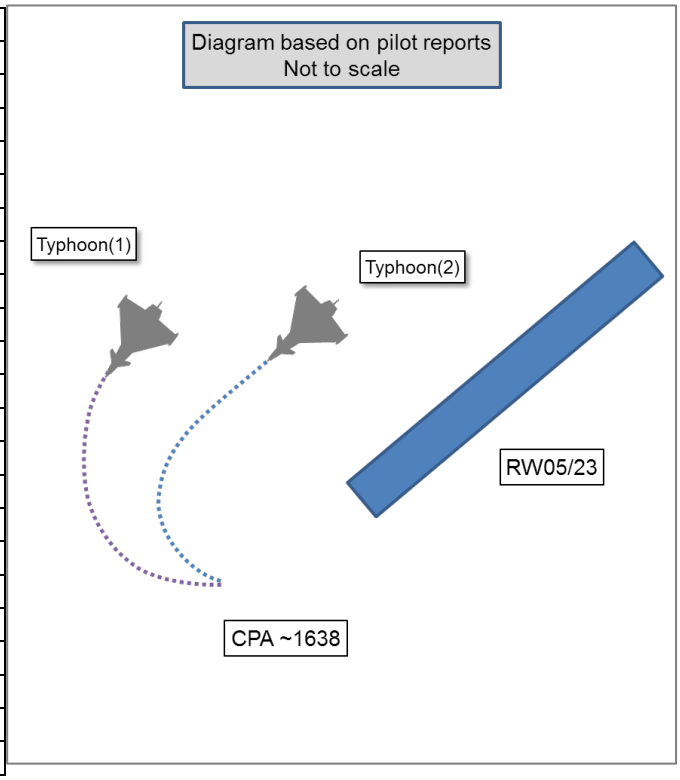
AIRPROX REPORT No 2018320

Date: 19 Dec 2018 Time: 1638Z Position: 5741N 00323W Location: Lossiemouth

PART A: SUMMARY OF INFORMATION REPORTED TO UKAB

Recorded	Aircraft 1	Aircraft 2
Aircraft	Typhoon(2)	Typhoon(1)
Operator	HQ Air (Ops)	HQ Air (Ops)
Airspace	Lossiemouth ATZ	Lossiemouth ATZ
Class	G	G
Rules	VFR	VFR
Service	ACS	ACS
Provider	Lossie Tower	Lossie Tower
Altitude/FL	NK	NK
Transponder	A, C	A, C
Reported		
Colours	Grey	Grey
Lighting	Red anti-col, nav	NK
Conditions	VMC	VMC
Visibility	>10km	NK
Altitude/FL	NK	500ft
Altimeter	NK (994hPa)	NK
Heading	170°	NK
Speed	NK	190kt
ACAS/TAS	Not fitted	Not fitted
Separation		
Reported	120ft V/50ft H	'100-200ft'
Recorded	80ft V/58m H[1]	



THE TYPHOON(2) PILOT reports that he was recovering to Lossiemouth RW05 as No2 of a pair via a radar-to-initials recovery, in radar trail at 1nm. Another pair [Typhoon A and Typhoon B], recovering via the same means, were adequately spaced ahead. On flying through initials, the radar broke lock on his leader and was re-locked. In the upwind turn, during which he was visual with the leader, the radar temporarily broke lock again. By this point he was flying the circuit visually and thought that he could see the leader's lights ahead of him, downwind. The aircraft lights and radio calls from ATC led him to establish the mental model that the preceding Typhoon pair were both on finals, and that, as he tipped in on finals, he had adequate spacing. Unknown to him at the time, his leader had flown a slightly wider circuit and was therefore out to the right-hand side of the canopy at that point - the lights he could see belonged to Typhoon B, not his leader. After tipping finals he started to doubt his SA and looked at the air-to-air TACAN, which was coupled to the leader. It read 0.7nm, which he thought seemed about right as they were both turning onto finals. He made his 'finals, gear down' radio call and continued to look at the lights of the two aircraft ahead of him on finals, who he thought were the Typhoon B and his leader. To cross-check this he looked back at the air-to-air TACAN, which now read 0.1nm. He rolled wings level and began a climb at the same time seeing another aircraft, his leader, directly in his previously planned flightpath, slightly to the right and below the nose. Once safe separation had been achieved, he continued the climb back to circuit height on the deadside and reported the Airprox to ATC before making a further approach to land. The pilot noted that he did not know what prompted him to check the TACAN but he was confident, in hindsight, that if he had not done so separation between the aircraft would have been non-existent. As is SOP in the Typhoon force, he was not using FLIR in the HUD, nor was he wearing night vision goggles at the time. Either of these systems may have increased his SA and helped to avoid the subsequent confused mental model. Of note, neither Typhoon were on the [data link] due to unserviceability. The canopy was also extremely scratched on both sides with noticeably reduced visual acuity, which may have been a factor in the incident.

