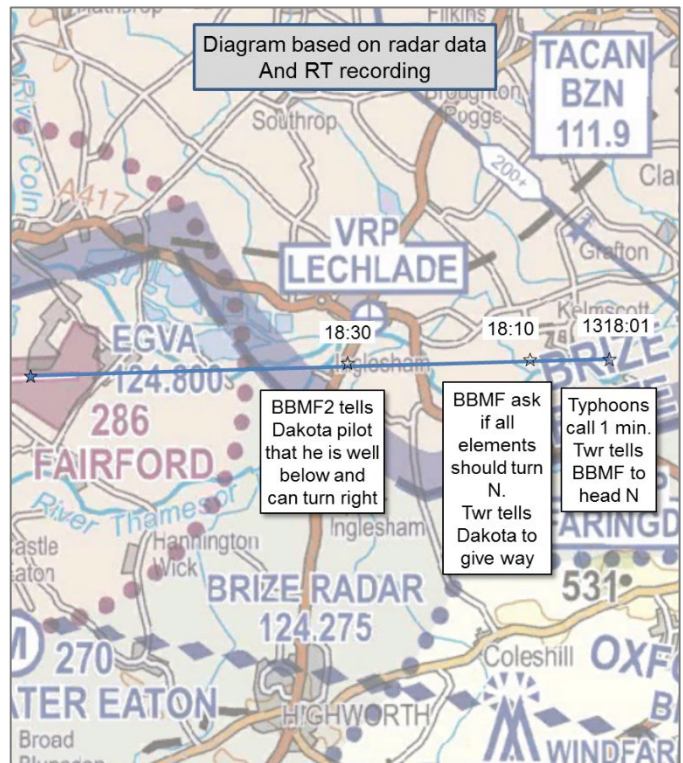


AIRPROX REPORT No 2018182

Date: 15 Jul 2018 Time: 1319Z Position: 5141N 00147W Location: Fairford

PART A: SUMMARY OF INFORMATION REPORTED TO UKAB

Recorded	Aircraft 1	Aircraft 2
Aircraft	9 xTyphoon	Dakota
Operator	HQ Air (Ops)	HQ Air (Ops)
Airspace	London FIR	London FIR
Class	G	G
Rules	VFR	VFR
Service	ACS	ACS
Provider	Fairford	Fairford
Altitude/FL		NK
Transponder	A, S, C	A, C, S
Reported		
Colours	Grey	Green
Lighting	HISLs Nav	
Conditions	VMC	VMC
Visibility	NR	
Altitude/FL	1300ft	NR
Altimeter	QNH (1015hPa)	NR
Heading	270°	NR
Speed	300kt	NR
ACAS/TAS	Not fitted	Not fitted
Alert	N/A	N/A
Separation		
Reported	~800ft V	NK
Recorded	NK	



THE TYPHOON PILOT reports leading 9 Typhoons for a diamond-9 flypast at RIAT, Fairford tasked at 1315. They departed the hold on time at 1256:29 and at 1300:17 he requested that the Swanwick Mill controller relay to Fairford that they were on time. At 1300:43 he received a request to 'Rolex¹ 6 mins to new Time On Target (TOT) 1-3-1-9'. A 6 min Rolex did not match a 1319 TOT, so he requested clarification and, at 1301:29, the controller confirmed the new TOT as 1319. At 1302 he executed an unplanned orbit in transit formation to the north of the Malvern Hills, rolling out on time. He changed frequency to Fairford App once south of the Malvern Hills, as directed by the Swanwick controller. The remainder of the transit was uneventful and there was no mention of further delays. He asked one of the formation to confirm another formation's TOT with their lead aircraft on their in-flight frequency and he reported back that it was 1321, 2 mins behind their own, as expected. He formed the Diamond-9 at 1307:20. At 1314:03 he requested to change to Fairford Tower and was cleared to do so by Fairford App. He descended to flypast height and checked in to Fairford Tower at 1314:08 calling '{C/S} on time'. At this point he heard BBMF communication and was told to 'minimise' by their formation lead. He rolled out on 'line of attack' (LOA) at 1317:00, 2 mins to TOT. He called '{C/S} 2 mins' to which there was an unreadable response from the BBMF formation. At 1318:01 he called '1 min' and Fairford Tower told the BBMF formation to 'head north now please, fly-by running in'. The continued presence of BBMF caused him some concern and he considered aborting to the south but discounted this as more dangerous than a fly through because he had insufficient situational awareness on other holding aircraft. At this point he saw the Dakota south of his LOA turning towards, slightly low and, at 1318:10, Fairford Tower instructed the Dakota to give way to the Typhoon formation. The Typhon pilot assessed there was a low risk of collision with the Dakota and he continued to search for the other BBMF aircraft, but didn't see them as his formation flew through. The Typhoon flypast occurred at 1319:08.

