SPECIAL EDITION: THE HOW AND WHY

SUMMARISING DFSB'S RECENT INVESTIGATIONS

02 2022 EDITION

Spotlight

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FOREWORD

WELCOME TO *SPOTLIGHT* 02/2022. Avid readers of this journal will have noticed that the first edition for this year (*Spotlight* 01/2022) was published for the first time under the banner of the Defence Aviation Safety Authority (DASA). However, this second edition is a Defence Flight Safety Bureau (DFSB) product. Why?

It's an essential element of the Defence Aviation Safety Program that DFSB maintains its role as an independent investigative capability, while remaining an important part of DASA in which we actively contribute to the One-DASA philosophy. DFSB's independence is enshrined in some high-level documents that clearly articulate our unique place in DASA and preserves our independence. A DFSB investigation may well, and often does, make findings about DASA's implementation, oversight and enforcement of regulation and we have a clear mandate to do so. To that end, every time DFSB investigates a safety event, the investigation is conducted independently of DASA; hence the DFSB branding for this investigation special.

In this edition we take an in-depth look at some of the key investigations that DFSB has conducted in the previous year. For those who have read DFSB reports in full you'd recognise that we've gone to considerable effort to summarise lengthy and comprehensive reports and hit the key facts and lessons. Therefore, some of the intricate detail that is revealed in the forensic style of investigations that DFSB conducts will have been omitted. Finally, as with all DFSB investigations it's not our intention or role to apportion blame or liability and there are separate administrative processes that can be undertaken if punitive action is being pursued, but that's out of DFSB's lane. However, it's still important that we figure out what happened and importantly, what didn't happen. Almost all the time there are human factors involved … to err is human.

In reading each of these case studies I invite you to look beyond the tactical matters and the specifics of what occurred to identify key themes. Look for things like inadequate supervision, human factors, poor decision-making, sub-optimal communications, stress/fatigue and system complexity. What are those bigger systemic and organisational issues that exist and form the pre-conditions to bad things happening? Conversely, what are we doing right as an organisation that means these events didn't escalate into something much worse? In other words, what are our risk controls and how effective are they on a day-to-day basis?

I always want to make the point that in every one of these safety events there have been no fatalities. Injuries, when they've occurred, have been minor. Damage to aircraft and equipment has been economically repairable. We are extremely fortunate to be in such a position and I acknowledge all the great work that is done every day by our people. All of you, through the approach that you take, help to keep us safe and preserve ADF capability.

Please enjoy reading this edition of *Spotlight*.

Regards,

GPCAPT Dennis Tan
Director DFSB

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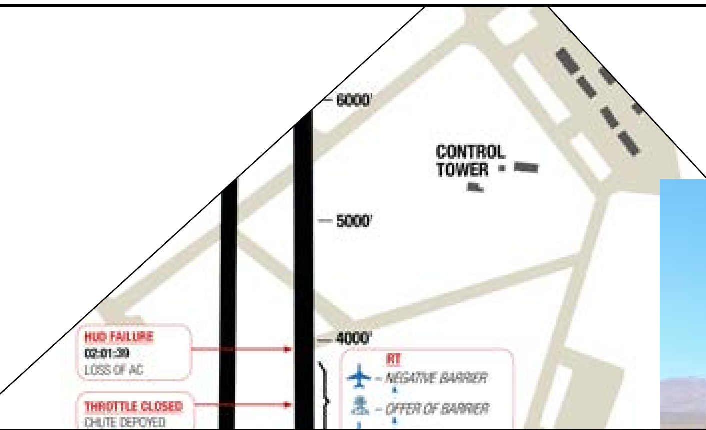
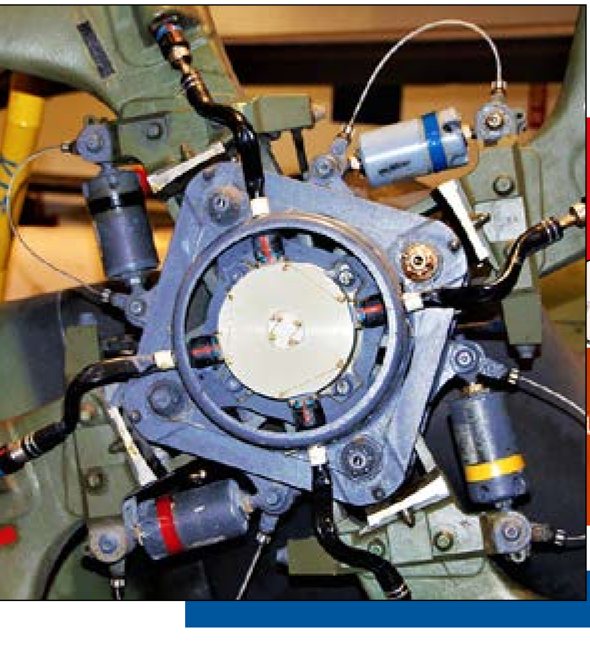