[1] As established by the Lossiemouth Occurrence Investigation team.

He assessed the risk of collision as 'Very High'.

THE TYPHOON(1) PILOT reports leading a pair on recovery to initial for RW05 in 1 mile trail formation. They were following another pair of Typhoons [Typhoons A and B], also recovering in trail formation. He broke into the pattern, commenced his turn to downwind, following Typhoon B, who was a mile ahead of him. He configured the aircraft and began to look for the visual ground cues to navigate to the final- turn tipping point. It was difficult to maintain SA on his position in the circuit because of the dark conditions and the fact that this was the first time that he had flown a RW05 pattern at night. He could make out the towns of Duffus and Hopeman, and knew that he had to correct his downwind position to the left in order to get to the final turn position. He could not make out the lighthouse, which is the standard visual cue for correcting the downwind leg. The primary indication that he needed to make a correction was that he could see line-of-sight movement across his canopy of Typhoon B, indicating that they had begun their downwind correction. This brought him to the conclusion that he was wide in the pattern and needed to correct. He made a left turn to correct, arrived at the final turn position and commenced the final turn. He was aware that he had flown a wide downwind leg but had corrected to a proper final turn position, so was comfortable to continue the approach. He called finals with the intention to land and Tower replied with an incorrect sequencing. They stated that there was one aircraft ahead of him when in fact there were two ahead, Typhoon A on short final and Typhoon B halfway around his final turn. This confused him, but he was comfortable to continue because he could see two aircraft ahead. Approximately halfway around the final turn he heard what sounded like an aircraft engine which rapidly increased in volume. This was the first indication that something was wrong. He looked to the high three o'clock position and saw an aircraft flying very close to him on a parallel heading with slight overtake. His perception was that it was directly above him but appeared over his right wing because he was in a left-hand bank. He levelled out and diverged from the other aircraft. He couldn't climb because of the proximity of the other aircraft so he descended slightly, to approximately 400ft agl, broke off the approach and continued out to the east, away from the visual circuit. He climbed to 3000ft and did several orbits over the water for sequencing, which gave him some time to do an Ops check on the aircraft and compose himself. He then re-joined to land. The subsequent approach was flown without further incident. Of note, during the subsequent downwind leg, the sequencing that was given by ATC was unclear again but was later clarified when queried. Also of note was his touchdown point on landing being right of centreline but safe, which he attributed to the stress from the incident which left him somewhat distracted.

He assessed the risk of collision as 'High'.