He assessed the risk of collision as 'Low'.

¹ 'Rolex' is a military codeword for instructing a delay to any task.

THE BBMF FORMATION PILOT reports that whilst on the ground the formation was advised that the display was running on time. This information is used for engine start times to avoid overheating the fighter aircraft and is therefore key information. However, a pair of aircraft ahead were taking off 4 mins late, so the BBMF pilot asked for confirmation that the display was actually running 4 mins late. The response from the Ground controller was that it was 3 mins late. They were delayed further by FOD on the runway, further delaying the display timings, and eventually took-off 9 mins after their original planned start time. During the latter part of their display the Typhoon formation were heard broadcasting '4 mins' on the display frequency. Believing it to be a formation on the wrong frequency, one of the BBMF formation instructed the station to minimise RT because the BBMF display has key radio communication requirements. At some stage subsequently there was a transmission that stated Typhoon in 3 mins, either from the Flying Display Director (FDD) or the Typhoon formation. The BBMF continued to display because the crews believed that they owned the airspace until the display was complete, which is standard air show procedure. As the BBMF fighters were conducting the re-join on the Lancaster as part of the final part of the display, the FDD transmitted words to the effect of '{BBMF C/S} go north now'. The Lancaster (No2) continued progressing north with the fighters (No3 and No4), but the Dakota (No1) which was south of the display line asked for confirmation that it too had to go north which would have resulted in it crossing the display line from off-crowd to on-crowd. The No3 saw the Typhoon formation well above and behind the Dakota and instructed the Dakota pilot to come right onto north, giving assurance that there was no immediate collision risk. The Dakota pilot, unable to see the Typhoon formation high in their 6 o'clock, turned right and descended 250ft to further increase separation. The Typhoon formation flew through and the BBMF continued for their last pass behind it.

He assessed the risk of collision as 'Low'.

THE FAIRFORD TOWER CONTROLLER reports that the BBMF formation were delayed on the runway due to FOD (a broken umbrella) and therefore rolled 7 mins later than their planned slot. The FDD informed him that the TOT for the Typhoon formation had been 'rolexed' by 4 mins to 1419 [1319]. This was passed to the BBMF with the additional information that 'there was no need to hurry'. This was not acknowledged by the BBMF, but this was put down to their need to minimise RT. During the display, the FDD asked how their display finished, but because the formation had landed at the end of the display the previous day and were not landing on this day, the Tower controller did not know. The previous day the Dakota had landed following his solo routine (leaving the fighters and Lancaster to complete their display), so the Tower Controller assumed that once the Dakota had vacated the display area, the aircraft would continue en-route to its final destination. At 1416 [1316] the Typhoon formation reported 2 mins to run-in, to which the BBMF told them to minimise RT. The Typhoon formation reported running in and at this time, unbeknown to the controller, the Dakota had split from the formation and was holding to the south of the display area as the Lancaster and fighters were running in on the 45° axis from the NW to turn NE at the datum. He was visual with the BBMF and the Typhoon running in from the east, and judged there was sufficient separation. However, as the BBMF turned over the datum, the FDD instructed him to break the BBMF onto 360°. Out of his line of sight, to the south of the airfield, the Dakota also appeared to take the 360° heading and flew towards the Typhoon formation. Whilst he was monitoring the inbound progress of the Typhoon formation against the BBMF Lancaster/fighter formation, the Tower Controller saw the Dakota appear from the south-east. Due to the proximity of the Dakota to the Typhoon formation, he only had time to pass Traffic Information both ways and both elements reported in sight and passed well clear.

He perceived the severity of the incident as 'Negligible'.

