSPAS-SARSAT, and operated at an altitude below that at which they could be detected by the land based TX/RX and DF network;

c. the aircrew were unable to inform D&D of the incident due to a combination of damage to their aircraft and lack of time to do so prior to ejection/impact with the sea.

1.4.5.97 The Panel concluded that, due to the altitude at which the incident occurred, and the likelihood of another LL ejection, this was an **other factor** due to its potential to aggravate another accident. The low altitude caused the automated alerting mechanisms to be ineffective and reduced the amount of time available for the aircrew to act following the collision.

1.4.5.98 The ARCC was notified by telephone by D Flight, the RAF Lossiemouth based SAR Flight, following a direct request to launch SAR assets from RAF Lossiemouth ATC. This notification only occurred because of the timely and considered actions of the Tain

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AWRCs, ABBOT 1 RS Pilot and the RAF Lossiemouth ATC Supervisor. The content of the call was to inform the ARCC that SAR had already been launched.

Search and Rescue (SAR) Action

1.4.5.99 This section covers the actions of the military SAR crews deployed to the accident site and follow up action by the SAR Force chain of command. It is subdivided as follows:

a. Search

b. Rescue

c. After Action Review and Identification of Lessons

Search

1.4.5.100 R137 launched with limited information, initially to the N. They understood that two aircraft had been lost in the vicinity of the Beatrice oil rigs and that beacons could be heard on the radios of nearby aircraft. Exhibit 42

1.4.5.101 R137 was passed the CAT locations and ABBOT 1's location once airborne. These locations conflicted with their understanding of the location of the incident, so they paused in their transit to the N and sought clarification from RAF Lossiemouth ATC. RAF Lossiemouth ATC confirmed that the incident they were concerned with had occurred to the E of Tain AWR. Exhibit 42

1.4.5.102 The course of action taken by R137, heading to the vicinity of the last known position of the aircraft, was validated very quickly when a beacon was picked up on their radios. Heading initially NW in the direction of the Eastern boundary of Tain AWR, R137 found that the homing signal was getting weaker even though instruments indicated that the homing signal was centred. This indicated that the aircraft was heading in the opposite direction to that of the beacon. R137 turned away from Tain AWR and headed E in the direction of the Beatrice oil rigs and Wick. Travelling direct from RAF Lossiemouth to the vicinity of the Beatrice oil rigs would have taken R137 approximately 10 mins. Using homing to find the location took 21 mins. Exhibit 42

1.4.5.103 R137 experienced difficulties whilst homing as the homing frequency (121.5/243 MHz) was also being used for voice transmissions. The voice transmissions drowned out the signal of the beacon they were homing to. A number of voice transmissions were being made to and in support of R137 and others were made by D&D following up an unrelated second incident. Exhibit 42 Witness 18 Witness 6

1.4.5.104 R138 maintained radio silence prior to launching in order to avoid causing disruption to the activity of R137. As a result, R138 launched in the midst of R137's search with a very limited knowledge of the incident. They did not seek clarification beyond that it was a Tornado mid air collision and the location of R137 to head to. As a result, they were prepared for a variety of scenarios including a search over land. Exhibit 43 Witness 5 Witness 17

1.4.5.105 R138 deployed carrying two University Air Squadron (UAS) cadets as supernumerary crew. The aircraft captain had considered that the cadets may prove useful in the conduct of visual search activity by acting as observers. The carriage and employment of the cadets was authorised in accordance with RAF SAR Force Standard Operating Procedures (SOPs). In interview, the aircraft captain stated that, with hindsight, he would not have taken the cadets on this sortie. On the limited information received by Exhibit 43 Witness 5 Witness 17 Exhibit 686

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the crew of R138 prior to launch, the aircraft captain had no way of knowing what the sortie would entail. Any supernumerary crew could be exposed to seeing serious injuries and death on any SAR operation. This operation was no different.