THE LOSSIEMOUTH TOWER CONTROLLER reports that a Typhoon pair [Typhoons A and B] joined the circuit in trail via the IP with [the Airprox] Typhoon pair following behind. There were also two tracks in the radar pattern at 14nm and 20nm to touch down. The first Typhoon pair broke into the circuit, Typhoon A to touch-and-go and Typhoon B to land. As this happened, the [Airprox pair] called on the break individually. Surface wind was passed and the intentions of both pilots where to land. As there were 4 aircraft in the circuit, the controller paid particular attention to the aircraft on radar and established that there would be integration between visual circuit traffic and the radar traffic. Typhoon A called 'Finals, gear down' and was cleared to touch-and-go. Typhoon B also called 'Finals, gear down' and was cleared to land, one ahead to touch-and-go. Typhoon(1) called 'Finals, gear down' and was cleared to land in turn, one ahead to touch-and-go. This clearance was passed because 'in turn' meant another aircraft was ahead to land, with a further one ahead to touch-and-go (as per Annex A, section 300, order 106). Typhoon(2) called 'Finals, gear down' and was cleared to land in-turn as at that point Typhoon A had carried out his touch-and-go and was climbing on runway track. Typhoon(2) then called an Airprox and said that he was going-around. Typhoon(1) broke out of the pattern to depart VFR and was noticed to be deadside heading further east and climbing through 1500ft. At this point aircraft positions were confirmed within the circuit Typhoon A requesting the position of the traffic deadside. Whilst this was happening the 4 mile call for radar traffic was made, at which point clearance was given to break off rather than add to an already complicated scenario. Input was then given by the ATC supervisor as to what information to relay. Typhoon(1) was sent back to Approach and Typhoon(2) continued round for another circuit.

THE LOSSIEMOUTH SUPERVISOR reports that he was present in the VCR due to traffic volume in both the radar training circuit and visual circuit and having a recently qualified first-tourist Aerodrome Controller (ADC) in position. The ADC narrative captured the incident exactly as the Supervisor witnessed it. It was a dark night and the only reference for aircraft position in the circuit was their anti-collision and navigation lighting. The range scale set on the VCR Hi-Bright Monitor did not allow for the radar spacing between aircraft on finals to be ascertained. He was unaware of the Airprox until Typhoon(2) advised the ADC that it had occurred. He aided the ADC in re-gaining SA on all aircraft positions and directed appropriate Traffic Information to be passed to the relevant aircraft and controllers affected. This was difficult due to the extra R/T from pilots and landline clearance requests from the Talkdown controller for the inbound radar traffic. After the situation had been safely managed, he arranged for a relief controller to take over the ADC position, instructed the off-going ADC to relax in the crew room and asked the ground controller if they too required a relief. The ground controller was happy to remain in position. The Supervisor informed the command chain of the incident and had a welfare chat with the off-going ADC, after which he asked him to file a DASOR. He then impounded the R/T recordings.

Factual Background

The weather at Lossiemouth was recorded as follows:

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METAR EGQS 191650Z 10006KT 9999 FEW040 BKN250 05/01 Q0995 BLU NOSIG=
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The Lossiemouth Airfield Manual at Annex A to Section 300, Order 106 states as follows:

300.106A GUIDANCE FOR ADC CLEARANCES AND RUNWAY OCCUPANCY

1. The following clearances can be issued to RAF Lossiemouth based AS[2] and briefed visiting AS in the visual circuit. There are no restrictions with the number of clearances that can be issued; however, for clearances with differing intentions that may become complex, the ADC may wish to consider limiting a clearance to the second AS in sequence only. In these instances, following AS are to be given the instruction to continue approach until they become the second AS in sequence.

Cleared to land, in turn.
Cleared to land, 1 ahead to touch and go.
Cleared to land, 1 ahead to low approach.
Cleared low approach, in turn.
Cleared to touch and go, in turn.
Cleared low approach, 1 ahead to touch and go.
Cleared low approach not below 200ft, reason. (e.g. 1 ahead landing/1 on).
Cleared touch and go, 1 ahead to low approach.

A transcript of the Lossiemouth Tower frequency was provided, as follows:

From	To	Speech Transcription	Time
Typhoon(1)	Tower	[Typhoon(1) C/S] break land	16:36:10
Tower	Typhoon(1)	[Typhoon(1) C/S] surface wind zero eight zero, seven knots	16:36:19
Tower	Airprox pair	[Airprox pair C/S] two ahead	16:36:25
Typhoon(2)	Tower	[Typhoon(2) C/S] break land	16:36:27
Tower	Typhoon(2)	[Typhoon(2) C/S] three ahead, surface wind zero eight zero, eight knots	16:35:29
Typhoon A	Tower	[Typhoon A C/S] finals gear down	16:36:49
Tower	Typhoon A	[Typhoon A C/S] clear touch and go	16:36:53
Typhoon A	Tower	Clear touch and go [Typhoon A C/S]	16:36:55
Typhoon B	Tower	[Typhoon B C/S] final. gear down.	16:37:10
Tower	Typhoon B	[Typhoon B C/S] cleared to land one ahead touch and go	16:37:13

[2] Air Systems.