THE FDD reports that at 1245 he was located in the tower acting as FDD for RIAT. The BBMF formation made up of the Lancaster, Dakota, Spitfire and Hurricane were the next display item, followed by a flight of 9 Typhoon aircraft. The display was running 4 mins late when the BBMF were given clearance to line-up on the runway. As the aircraft positioned, the Tower controller noticed FOD, subsequently found to be an umbrella, blowing across and coming to rest on the runway. The BBMF was instructed to hold and an ATC vehicle despatched to retrieve the FOD item. Once the vehicle was clear of the runway, the BBMF was given clearance to take off. The first element of the formation took off at 1254 for a scheduled 23 min display slot. The Typhoon formation had a TOT of 1315, and he

realised that this would place their run though towards the end of the BBMF display slot, so he liaised with the Typhoon formation authoriser to see what delay could be applied to their TOT. Following this conversation, and based on the take-off time and slot duration, he made the decision to delay the Typhoon TOT to 1319. This information was passed through Brize radar to the Typhoons and he asked the Tower Controller at Fairford to pass the same message to the BBMF. The BBMF commenced their display and, at 1316, the Typhoon formation came on frequency and called on time. The BBMF called for a minimise on the RT. He watched their display and believed it to be almost complete; however, as the Typhoons called 1 min it became evident that there was one more element of the display to go. With the Typhoons now committed to their run-in, he took the decision that it was now safer to stop the BBMF rather than the larger Typhoon formation. The Lancaster and 2 fighters were to the north of the display line/runway and rolling away from Fairford, but the Dakota was to the south of the runway. Both elements were made aware of the Typhoon formation, with control instructions to remain clear. The Tower controller was instructed to tell the BBMF to route north; however, with the Dakota displaced south of the runway, this would have brought the aircraft closer to the Typhoon and a subsequent call was made for the Dakota to remain south. He believed that both elements called visual with the Typhoons. Following the fly through, the BBMF positioned for a final fly-through and departed Fairford for other display tasks. He was made aware of the safety reporting at 1515z.

Factual Background

The weather at Fairford was recorded as follows:

METAR EGVA 151250Z 22009KT CAVOK 26/10 Q1015 BLU NOSIG=

Analysis and Investigation

UKAB Secretariat

The Typhoon and BBMF pilots shared an equal responsibility for collision avoidance and not to operate in such proximity to other aircraft as to create a collision hazard².

Occurrence Investigation

The RAF conducted an in-depth Operational Safety Investigation (OSI). The OSI found that the BBMF was displaying more than once over the course of the 3-day event and, depending upon which elements were included in the display, the display time differed. Additionally, there was a time allowance if the aircraft were taking off or landing at Fairford. During the planning phase of RIAT when timing for the display was being discussed, the flying display for the BBMF on the Friday required 25 mins, and this time was used for the Sunday display, minus 2 mins because the formation was not landing after the display. In fact the Sunday display required 27 mins. The promulgated flying programme included a 'tolerance' of 4 mins to allow the Lancaster to complete the display with the BBMF and then join up with a GR4 and F35 for a flypast, and this also allowed a degree of flexibility for managing delays. A further gap of 6 mins was planned from the expected end of the BBMF slot (1309) and the Typhoon flypast (1315). The OSI noted that although the TOTs were given to the aircrew participants, they were not included in the flying programme for other interested parties, e.g. ATC. The planned flying programme was sent to the second FDD and the Flying Control Committee for review, but the discrepancy in the timing for the BBMF display required a detailed cross check and was not picked up. The programme was briefed to all participants of the display, but again attention was not drawn to the 23 min BBMF display allocation because of an understanding that the slot lengths were only an estimate and that they would be managed dynamically on the day.

The morning display went uneventfully, and the morning Senior FDD handed over to the afternoon FDD at 1215. By then the display was running 4 mins late, which was considered routine for this type of event. But neither FDD appreciated that the delay had absorbed the 4 min tolerance for the

² MAA RA 2307.

Lancaster to reposition for his second flypast. The handover was completed at 1230 and the Senior FDD left the Tower for other duties shortly afterwards. The FOD collection delayed the BBMF take-off, which, together with the 4 min delay, meant that the BBMF took-off at 1254, 8 mins later than planned. The FDD was aware of the delay and, after consulting with the planner, delayed the Typhoon TOT to 1319, which he believed would give the BBMF time to complete their display (based on the understanding that it would take 23 mins) plus 2 mins as a buffer.