1.4.5.106 Trauma Risk Management (TRiM) procedures are in place to support the mental well being of SAR crews who are exposed to trauma on a daily basis. The Panel **observed** that the provision of TRiM for supernumerary crew is not mandated and is provided on a best practice basis. The cadets were retained within D Flight for the remainder of their visit to RAF Lossiemouth in order to monitor and provide care for them. The Flt Cdr of D Flight informed the UAS Officer responsible for the cadets of their experience, for the purpose of the continuing monitoring of the cadets well being, and RAF Lossiemouth OC Personnel Services Flt arranged TRiM qualified personnel to support the SAR flight as required. Exhibit 452 Witness 5 Witness 17

1.4.5.107 R137 diverted from its homing course to investigate a parachute (Site 1 (P)) sighted by the crew not far from the homing course. Diverting to investigate Site 1 brought another parachute and liferaft, belonging to the ASTON 1 Pilot (Site 2), into view. Exhibit 42

1.4.5.108 From above there was no evidence of aircrew on or near the surface at Site 1. The captain of R137 made the decision to investigate Site 2 rather than linger further at Site 1. Whilst it was possible that a member of aircrew was present below the surface, the SAR Force has no SOPs for conducting sub surface searches and its operators are not trained to do so. The purpose of SAR helicopters is to rescue survivors on the surface of land or sea and crews are trained to prioritise accordingly. Exhibit 42 Witness 6 Witness 18 Exhibit 452

1.4.5.109 At Site 2 the crew of R137 could not see aircrew in the liferaft, but believed that they could see somebody just beneath it. For that reason, the winchman paramedic was deployed to the surface. Witness 6 Witness 18

1.4.5.110 At Site 2, as the ASTON 1 Pilot was raised to the surface, more than one beacon was heard clearly on the aircraft radio. Once the beacon was switched off, a single beacon remained transmitting. R137 resumed homing rather than deploying the winchman paramedic to Site 1. The likelihood was that a transmitting beacon was on the surface of the water with a member of aircrew awaiting rescue. Exhibit 42 Witness 6 Witness 18

1.4.5.111 The homing course brought two further liferafts (Sites 3 and 4) into view. R137 investigated Site 3 first and found ABBOT 2 RS Pilot alive in the water. On bringing the RS Pilot aboard, R137 manoeuvred to Site 4 where no aircrew were visible in either the liferaft or water. The RS Pilot was in need of medical attention due to a combination of physical injury and cold immersion [redacted] R138 was due to arrive on scene in 2 mins so the captain of R137 decided to hand over the search for aircrew at Site 4 to R138 in order to expedite the transport of ABBOT 2 RS Pilot to hospital. Exhibit 42 Witness 6 Witness 18

1.4.5.112 A misunderstanding occurred between R137 and R138 on handover of the search. R138 re-investigated Site 3 from the air before deploying their winchman paramedic to investigate Site 4. Exhibit 42 Exhibit 43 Witness 6 Witness 18 Witness 5 Witness 17

1.4.5.113 Once activity at Site 4 was complete, a thorough surface search by R138 and surface vessels continued but did not result in any further aircrew being found. Witness 5 Witness 17 Exhibit 43

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1.4.5.114 A summary of what personnel and survival equipment were identified during the SAR operation is in Table 7 overleaf.

Location	Personnel	Survival Equipment	Remarks
Site 1 58°06.37 N 003°26.35 W		Parachute	Belonging to ASTON 1 WSO
Site 2 58°06.58 N 003°25.40 W	ASTON 1 FS Pilot	Parachute Liferaft	
Site 3 58°05.97 N 003°23.87 W	ABBOT 2 RS Pilot	Parachute Liferaft	
Site 4 58°05.87 N 003°23.77 W	Sighting of ABBOT 2 FS Pilot	Parachute Liferaft	

Table 7. Summary of Personnel and Survival Equipment Found.

Conclusions

1.4.5.115 The lack of a 406 Mhz beacon signal being generated (manual or automatic) introduced delays in finding the aircrew. Had a 406 Mhz signal been received, a coarse (15 nm) or fine (10 m) location could have been passed to the SAR assets.

1.4.5.116 The initial brief upon which R137 launched conflicted with the information received once in flight. The confusion resulted in one minute of delay in the rescue of the aircrew.

1.4.5.117 The combination of heading to an unconfirmed area to search and homing to the aircrew took R137 twice as long as it would have taken to travel directly to the crash sites from RAF Lossiemouth.

1.4.5.118 The search operation would have taken much longer if the collision had not occurred so close to RAF Lossiemouth. It was fortunate that R137 was able to detect the beacon almost immediately after it had launched.