From	To	Speech Transcription	Time
Typhoon B	Tower	[*unreadable*] [partial Typhoon B C/S]	16:37:17
Typhoon(1)	Tower	[Typhoon(1) C/S] finals. gear down. Land.	16:37:32
Tower	**Typhoon(1)**	**[Typhoon(1) C/S] clear to land in turn, 1 ahead eh touch and go**	**16:37:37**
Typhoon(1)	Tower	Clear to land in turn Typhoon(1)	16:37:40
Typhoon(2)	Tower	[Typhoon(2) C/S] finals gear down	16:37:51
Tower	Typhoon(2)	[Typhoon(2) C/S] cleared to land in turn	16:37:54
Typhoon(2)	Tower	Clear to land in turn [Typhoon(2) C/S]	16:37:59
Talkdown	Tower	Approaching seven and a half miles [other aircraft C/S] low approach Join (?)	16:38:12
Unknown	Tower	[*unreadable*]	16:38:14
Tower	Talkdown	[other aircraft C/S] low approach further Tower	16:38:16
Tower	All stations	[*unreadable*] eight miles low approach [*unreadable*]	16:38:20
Typhoon(1)	Tower	[Typhoon(1) C/S] is breaking out of the pattern	16:38:24
Tower	Typhoon(1)	[Typhoon(1) C/S] roger	16:38:31
Typhoon(2)	Tower	[*unreadable*] [Typhoon(2) C/S] declare an Airprox	16:38:35
Tower	Typhoon(2)	[Typhoon(2) C/S] roger	16:38:39
Tower	Typhoon(2)	[Typhoon(2) C/S] just confirm that was with [Typhoon(1) C/S] (?)	16:38:43
Typhoon(2)	Tower	Aaaaafirm	16:38:45

Analysis and Investigation

Military ATM

The Typhoons involved in this Airprox [Typhon(1) and Typhoon(2)] were both part of the same formation and had joined the Lossiemouth visual circuit via the initial position as individual elements in trail. At the time of the incident there were two other Typhoons in the circuit [Typhoon A and Typhoon B] (who had completed a similar join) and two further aircraft in the instrument pattern at 14nm and 20nm from touchdown. Due to the complexity of the situation, the ATC Supervisor was present in the Visual Control Room and the range of the Air Traffic Monitor (slave radar) had been placed at a slightly extended range to aid the integration of the radar traffic. This incident occurred below radar coverage and therefore radar pictures are unavailable. Following this incident an Occurrence Safety Investigation (OSI) was convened and, as part of that process, diagrams of the incident were created using the cockpit video and they are reproduced below. The two aircraft involved in the incident are coloured black and yellow, the other (non-incident) Typhoons are shown in blue. The Typhoons involved in the Airprox joined the visual circuit via initial in one-mile trail. The other two Typhoons in the circuit were just ahead breaking into the circuit.

Figure 1

Having established in the visual circuit the pilot of Incident AC1 [Typhoon(1)] reported losing some of the ground cues required to fly the circuit and as such flew a wider than normal downwind leg. The pilot of Incident AC2 [Typhoon(2)] flew a standard pattern and was therefore inside the track of Incident AC1 [Typhoon(1)].

Figure 2

As Incident AC1 [Typhoon(1)] turned final they were given the clearance 'Callsign, cleared to land in turn, one ahead touch and go'. Although this clearance was not CAP413 compliant it was allowed in local orders but was misinterpreted by the pilot of Incident AC1 [Typhoon(1)] who could see two aircraft ahead of him and believed the Tower Controller had misspoken.