When the Typhoon formation checked in on the Tower frequency, the BBMF leader was focused on coordinating the BBMF activity and he didn't have the capacity to realise that their arrival on frequency would impact his display. Furthermore, he expected that he had sole use of the display airspace. The FDD heard the Typhoons check-in at 1314, but he had not seen the BBMF display before and could not assess whether the BBMF were nearly at the end of their display so was relying on the flying programme for the timing. He therefore still believed that the BBMF would finish their display prior to the Typhoon's arrival in approximately 3min. At 1318 the Typhoon gave a 1min call, the BBMF were now 24min into their display and split into two elements north and south of the display line. They still required 2min to rejoin and commence their final fly-through. The Typhoon's 1min call prompted the FDD to take action by directing the BBMF to head north.

The OSI made a number of recommendations including that: R/T terminology should be introduced to avoid confusion over use of terms such as TOT, slot time, and display time; FDDs are to ensure that all participants are aware of the priority of flypasts at flying displays; timing changes should be passed as actual times to avoid confusion with use of 'ROLEX'; approval should be received from the TWR controller prior to handover of aircraft; a single reference should be used to ensure accurate, approved figures are used for display lengths; and that flying programmes should be cross-checked against display timings.

Comments

HQ Air Command

This incident led to an Occurrence Safety Investigation (OSI) being convened; the lead investigator is to be commended for the thorough investigation into this unusual and complex Airprox.

Most of the more typical barriers to MAC were available in this incident, albeit under slightly different guises. Display timings are closely coordinated to ensure not only the safety of the participants and spectators, but also to ensure a smooth-flowing show for the public. In this case, the planned display slot lengths and timings did not accurately reflect what was needed by the BBMF for this specific day and therefore the planned TOT for the Typhoon formation was, in fact, during the BBMF display. This only became fully apparent at a very late stage, when the FDD intervened and directed that BBMF head north to allow the formation of 9 Typhoons to conduct their flypast.

A 9-aircraft formation is very difficult to manoeuvre and, when the leader of the Typhoon formation became fully aware that there were still BBMF aircraft on his line of approach, he took the sensible decision to continue into a known environment rather than splitting the formation into multiple unknown environments. At this point he was visual with the BBMF aircraft and deemed there to be adequate, but less than ideal, separation. One of the BBMF fighter pilots also became visual with the Typhoon formation and passed directive information to the BBMF Dakota to assure adequate separation for this element of the BBMF formation.

Many lessons have been identified and recommendations made that should be available to the wider airshow fraternity. In this case, an 'uneasy feeling' on the part of the Typhoon formation leader led to his rightly questioning the information that was being passed to him. That, coupled with continued lookout to build SA, prevented separation between the two formations being eroded further.

Summary

An Airprox was reported when a formation of 9 Typhoons and a Dakota flew into proximity whilst displaying at Fairford at 1319hrs on Sunday 15th July 2018. All pilots were operating under VFR in VMC, and were in receipt of an ACS from Fairford.

PART B: SUMMARY OF THE BOARD'S DISCUSSIONS

Information available consisted of reports from the pilots of both aircraft, transcripts of the relevant RT frequencies, radar photographs/video recordings, reports from the air traffic controller and FDD involved and reports from the appropriate ATC and operating authorities.

The Board began by looking at the actions of the Typhoon leader. After being advised of the delay to the flypast, he had been allocated a revised TOT of 1319. Having arranged his approach to meet this new time, members with fast-jet experience commented that the formation of nine Typhoons would not have been very manoeuvrable once committed to the flypast at 2mins out and they could well understand why he had continued to fly through with the BBMF in the vicinity given that he was visual with them. Members noted that the Typhoon leader had been allowed to switch to the Fairford Tower frequency by the Approach controller, and until that point he had no knowledge that there was anything untoward. It was not until he had checked in on the Tower frequency (and was subsequently told to 'minimise' RT calls by the BBMF), that he received the first indication that something had gone awry. However, he had not been told that the fly-through could not continue, and by now the formation was committed. The Board agreed that in the circumstances there was little more he could have done: he was visual with the BBMF and in particular the Dakota; assessed that the risk of breaking the formation off and potentially into the next formation waiting to fly-through behind was greater than the risk posed by the Dakota; and rightly concluded that he was better placed to continue towards the Dakota that he could see was below and not a threat.