1.4.5.119 Voice transmissions on 121.5/243 MHz disrupted homing operations. Efforts were made by controlling stations to minimise disruption, but some transmissions were equally urgent in nature.

1.4.5.120 It was coincidence, due to the proximity of the downed aircrew and direction of approach, that brought R137 to Sites 1 and 2. The signal from the beacon of ASTON 1 Pilot was only audible on the aircraft radio once it was raised above the surface of the water.

1.4.5.121 The carriage of UAS cadets on R138 was legitimate and authorised. The risk of exposure to trauma is perpetual on SAR operations. TRiM procedures are in place to support RAF SAR Force personnel, but there is no formal requirement/procedure to make similar provisions for UAS cadets or other supernumerary crew.

1.4.5.122 The misunderstanding over which liferafts remained to be investigated led to R138 spending one minute investigating Site 3 before investigating Site 4. There was no impact on the outcome of the incident.

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Rescue

1.4.5.123 At Site 1, apart from the parachute, no aircrew or other related survival equipment was sighted in the water by the crew of R137. No rescue was attempted. Exhibit 42 Witness 6 Witness 18

1.4.5.124 From the personnel and equipment found and recovered at subsequent locations, it is assessed that the parachute at Site 1 was the parachute belonging to ASTON 1 WSO. Further action/investigation at Site 1 would not have resulted in saving life. Exhibit 42 Witness 6 Witness 18 Witness 5 Witness 17 Exhibit 43 Exhibit 15

1.4.5.125 The liferaft at Site 2 appeared empty, but the crew of R137 believed that they could see a member of aircrew just beneath it. The winchman paramedic was deployed to either effect a rescue or to confirm that there were no aircrew present. Exhibit 42 Witness 6 Witness 18

1.4.5.126 In the crew brief prior to deployment of the winchman paramedic, the parachute at Site 2 was identified as a hazard. It appeared to be caught up with the liferaft and the winchman paramedic was briefed to cut it away quickly with his J knife on entry into the water. The winchman paramedic was wearing his Alpha helmet and was able to hear communications over the aircraft intercom, but could not talk back. His information passage back to the aircraft was done via well rehearsed hand signals. Exhibit 42 Witness 6 Witness 18

1.4.5.127 On entry into the water the winchman paramedic saw the ASTON 1 Pilot just below the surface of the water and his focus was switched to the ASTON 1 Pilot rather than the liferaft and parachute. The winch operator maintained a watch on the parachute and provided updates over the aircraft intercom. Exhibit 42 Witness 6 Witness 18

1.4.5.128 The winchman paramedic did not identify that the ASTON 1 Pilot was still attached to his parachute before attaching him to the aircraft winch. This was due to the parachute risers having slipped down around the waist of the casualty and not being present in the position in which he expected to find them. Exhibit 42 Witness 6 Witness 18

1.4.5.129 RAF SAR Force SOPs state *"Once with the survivor, the winchman must release him from the parachute harness **before** attempting to secure him".* At the point the winchman paramedic attached himself to the ASTON 1 Pilot, he attached himself to a casualty who remained attached to his parachute. Exhibit 42 Witness 6 Witness 18 Exhibit 452

1.4.5.130 The subsequent cutting away of the parachute risers and other entanglements was carried out in accordance with the RAF SAR Force SOP for cutting away entanglements. This involves lifting the person being rescued out of the water using the aircraft winch whilst the winchman operates on a long lead; whilst still attached to the aircraft winch hook, the long lead provides the winchman greater freedom of movement beneath the casualty. Exhibit 42 Witness 6 Witness 18 Exhibit 452

1.4.5.131 The parachute at Site 3, the location of ABBOT 2 RS Pilot, was not discussed in the crew brief/checks prior to deployment of the R137 winchman paramedic into the water. Exhibit 42

1.4.5.132 The winch operator, using the aircraft intercom, informed the winchman paramedic that the survivor was still attached to the parachute. It is not clear whether the winchman paramedic heard this information or not as the winch operator commented that the intercom was *"going funny"* at that point. Exhibit 42 Witness 6 Witness 18