Figure 3

Incident AC2 [Typhoon(2)] called final 19 secs after Incident AC1 [Typhoon(1)] and was cleared to land in turn. Having heard the previous call, Incident AC2 [Typhoon(2)] believed he could see the two aircraft ahead (when in fact there were 3) and was unaware that Incident AC1 [Typhoon(1)] had flown a wider than usual visual circuit.

Figure 4

CPA occurred 18 secs after the final call from Incident AC2 [Typhoon(2)] . The pilot of Incident AC2 [Typhoon(2)] became aware of the confliction (aided by TACAN) at approx. 0.1nm and initiated a climb to increase separation. The pilot of Incident AC1 [Typhoon(1)] was alerted to the presence of the other Typhoon by the sound of its engines and initiated an immediate descent. The OSI established that, having taken this avoiding action, slant range at CPA was 208ft.

Figure 5 – CPA

This incident occurred at night in the visual circuit. Both the Typhoon pilots involved reported being confused by the clearance issued by the Tower Controller and, subsequent to this incident, Lossiemouth have initiated a review of all night circuit procedures. However, at the time of the incident, the phraseology used was correct (in accordance with local orders) and therefore the controller could reasonably expect the aircrew to understand it. The decision to extend the range on the Air Traffic Monitor was sensible given that the integration of instrument traffic into a busy visual circuit was likely to be challenging.

UKAB Secretariat

The Typhoon pilots shared an equal responsibility for collision avoidance and not to operate in such proximity to other aircraft as to create a collision hazard[3]. An aircraft operated on or in the vicinity of an aerodrome shall conform with or avoid the pattern of traffic formed by other aircraft in operation[4].

Lossiemouth Occurrence Investigation

The Lossiemouth investigation identified the following causal factors:

> [Typhoon(1) pilot] flew the incorrect circuit ground track; he flew wider downwind and, having corrected back to the circuit, turned finals beyond the end of the downwind leg.
>
> [Typhoon(1) pilot] had not previously flown the 05 circuit at night and was therefore unfamiliar with how the circuit visual cues would appear at night.
>
> [Typhoon(1) pilot] did not raise the fact that he had not performed a 05 circuit at night as part of the sortie preparation/briefing process as he believed that his experience of day flying in the 05 circuit was sufficient to allow him to fly the correct circuit, honouring the noise abatement avoids.
>
> The circuit was flown at night, some of the visual cues for the circuit were not well lit and there was significant other cultural lighting in circuit area.
>
> [Typhoon(2) pilot] flew the correct circuit ground track; therefore, his finals turn was inside that of [Typhoon(1)].
>
> As he flew his finals turn, [Typhoon(2) pilot] was not aware of the position of [Typhoon(1)].
>
> As [Typhoon(2) pilot] flew his final turn, the position of [Typhoon(1)] was masked by the cockpit.
>
> [Typhoon(2) pilot] believed that the aircraft ahead, and therefore the nearest aircraft to him, was [Typhoon(1)] when it was [Typhoon B]. He had formed an incorrect mental model regarding the position of aircraft in the circuit.
>
> [Typhoon(2) pilot] lost visual with [Typhoon(1)] at some point during the first portion of the circuit. At some point his focus subconsciously shifted to [Typhoon B], believing that it was [Typhoon(1)].
>
> It is possible that [Typhoon(1) pilot] flying wider downwind contributed to [Typhoon(2) pilot's] focus shifting to [Typhoon B].
>
> The circuit was flown at night and there was significant other cultural lighting in the circuit area. It is possible that the cultural lighting may have contributed to [Typhoon(2) pilot's] focus shifting to [Typhoon B].
>
> Neither [Typhoon(1) pilot] or [Typhoon(2) pilot] had functioning [data-link]. A functioning [data-link] may have provided further SA to [Typhoon(2) pilot] regarding the position of [Typhoon(1)] thus preventing the formation of the incorrect mental model.
>
> Several SA enhancing systems were not available to [Typhoon(2) pilot] . The FLIR was not used (in line with Typhoon Force norms) as it has significant limitations. NVGs are not cleared to be worn below Safety Altitude and [the helmet mounted sighting system] is not NVG compatible. Typhoon ac are not equipped with a traffic alert or collision warning system. Availability of any of these systems may possibly have enhanced [Typhoon(2) pilot's] SA sufficiently to break his incorrect mental model regarding the position of [Typhoon(1)].