For their part, the BBMF were conducting their display and had no knowledge that the FDD was expecting their display to last 23mins when in fact it was 27mins long. Acknowledging that the BBMF display choreography was complex and relied on RT calls for safety, some members wondered nonetheless whether when the Typhoons came on frequency and called 2mins, the BBMF leader should have assimilated that this would put the Typhoons within their display slot and queried ATC rather than just call for minimised RT. Had he done so, there was the opportunity for the BBMF to curtail their display in a more orderly fashion. That said, it was agreed that the BBMF leader would likely have been task-focused on his display at the time, and perhaps did not fully assimilate the ramifications of the Typhoon leader's call. Having been unexpectedly told by ATC to route to the north, the Dakota pilot, who was south of the runway at the time, was then left uncertain about whether the instruction included him. He asked for clarification and was told to 'give way' to the Typhoons but another BBMF pilot then told him he was ok to turn north. The Board debated for some time whether this latter instruction had made the situation worse, and whether the other BBMF pilot was right to issue it. Without radar recordings, the Board could not determine whether the Dakota pilot was already turning before the other BBMF pilot's call, or whether it had been the trigger for him to turn. The military member informed the Board that he had spoken with the BBMF pilots and, knowing that the Dakota has very poor visibility out of the cockpit, the other BBMF pilot was simply trying to assist his fellow pilot by reassuring him that he was clear, rather than issuing controlling instructions *per se*. Regardless, the Dakota pilot descended anyway to increase the separation from the Typhoons as he routed towards their run-in track, and by this time was around 300ft versus the Typhoons at 1000ft.

The Board then looked at the actions of the Fairford Tower controller and were told that the Typhoons had called on his frequency without him receiving prior handover from the Approach controller (situated at Brize Radar). Although expecting the Typhoons, controller members with air display experience opined that their arrival during the BBMF display may have come as a surprise. They went on to comment that they were surprised that the Typhoons were sent across to the Tower frequency without the Approach controller confirming first that Tower was able to accept them. This was a breakdown in coordination which might otherwise have provided an opportunity to delay the Typhoons before they ran in. The Board were heartened to see a recommendation from the OSI address this issue.

The Board then discussed at length the crossover of responsibilities between the FDD and ATC, and wondered who had primacy regarding the display schedule versus air traffic safety. RA2335 states that the FDD is responsible for the safe and efficient conduct of the flying display and for flying discipline generally³, and some members felt that this meant there could easily be a crossover in responsibilities between the FDD conducting his role and the controllers managing traffic flows in a safe and efficient manner. Having been told by the FDD to instruct the BBMF to go north, the controller was now left with the Dakota split from the rest of the formation, and controlling members thought that he should have been much more directive in his controlling at this point and overridden the FDD's instruction to route it north. As it was, his instruction to 'give way to the Typhoons' wasn't very helpful to the Dakota pilot who couldn't see them, and left the pilot unsure of whether to flow north or not. Controller members felt that once he had realised that the Dakota was south of the runway, a more directive instruction such as 'remain south of the runway' would have been far more preferable, even if it did contradict the FDD's instructions.

Turning to the role of the on-duty FDD, the Board were very surprised that neither he nor the controller knew what the last BBMF manoeuvre was, nor how long their display would last on the day. Some members commented that they would have expected that pilots would be required to give a detailed breakdown of their displays for just such a reason, and that the FDD would have a 'running sheet' with precise times and manoeuvres. However, they were told that pilots frequently have to amend their routines to allow for weather/wind, and so only generic details were available - BBMF displays were apparently particularly susceptible to wind and so they had a flexible display. Nevertheless, it was clear to the Board that the FDD had been let down by the planning of the display and the timing of the BBMF slot in particular. The Board debated whether he should have identified the timing error himself from the published flying display, but noted that the error had also not been identified by the Senior FDD/Flying Control Committee or by the aircrew. Controller members with air display experience recalled that when they had been involved in their numerous displays, the key timing requirement was for those engaged in a display to give a '2 mins' call to completion; it was only after this was received that ATC would 'call-in' the next element to display. It was not known whether this system was useable for something as complex as RIAT, but the Board agreed that without a mechanism for knowing how long the BBMF still had to display, the FDD was left trying to second-guess the finish point as the Typhoons were already running in. As a consequence, he allowed the situation to develop where the Typhoons began their run in for their flypast before the BBMF had completed their display, and members thought that he should have been more pro-active in deconflicting these two elements earlier. Again, the Board were heartened to see that the OSI had made recommendations to ensure that mistakes in planning the display flying programme should not be made again.