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1.4.5.133 The winchman paramedic could not see the parachute risers but could feel entanglements around the legs of the ABBOT RS Pilot. The ABBOT RS Pilot was attached to the aircraft winch and, thus, the winchman paramedic, before the parachute was cut away. This was contrary to RAF SAR Force SOPs as discussed in Section 1.4.6. Exhibit 42 Witness 6 Witness 18

1.4.5.134 The subsequent cutting away of the parachute risers and other entanglements was carried out in accordance with the RAF SAR Force SOPs. Exhibit 42 Witness 6 Witness 18

1.4.5.135 R137 was capable of rescuing and carrying all four casualties from this ejection. The impact of carrying multiple ejectees would be that the casualties would have to lie close together on the floor of the aircraft and the attention of the rear crew would be divided between managing the injuries of all four casualties. It was sensible to send a second aircraft, dividing the casualties between the two and providing a better level of care. Exhibit 42 Witness 6 Witness 18

1.4.5.136 The crew of R138 could not identify any aircrew in the water or liferaft from overhead Site 4. The presence of the liferaft, albeit partially submerged, was sufficient to warrant further investigation. The winchman paramedic was deployed into the water to do so. Witness 5 Witness 17 Exhibit 43

1.4.5.137 The winchman paramedic of R138 carried a diving mask by personal choice, in addition to his issued equipment. The mask is used as a defence against sea spray and also gave him additional capability to conduct sub surface searches, although there are no SOPs for making sub surface recoveries. It was during such a search that he identified what was potentially a submerged casualty suspended below the liferaft by a lanyard. He could also see what appeared to be a parachute which had streamed out, but had not inflated. The potential sighting of a member of aircrew under the water led the winchman paramedic to attempt a recovery. Witness 5 Witness 17 Exhibit 43

1.4.5.138 The submerged weight attached to the lanyard was sufficient to overcome the buoyancy of the winchman paramedic when he attempted to pull it to the surface. He decided to attempt to raise what was potentially a member of aircrew to the surface using the aircraft winch. Raising sub surface loads of unknown weight is not covered in the RAF SAR Force SOPs. It is a scenario which may not previously have been encountered, given that the carriage of diving masks is not routine. Winchmen would not normally be able to identify subsurface casualties. Witness 5 Witness 17 Exhibit 43

1.4.5.139 The remainder of the crew of R138 were not aware of the course of action being taken by their winchman paramedic and that they were taking part in an operation to raise an unknown load from beneath the surface of the sea. The Polycon radio with which the winchman paramedic was equipped was not operating sufficiently well for him to communicate this. Witness 5 Witness 17 Exhibit 43

1.4.5.140 The winchman paramedic conducted his own risk assessment for the lifting operation and considered the risk it would pose to the aircraft. He assumed that the grabbit hook he had attached to the load would deform or break before the aircraft hoist would be damaged because the grabbit hook has a lower Safe Working Load (SWL). The SWL indicates the load for which the manufacturer has designed the piece of lifting equipment to lift; the breaking strain is the load under which the lifting equipment is predicted to fail. Breaking strains can be a number of times greater in magnitude than SWLs. Witness 5 Witness 17 Exhibit 43

1.4.5.141 On attempting to raise the casualty, the liferaft and lanyard broke free from its anchor and the subject of the attempted recovery sunk out of view. It is not clear how the load was suspended or released. It is likely that the R138 winchman paramedic had correctly identified the ABBOT 2 FS Pilot suspended beneath his liferaft and that he was weighted down by his parachute. Exhibit 15

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1.4.5.142 The serial number of the detached liferaft matched that of the seat of ABBOT 2 FS Pilot. Exhibit 15

1.4.5.143 ABBOT 2 FS Pilot was subsequently found on the sea bed attached to his parachute and the CO_2 cylinder from his liferaft. The crane of the salvage vessel could not overcome the drag of the parachute when attempting to raise the Pilot to the surface; an indication of the enormous load created by a submerged parachute. The parachute had to be cut away by divers to enable recovery. Exhibit 15

Conclusions

1.4.5.144 The parachute at Site 1 was most likely that fitted to the seat of the ASTON 1 WSO. There were no other signs of survival equipment or survivors at this location and the SAR crew made the correct decision to prioritise homing to the emitting beacon.

1.4.5.145 The winchman paramedic of R138 used his initiative to try and raise what he thought was a body beneath the surface of the water. Although he was a very experienced winchman paramedic, this was a situation he had not been trained to deal with.