Commanders' guide to DFSB safety investigations



WE ARE EXPERIENCING fewer Class A and Class B events today than we have in previous years, which means when a major safety event occurs within your unit, it won't be routine. This can be distressing to unit personnel and their families. Add to that the DFSB investigation team arriving to ask some tough questions.

This guide is useful in diffusing some of the anxiety that might be felt during a DFSB-led investigation. The key phrase in the article is that 'DFSB performs **non-punitive** safety investigations which seek to **prevent recurrence and enhance safety**', which means the ASIT is NOT there to point the finger and find someone to blame ... that's the job of a separate administrative process, not the role of DFSB.
DFSB is there to identify the lessons learned all the way to the top of the organisation so that we can have fewer accidents and serious incidents. It's more than a worn cliché when we say that 'we're here to help'.

It provides general advice regarding DFSB investigations. As every investigation is unique, each will require tailored coordination and support. Regular communication between your unit and DFSB will help enable an effective and efficient investigation.

Who we are and what we do

DFSB's investigation team provides independent, dedicated aviation safety investigators to investigate all Class A and select Class B events on behalf of the Defence Aviation Authority. DFSB investigations are conducted for the sole purpose of preventing recurrence and enhancing safety. DFSB investigations are non-punitive and do not assign fault or blame.

Why are we investigating?

You may have already received notification that DFSB will be investigating your unit's safety event. If not, in order to clarify the process, please refer to Figure 1 for a flow-diagram of how investigation of safety events are assigned to either DFSB or Command.

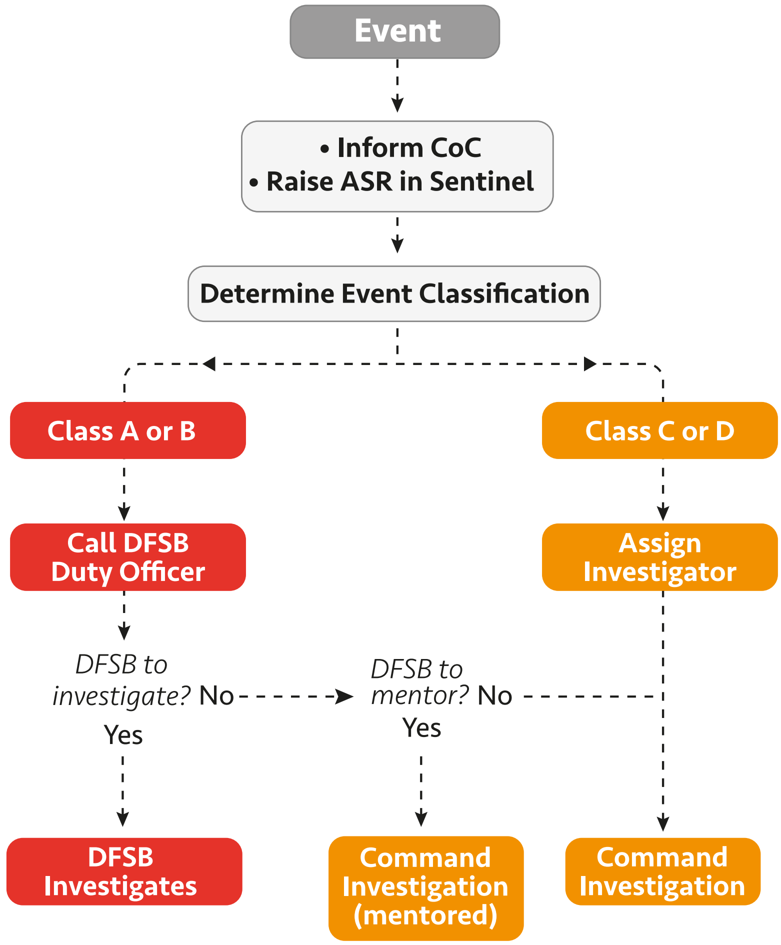


Figure 1. How an investigation is appointed

Preliminaries

DFSB assigns an ASIT to conduct investigations. The composition of each ASIT is tailored to best carry out the investigation. Table 1 (page 6) describes the normal composition of an ASIT.