The Board then deliberated at some length about the cause of the Airprox. Some members initially opined that, given the fact that the incident had occurred in Class G airspace where the pilots were ultimately responsible for collision avoidance, the Dakota pilot had evidently turned into conflict with the Typhoons that he had been told to give way to. However, the majority felt that this was harsh, given that he had been instructed earlier by ATC to route north, and encouraged to do so by his fellow formation pilot. Other members thought that ATC should have been more directive within the ATZ to ensure that the Dakota remained out of the path of the Typhoons, but they acknowledged that the controller had been reacting to instructions from the FDD whom they may have felt had primacy. This led the Board to settle on who was ultimately responsible for the safe conduct of the display and, in the end, they agreed that the cause had been that the FDD had allowed the Typhoons to run-in before the BBMF had completed their display. Recognising the complexity of the situation and the length and breadth of the debate, the Board also agreed on a number of contributory factors, namely: that the BBMF display duration disparity had not been assimilated by the FDD; that the ATC instructions to the Dakota pilot were ambiguous; and that ATC had instructed the Dakota to fly north when it was already south of the runway. Notwithstanding, in assessing the risk of collision, the Board quickly agreed that because the Typhoon pilots were visual with the Dakota during their run-in, and the Dakota pilot had descended to increase the separation, although safety had been degraded there had been no risk of collision; Risk Category C. Recognising the pivotal role that FDDs played in the conduct of flying

³ RA2335 Flying Displays and Flypasts

displays and the need for them to be absolutely clear as to display durations and content, the Board also resolved to make recommendations to the MAA and CAA that FDDs be reminded of their responsibility to proactively direct activities in the display to ensure deconfliction.

PART C: ASSESSMENT OF CAUSE AND RISK

Cause: The FDD allowed the Typhoon formation to run-in before the BBMF had completed their display.

- Contributory Factors:
1. The BBMF display duration disparity was not assimilated by the FDD.
 2. ATC instructions were ambiguous regarding the requirement for the Dakota pilot to give way.
 3. ATC instructed the Dakota pilot to fly north.

Degree of Risk: C.

Recommendations: The CAA and MAA remind FDDs of their responsibility to proactively direct activities in the display to ensure deconfliction.

Safety Barrier Assessment⁴

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 **ineffective** because the FDD and ATC allowed the Typhoons to commence their flypast when the BBMF were still displaying.

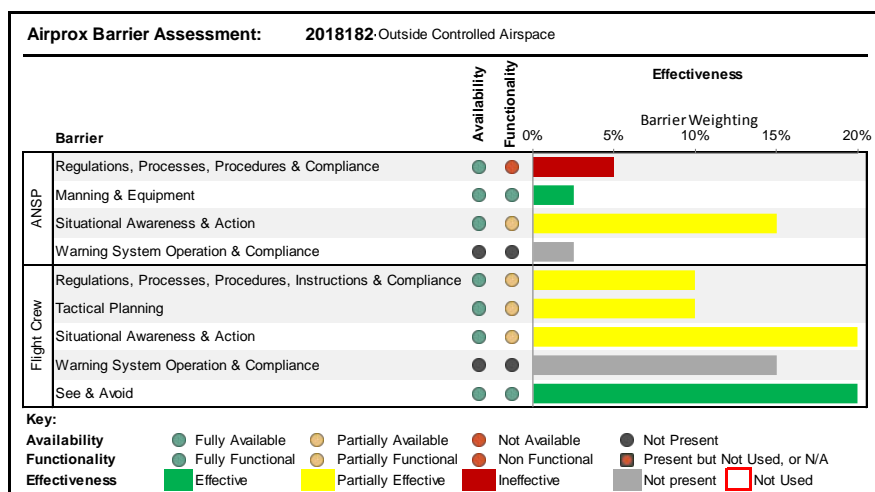
Situational Awareness and Action were assessed as **partially effective** because the Fairford Twr Controller did not fully resolve the conflict between the Dakota and the Typhoons.

Flight Crew:

Regulations, Processes, Procedures, Instructions and Compliance were assessed as **partially effective** because the Dakota pilot did not fully give way to the Typhoons.

Tactical Planning was assessed as **partially effective** because the length of the BBMF display duration was not fully assimilated in the planning stages prior to the display.

Situational Awareness and Action were assessed as **partially effective** because the Dakota pilot was aware that the Typhoons were running in but continued to turn north, albeit querying the instruction.



⁴ The UK Airprox Board scheme for assessing the Availability, Functionality and Effectiveness of safety barriers can be found on the [UKAB Website](#).