[3] MAA RA 2307 paragraphs 1 and 2.
[4] MAA RA 2307 paragraph 15.

The clearance passed to [Typhoon(1) pilot] on calling finals was misinterpreted by [Typhoon(2) pilot] and this reinforced his incorrect mental model, believing that there were 2 aircraft ahead and that he was visual with both.

Lossiemouth specific policy allows ADC clearances that have potential for misinterpretation.

The Lossiemouth investigation made the following recommendations:

1. Use this incident to publicise the often inconspicuous nature of the night visual cues for the Runway 05 circuit. Consider using Typhoon Simulator Facility to practice night circuits. Ensure pilots are briefed on cockpit priorities and lookout in the visual circuit.

2. Examine and review Runway 05 night circuit procedures at RAF Lossiemouth. Work to include, but not limited to, consideration of alternative (more conspicuous) visual cues and possible ground track adjustment, circuit number limitations and simplification of RT procedures and approved clearances. Outcomes to be read across to other Lossiemouth night circuits where appropriate.

3. Provide Typhoon ac with a suitable traffic alert or collision warning system.

4. Examine the possibility and associated risks of Typhoon aircrew using NVG below Safety Altitude. Consideration to be given to the provision of an appropriate NVG-helmet separation system.

In the Runway 05 Visual Circuit at night Typhoon(1) pilot missed the visual cue of Covesea Cottages and flew a wide and elongated circuit. At the same time, Typhoon(2) pilot's radar lock on Typhoon(1) dropped out as he called on the break to land and, although he was monitoring Typhoon(1)'s proximity on the A-A TACAN, he mistakenly believed that the aircraft he could now see ahead was Typhoon(1) when in fact this aircraft was Typhoon B. Typhoon(2) pilot's incorrect mental model was inadvertently re-enforced through the misinterpretation of the ATC communication to Typhoon(1) pilot following his call of "Finals Gear Down". The ATC response of "clear to land in turn, one ahead touch and go" was interpreted by Typhoon(2) pilot as only having the 2 aircraft he was visual with ahead, with the belief that Typhoon A had completed his touch-and-go and was no longer a factor. Typhoon(2) pilot also misinterpreted the ATC call believing that it was an error as he believed the call only indicated one aircraft ahead when he was visual with both the preceding Typhoon pair. As Typhoon(1) pilot tipped in to land he came into confliction with Typhoon(2), who's pilot was flying the standard circuit pattern and taking his spacing from the aircraft ahead (Typhoon B), which he incorrectly believed to be Typhoon(1). In the turn, Typhoon(2) pilot checked his A-A TACAN and saw the spacing between Typhoon(1) was reduced to 0.1 nm and so he took avoiding action.

The events that led to this Airprox highlight that the margin for error is slim and a routine situation can rapidly develop into a safety critical event. The Occurrence Review Group fully endorsed the findings and recommendations from the Occurrence Safety Investigation and believe that these recommendations should be implemented as soon as practicable to reinforce the Mid-Air-Collision barriers which were defeated in this Airprox.

Comments

HQ Air Command

This incident led to an Occurrence Safety Investigation (OSI) on the unit concerned, which established 15 (fifteen) causal factors and made 4 recommendations.