Before the ASIT arrives

Unit point of contact (POC) – assign an enduring liaison officer for the DFSB team.

This person may also be appointed to the ASIT. Consider using an Aviation Safety Officer (ASO) as the experience may enhance the member's ability to conduct Command safety investigations. Additional POCs may be required for your maintenance organisation, engineering support, et cetera.

ASIT POSITION	DESCRIPTION	PERSON
Officer In Charge (OIC)	Oversees the investigation	• Director DFSB
Investigator In Charge (IIC)	Manages the conduct of the investigation	• Deputy Director — Investigation
Lead Investigator	Manages day-to-day running of investigation Is the best staff-level POC	• DFSB investigator (usually an operations/technical lead for Class B)
Operations Lead	Manages operational aspects of the investigation	• DFSB Investigator (aircrew)
Technical Lead	Manages technical aspects of the investigation	• DFSB Investigator (engineer/technician)
Data Lead	Manages data collection and analysis	• DFSB Investigator (data specialist)
Investigation Support Network SME	Provides specialist support	• Defence Science & Technology (DST) Group • Institute of Aviation Medicine (IAM) • Australian Transport Safety Bureau (ATSB) et cetera
Local SME	Provides specialist knowledge	• ASO and/or platform aircrew, engineer, technician et cetera

Table 1. Typical ASIT composition

The Lead Investigator will work with your POC to try and minimise the impact of the investigation on unit activities.

The Unit POC should:

- organise ASIT access to the base, unit and areas of interest
- inform the base support agency (for example, Combat Support Group (CSG)) of the investigation, especially if support is likely to be requested (for example, shelter, accommodation, PPE, et cetera)
- Liaise with the Lead Investigator regarding an initial schedule and access to relevant personnel (for example, the event aircrew)
- Obtain details of base photography (including Uncrewed Aerial Systems Capability) POC.

Formal appointment of the ASIT – for information – you will receive a copy of the Letter of Appointment.

ASITs are appointed via a minute (Letter of Appointment) from the Appointing Authority to the investigating organisation (in this case, DFSB).

The Appointing Authority for Class A events is usually the Defence Aviation Authority (DAA).

The Appointing Authority for Class B events is usually ACAUST, COMFAA or COMD AVNCOMD depending on service.

Responsibility for raising a Letter of Appointment lies with the Appointing Authority's staff; however, DFSB will assist. The ASIT is able to commence activities based on a verbal authorisation from the Appointing Authority.

Investigative quarantine — ensure evidence is preserved.

Quarantining helps preserve evidence, which enables a faster, more effective investigation. Ideally, quarantining should have already begun (IAW the DASM and local instructions); and should include:

- data (including Flight Data Recorder/Cockpit Voice Recorder)
- documentation (including flight planning and maintenance documentation)
- physical items (including the aircraft and support systems)
- an entry in the Aircraft Maintenance Documentation (AMD) to formally enforce an aircraft investigative quarantine.

The Lead Investigator must first approve any activities relating to a quarantined aircraft.

The Lead Investigator will formally communicate the removal of the aicraft from investigative quarantine.

Unit evidence collection — you may be asked to collect specific forms of evidence.

Usually there is a delay between DFSB's appointment as the investigating organisation and the arrival of a DFSB ASIT.

In this situation, the Lead Investigator may contact the unit in order to arrange for specific evidence to be collected.

Unit notification – it is suggested your unit personnel are informed of the DFSB investigation.

It is advisable to inform your personnel of the DFSB investigation, especially that:

- DFSB performs non-punitive safety investigations which seek to prevent recurrence and enhance safety
- The investigation will be aided by honest and open communication by all personnel.Once the initial interviews with personnel directly involved in the event are complete, DFSB strongly encourages open and honest discussion of the safety event within the unit to maximise safety improvement.
- **Unit POC.** The ASIT will rely heavily on the Unit POC.
- **Safety brief.** The ASIT will require a safety brief regarding hazards specific to your workplace.
- **CO's initial brief.** The Lead Investigator will provide a brief describing the ASIT's intended plan. The brief is normally provided to the CO, but you are welcome to invite executives or other stakeholders.
- **Work-space requirement.** The ASIT will need a working space and an interview room. If possible, the work-space should have access to DPN. The interview room should be quiet, private, and large enough for at least three people.
- **Physical access.** The ASIT will need access to the site and areas of interest. This may include transportation if difficult to access.
- **Data access.** The ASIT may need access to data sources such as objective.