Post Crash Management

1.4.5.146 This section covers the actions of RAF Lossiemouth personnel in the execution of Op DERMIS, the RAF Lossiemouth crash response plan. It is subdivided as follows: Exhibit 685

a. Initial Response

b. Deployment of Post Crash Management Incident Officer (PCMIO)

c. Observations

Initial Response

1.4.5.147 A Tain AWRC telephoned XV(R) Sqn, shortly after the collision, and stated that he had lost radio contact with two aircraft. The 2nd DA immediately informed a Flt Cdr who later became the Squadron Incident Commander (SIC); the Flt Cdr asked the 2nd DA to keep him informed of the situation. The Tain AWRC had also contacted RAF Lossiemouth ATC. Following reports of PLB transmissions and a concern that the aircraft may have collided, the ATC Supervisor contacted D Flt, 202 Sqn to request that they launch R137. The Duty Commander Flying (DCF) was requested to attend ATC. Upon arrival, he was informed that radio contact had been lost with three aircraft from ASTON and ABBOT formations. The DCF's immediate plan was to attempt to obtain radio contact with the aircraft, and communication was established with ASTON 2. The DCF informed OC Ops Wg of the situation. Witness 12 Witness 8 Witness 9 Witness 52 Exhibit 435

1.4.5.148 At XV(R) Sqn, the Flt Cdr proceeded to the Ops Desk to supervise events at 12:20 hrs. Over the next 30 mins the Sqn prepared to action the crash plan by identifying individuals to fulfil the various Post Crash Management (PCM) roles, corralled personnel into the main briefing room, impounded mobile telephones and also informed OC XV(R) Sqn, who was deployed to Cyprus, of the situation. Witness 8 Exhibit 435 Exhibit 436

1.4.5.149 The DCF became increasingly concerned that an incident may have occurred and therefore recalled all Stn based aircraft with the exception of ABBOT 1, who was attempting to locate the two non-responding aircraft. Following reports from R137 that parachutes had been sighted in the water the DCF informed OC Ops Wg. Witness 9 Exhibit 435

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1.4.5.150 At 12:40 hrs, OC Ops Wg initiated Op DERMIS, the Stn response to an aircraft accident. The Emergency Control Centre (ECC) was stood up and OC Ops Wg assumed the role of ECC Coordinator. Witness 9 Witness 52

Deployment of Post Crash Management Incident Officer (PCMIO)

1.4.5.151 As the collision occurred over the sea, there was not a crash site for the for PCMIO to attend. Nevertheless, the PCMIO and an assigned team remained active in the ECC or deployed to coastal areas over a period of 17 days. Exhibit 309 Exhibit 438

Observations

1.4.5.152 **ASTON vs ABBOT Callsigns.** The Panel **observed** that the ASTON and ABBOT callsigns were confused during PCM, particularly as they were both from the same Sqn. Some personnel confused the callsigns when recounting information in interview and the similarity of the callsigns on the same Sqn created the opportunity for confusion. Witness 9 Witness 3 Witness 12 Exhibit 4 Exhibit 5

1.4.5.153 **Orderly Officer vs 2nd DA.** Op DERMIS requires that the Main Guard Room (MGR) contact the Orderly Officer regardless of the time of day in the event of an accident. Orderly Officer is an out-of-hours Stn duty from 15:30 hrs to 07:00 hrs performed by nominated junior officers. On the day of the accident the 2nd DA was also the Orderly Officer. The Panel **observed** that the 2nd DA received a number of telephone calls directing him to report to the MGR, which he was unable to comply with due to his role as DA. Although he stated that he was not distracted from his Sqn PCM duties, he described it as an annoyance. Exhibit 310 Witness 12 Exhibit 311 Exhibit 435

1.4.5.154 **Communication – Short Term.** It was commented that communication between the ECC and XV(R) Sqn Ops Desk was difficult due to the limited number of telephone lines. The XV(R) SIC believed there would be a lot less duplication of effort if information could be disseminated to all stakeholders at once rather than having to be passed several times to numerous individuals. Due to a reconfiguration of the building, the ECC had recently been moved. The Panel **observed** that at 17:00 hrs, all ECC telephone lines went down as they were limited to daytime working hours only. The ECC staff reverted to mobile telephones. Witness 8 Witness 52 Exhibit 439