A number of barriers to MAC were defeated in this Airprox and this once again reinforces the importance of a layered defence to conflict prevention. It could be argued that the main cause of this loss of separation was that the pilot of Typhoon(2) lost sight with Typhoon(1) and flew into conflict – this would underplay the myriad factors identified by the OSI. Undoubtedly, the wider downwind track flown by the pilot of Typhoon(1) meant that his position would now be less predictable to the pilot of Typhoon (2); this would, of course, not be a problem if the pilot of Typhoon(2) had remained visual with Typhoon (1), but he did not. Furthermore, there was another

formation of 2 aircraft ahead in the circuit and this, coupled with a misinterpretation of local procedures regarding ATC clearances, reinforced for the pilot of Typhoon(2) what was now a flawed mental model of circuit traffic.

On commencing the finals turn, the pilot of Typhoon(2) checked his air-to-air TACAN range to his leader and saw it to be 0.7nm, which is coherent with what he would expect to see. He is unable to explain what led him to re-check the range during the turn (as he was convinced that he had SA on all the circuit traffic) but, seeing a much reduced range, he immediately surmised that 'something was not right' and flew his aircraft away from the circuit pattern. The investigation measured the slant range separation as 208ft; with a recorded (Mode C) height difference of 80ft, this equates to a lateral separation of 190ft, or approximately 0.03nm

The recommendations from this investigation include a review of night circuit procedures, including terminology used for clearances, at the unit concerned. Furthermore, a review of the use of NVDs below Safety Altitude is being conducted along with other possible mitigations that were not, or could not have been, used at the time of this occurrence. Whilst the Typhoon is not yet equipped with an ACAS, solutions continue to be examined/developed with capability being inserted as it becomes suitable/available.

Summary

An Airprox was reported when a Typhoon pair flew into proximity with each other in the Lossiemouth visual circuit at about 1638hrs on Wednesday 19th December 2018. Both pilots were operating at night under VFR in VMC, both in receipt of an Aerodrome Control Service from Lossiemouth Tower.

PART B: SUMMARY OF THE BOARD'S DISCUSSIONS

Information available consisted of reports from both pilots, a transcript of the relevant R/T frequency, radar photographs/video recordings, reports from the air traffic controllers involved and reports from the appropriate ATC and operating authorities.

The Board quickly agreed that the Lossiemouth Occurrence Investigation had been thorough and that relevant causal factors had been identified that did not warrant further detailed debate by the Board. That being said, although the Board agreed that there had been a series of cumulative factors that had led to this incident, they were struck by the fact that, having lost sight of and formed a flawed mental model about the position of his leader, it had been the reinforcement of that model by the ambiguous R/T phraseology that had been a key element in the chain of events. Although the OSI acknowledged this with its finding that: *'The clearance passed to [Typhoon(1) pilot] on calling finals was misinterpreted by [Typhoon(2) pilot] and this reinforced his incorrect mental model, believing that there were 2 aircraft ahead and that he was visual with both.'* the Board felt that this was particularly worthy of more prominence within its findings. By telling the Typhoon(1) plot that he was '*... clear to land in turn, one ahead eh touch and go*' (16:37:37 on the transcript) the Typhoon(2) pilot's belief that he could see each of what he thought were only 2 aircraft ahead of him was powerfully embedded - he could see 2 aircraft ahead (the previous Typhoon pair in trail) and the controller's wording to Typhoon(1) appeared to confirm this to be so.

The controller's clearance was in accordance with the regulations extant at Lossiemouth at the time because, in an effort to reduce R/T, the terminology 'clear to land in turn' implied that there was an aircraft ahead also landing. The meaning of the ADC's clearance was therefore that the Typhoon(1) pilot was 'clear to land in turn' (i.e. behind one ahead also to land), and that there was 'one ahead to touch-and-go', a total of 2 ahead of Typhoon(1). In the Board's opinion this ambiguous terminology was fundamentally flawed and had unsurprisingly reinforced Typhoon(2) pilot's incorrect mental model as he interpreted it to mean that Typhoon(1) pilot was 'clear to land in turn behind one ahead to touch-and-go'. As a result Typhoon(2) pilot had continued into conflict with Typhoon(1), with which he was not visual but thought he was. The Board wondered how this phraseology had come about, whether it was exclusive to the Typhoon force or to RAF Lossiemouth and whether it was used routinely in training. If the latter was true, then there would be an entirely reasonable expectation that all the pilots