Examples may include:

- completion of DFSB self-administered witness interview forms
- photography
- collection of samples such as oil and fuel.

Finance – your unit is responsible for funding travel costs.

IAW the Letter of Appointment, ASIT travel costs are borne by the event unit (or its parent command).

Authorised travel codes will be sought by the HQ drafting the Letter of Appointment.

In order to rapidly deploy at short notice, the ASIT is authorised to expend funds to travel based upon the Letter of Appointment or a verbal authorisation from the Appointing Authority.

- **Custody of evidence.** The ASIT may need to take custody of evidence, such as aircraft parts, and samples.
- **Safety concerns.** If at any time the ASIT has safety concerns, they will be raised without delay to appropriate personnel (for example, CO, MAO-AM, et cetera).
- **Clarification of responsibilities.** Please note, DFSB is not responsible for the decisions regarding rectification of aircraft unserviceabilities, continuing airworthiness or management of personnel.
- **Just Culture.** Aviation safety investigations only focus on the performance of the aviation system, and seek to address only safety issues.

  No disciplinary or administrative action is to be based on information obtained exclusively for the purpose of the aviation safety investigation.

  If, during an investigation, it becomes apparent that a DFDA or civilian offence is likely to have been committed, the chain of command will be advised.

  While any administrative or disciplinary action may run in parallel with the safety investigation, they must be managed as separate organisational processes.

After the ASIT leaves

- **Unit POC.** Expect the Lead Investigator to remain engaged with the POC for the duration of the investigation. The ASIT may need ongoing access to personnel and data sources. The Lead Investigator will maintain communications regarding the return of evidence.
- **Investigation status.** Updates to the investigation will be provided IAW the instructions in the Letter of Appointment.
- **Investigation timeframe.** The time taken to complete an investigation varies significantly based upon complexity and reliance on external parties (for example, technical reports). Typically, investigations take upward of six months to complete.
- **Report review.** Prior to the report's final release, a draft copy will be made available to stakeholders for comment on factual matters, and the efficacy of recommendations.
- **Report submission.** The report will be delivered to the Appointing Authority. Once accepted, it will be published on the DFSB website.
- **Unit brief.** Post-report, DFSB will visit the unit and provide an investigation brief (as coordinated with the Unit POC).
- **Proactive safety actions.** Whether or not DFSB identifies safety issues during its investigation, relevant organisations may proactively initiate safety action(s) to reduce their safety risk as they see fit.

Near collision

A PILATUS PC-21 CONDUCTING a practice forced landing (PFL) to Runway 27 at RAAF Base East Sale experienced a near mid-air collision with another PC-21 conducting a straight-in, flapless approach to the same runway in early August 2021. The two aircraft re-established safe separation after East Sale Air Traffic Control Tower issued a safety alert.

History of the flight

On 5 August 2021, a Pilatus PC-21, (ACFT 1), departed RAAF East Sale aerodrome at 1520 hrs to conduct an ADF Basic Pilot Course basic general flying sortie involving practice forced landings. At approximately 1543 hrs, it positioned to complete a PFL to Runway 27.

The PC-21 forced-landing pattern has two identified key points, High Key (HK) and Low Key (LK), which are used to assess the aircraft's descent performance. HK is the point 1000 ft laterally abeam the landing threshold, on the dead side of the runway, at 3500 ft above ground level (AGL). LK is the point 4500 ft laterally abeam the landing threshold, on the live side of the runway, at 2500 ft AGL. In the forced-landing pattern, the aircraft is flown through HK, tracking parallel to the landing direction, before turning and descending to LK in a downwind direction.

As the aircraft approached HK, the QFI handed control of the aircraft to the student pilot while continuing to manage external communications. At 1543:11 hrs, the QFI advised ATC 'ACFT 1, approaching high key'. In reply, ATC advised 'ACFT 1, traffic ACFT 2 on a two-mile final', which was acknowledged by ACFT 1's QFI.