1.4.5.155 **Communication – Longer Term.** The creation of an ECC Group email and limited folder did much to improve communication to and within the ECC. The Panel **observed** that this was particularly apparent in the first week when the ECC Clerk was inputting information in to the ECC log which prevented personnel from reviewing the log to verify information. Exhibit 309 Exhibit 439

1.4.5.156 **Training "e-folders."** 1Gp ASO 2103 states that *"Units are to maintain a training folder for all pilots and WSOs. It is to include all flight check reports not retained on the F5200 and all work-up sortie Reports."* The order does not specify if the Training Folder is to be electronic, a physical folder or a combination of both. XV(R) Sqn staff use a combination of Training Folders and "e-folders". The Panel **observed** that ASTON 1 WSO's e-folder was not impounded following the accident; the Panel was unaware of the existence of e-folders until a number of months after the accident by which time ASTON 1 WSO's e-folder had been deleted. Subsequently, it was possible to restore the e-folder. Exhibit 312 Exhibit 313 Exhibit 123 Exhibit 314

1.4.5.157 **Impounding Documentation: Aircrew Not Assigned to a Sqn.** The Tornado Training Syllabus states that *"OC Ops Wg is to maintain a Training Folder on all Tornado aircrew that fly with the Wg* [Wing] *but who are not assigned to a Sqn."* ABBOT 2 RS Pilot, a member of STANEVAL and therefore not assigned to a Sqn, had a shared training folder with other STANEVAL members at XV(R) Sqn, although the only insert present was a sortie Exhibit 131 Exhibit 315 Exhibit 130 Exhibit 434

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report from 2009. The XV(R) STANEVAL Training Folder was not impounded as part of the PCM process. ABBOT 2 RS Pilot also had another Training Folder which was kept in the STANEVAL office. The Panel **observed** that this was not impounded immediately following the accident.

1.4.5.158 **Impounding Documentation: Electronic Documentation.** The aircraft records were initially quarantined on LITS and a copy was made. LITS was implemented as a purely logistic information system, but it is now fully integrated into managing the continuing airworthiness of the Tornado, providing asset life forecasting, tracking of satisfaction/embodiment of SI(T) and modifications. The Panel **observed** that LITS cannot function with aircraft quarantined on the system, as is required by MRP RA 4305. It is not possible to run database maintenance without affecting those aircraft which are supposed to be quarantined. It is for this reason that the LITS process at DAP300A-01 Section 2, Order 9 exists. That order directs that copies are to be made and verified before changes are made to the database, but the quarantined aircraft data on LITS is not protected beyond that point. The Panel was required to release the quarantined data so that essential work could be done on LITS. The integrity of the accident aircraft data on LITS is no longer assured. Exhibit 455 Exhibit 456 Exhibit 454

1.4.5.159 **Impounding Documentation: In Use Documentation.** A large number of in use documents, required to enable flying, were impounded as part of the PCM process. There was a time pressure on the Panel to review this documentation rapidly to facilitate further flying. They were reviewed and checked for amendment state in the time available, before being returned to XV(R) Sqn to allow flying to resume. The Manual of Post Crash Management requires that unit staff impound *"Any electronic media used for flight preparation or briefing; such as electronic ODMs* [Operating Data Manuals] *and PC based Aircrew Manuals."* The Panel **observed** that electronic copies of online documents were not provided as part of the PCM process, nor was it detailed within Op DERMIS. The current practices of using website repositories of online documentation means these should be captured in the PCM impounding process. Exhibit 315 Exhibit 660

1.4.5.160 **Support to PCMIO Team.** The Panel **observed** that accommodation and financial support to the PCMIO team was lacking; an advance of pay was issued to personnel when an imprest would have been more appropriate, particularly given the length of the deployment. Furthermore, Op DERMIS requires OC Accounts to arrange an imprest. Exhibit 309

Other Observation

1.4.5.161 The Panel **observed** that the aircrew crewroom was no longer regularly used, particularly during lunch time. An important by-product of crewroom use is the opportunity to learn from others' flying experiences, spread flight safety information, and in the case of an OCU, for students to learn from more experienced operators. Witness 73 Exhibit 41

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