involved should have understood it, formed the correct mental model and averted the subsequent risk of collision. However, both the Airprox Typhoon pilots reported misunderstanding the ADCs transmissions on a number of occasions. The Board therefore surmised that the phraseology was not well understood. Members felt that an R/T clearance explicitly identifying the number of aircraft ahead was a more pragmatic approach, especially at night, and which in this case may then have prompted the Typhoon(2) pilot into taking action sooner. The Board considered making a recommendation to such effect but were heartened to be informed by the RAF ATC advisor that the Lossiemouth R/T and circuit procedures had already been changed and that work was being undertaken to standardise controller R/T phraseology across the Typhoon Force. However, members also commented that an additional aspect in this Airprox was an understanding of the human factors that allowed such a flawed phraseology to be adopted in the first place.

Turning to the cause and risk, members agreed that fundamentally the Typhoon(2) pilot had lost Situational Awareness on his leader as his radar broke-lock on the break to land and that he had then flown into conflict with Typhoon(1). Contributory factors were that: the Typhoon(1) pilot inadvertently created the geometry to allow for a conflict by flying a wider than normal circuit; Typhoon(2) pilot did not follow Typhoon(1) because he lost sight of Typhoon(1) on the break; Typhoon(2) pilot, now unsighted to Typhoon(1), misidentified Typhoon B as Typhoon(1) and formed an incorrect mental model of his sequencing in the visual circuit; and the format of the Tower controller's landing clearance to Typhoon(1) confirmed Typhoon(2) pilot's incorrect mental model, thereby allowing him to continue into conflict. The Board noted that the conflict had been resolved when the Typhoon(2) pilot had re-checked his air-to-air TACAN and, on seeing that it indicated 0.1nm separation, took action to deconflict from the circuit pattern. It was only after he took action that the Typhoon(2) pilot saw Typhoon(1) and, by the Typhoon(2) pilot's own admission, 'he did not know what prompted him to check the TACAN'. The Board members unanimously applauded him for so doing and agreed that this had most likely prevented much more serious consequences. Although recognising Typhoon(2) pilot's actions had ultimately improved the situation, members were unanimous in their agreement that, even so, separation had been reduced to the bare minimum and that, with a slant range at CPA of only 208ft, a serious risk of collision had existed in which providence had played a major part.

PART C: ASSESSMENT OF CAUSE AND RISK

Cause: Typhoon(2) pilot lost SA and flew into conflict with Typhoon(1).

Contributory Factors:

1. Typhoon(1) pilot flew a wider than normal circuit.
2. Typhoon(2) pilot lost sight of Typhoon(1) on the break.
3. When downwind, Typhoon(2) pilot misidentified Typhoon B as Typhoon(1).
4. The controller's landing clearance to Typhoon(1) confirmed Typhoon(2) pilot's incorrect mental model.

Degree of Risk: A.

Safety Barrier Assessment[5]

In assessing the effectiveness of the safety barriers associated with this incident, the Board concluded that the key factors had been that:

ANSP:

Regulations, Processes, Procedures and Compliance were assessed as **partially effective** because the ADC's clearance was open to misinterpretation.

[5] The UK Airprox Board scheme for assessing the Availability, Functionality and Effectiveness of safety barriers can be found on the UKAB Website.

Situational Awareness and Action were assessed as **ineffective** because the Lossiemouth controller could not detect the conflict.

Flight Crew:

Tactical Planning was assessed as **partially effective** because the Typhoon(1) pilot flew a wider circuit pattern than normal.

Situational Awareness and Action were assessed as **partially effective** because although Typhoon(2) pilot lost positional awareness on Typhoon(1), and mis-identified Typhoon B as Typhoon(1), he did ultimately receive situational awareness from his air-to-air TACAN and was then able to act to improve the situation.

See and Avoid were assessed as **ineffective** because neither Typhoon pilot saw the others' aircraft in time to take avoiding action.