ACFT 2, also a Pilatus PC-21, departed East Sale at 1450 hrs to conduct a similar sortie profile to that of ACFT 1. At the time of the event, the student pilot (under QFI instruction) was conducting a flapless approach to Runway 27 via a 3 NM final. At 1543:24 hrs, the student pilot advised ATC 'ACFT 2, three miles, three greens, touch and go'. ATC replied 'ACFT 2, cleared touch and go, check wheels', which was correctly read back by the student followed by the landing gear tone.

Meanwhile, at 1543:40 hrs, upon reaching HK, the QFI of ACFT 1 began to direct the student pilot through the PFL sequence, before advising ATC 'ACFT 1, high key'. The QFI continued directing the student pilot as they flew the aircraft from HK to LK, and at 1544:11 hrs advised ATC 'ACFT 1, high base, three greens, touch and go'. ATC advised 'ACFT 1, number two, check wheels', which was read back by the QFI followed by the landing gear tone.

At 1544:57 hrs, as ACFT 1 rolled out on final, the QFI initiated final checks, internally stating 'Three greens ...' before the student pilot continued by stating 'Flaps land, runway clear, were we cleared sir?' The QFI replied 'Affirm' before taking control of the aircraft to complete a touch and go.

At 1545:08 hrs, ATC broadcast 'ACFT 1, safety alert, go around now'. The QFI of ACFT 1 immediately initiated a climb on runway track, and replied 'Going around, ACFT 1'. ATC subsequently asked 'ACFT 1, confirm you have ACFT 2 in sight?' to which the QFI of

ACFT 1 replied 'On the runway, ACFT 1?' ATC subsequently instructed 'ACFT 1, track dead side'. The QFI of ACFT 1 continued to climb, initiated a 45-degree angle-of-bank turn to the left, and replied 'Dead side, ACFT 1' before completing the go-around checks and sighting ACFT 2.

Shortly after this, on the aircraft intercom, the student pilot of ACFT 1 said 'That was my bad sir, I didn't see him' to which the QFI of ACFT 1 replied 'I didn't see him either', and later, 'He must have been under the nose that entire time, I thought he was [on] two mile finals before!' The crew of ACFT 1 subsequently completed a normal circuit to land on Runway 27, terminating the sortie.

Upon hearing the safety alert from ATC, the student pilot of ACFT 2 asked their QFI 'Is that us?' The QFI stated 'Go around' to which the student pilot answered 'Going around' before initiating a go-around on runway track.

The QFI proceeded to take control of the aircraft, and complete the go-around checks. The student pilot of ACFT 2 subsequently commented 'I'm surprised ATC gave them the go ahead on high key'. ACFT 2 continued its sortie, landing at 1608 hrs.

Air traffic control

Between 1538:53 hrs and 1546 hrs on 5 August, the ADATS feed to East Sale ATC was severed, a failure with similar symptoms as a radar failure. It was presented to the tower controller through the message 'DISPLAY FROZEN SELECT DRA MODE', which was displayed on their Situation Data Display (SDD).

The approach controller selected Direct RADAR Access (DRA) mode, which is a degraded mode of operation. However, the RADAR did not immediately enter DRA mode, resulting in all aircraft paints being wiped from the controllers' SDDs.

Immediately following the ADATS degradation, the tower controller broadcast 'All stations East Sale, identification terminated due RADAR failure, expect delays, standby for further instructions'.

The approach controller advised the tower controller that DRA mode was active and commenced the co-ordination of traffic. The tower controller advised 'I've got nothing on my RADAR' and subsequently selected DRA mode. With the RADAR in DRA, abbreviated verbal co-ordination was not possible.

The subsequent co-ordination provided by the approach controller to the tower controller was described as 'confusing' by the tower controller. At 1545:08 hrs, with the co-ordination instructions ongoing, the tower controller looked up to conduct a visual scan of ACFT 2, observed ACFT 1 and ACFT 2 as '... uncomfortably close' and issued the safety alert.

The tower supervisor said that in the time between the ADATS degradation and the occurrence, they were primarily seated at their desk, facing away from the tower controller, conducting phone calls to the approach supervisor and various squadron operations cells. Upon hearing the safety alert, the tower supervisor looked outside and observed ACFT 1 and ACFT 2 '... in close proximity'.

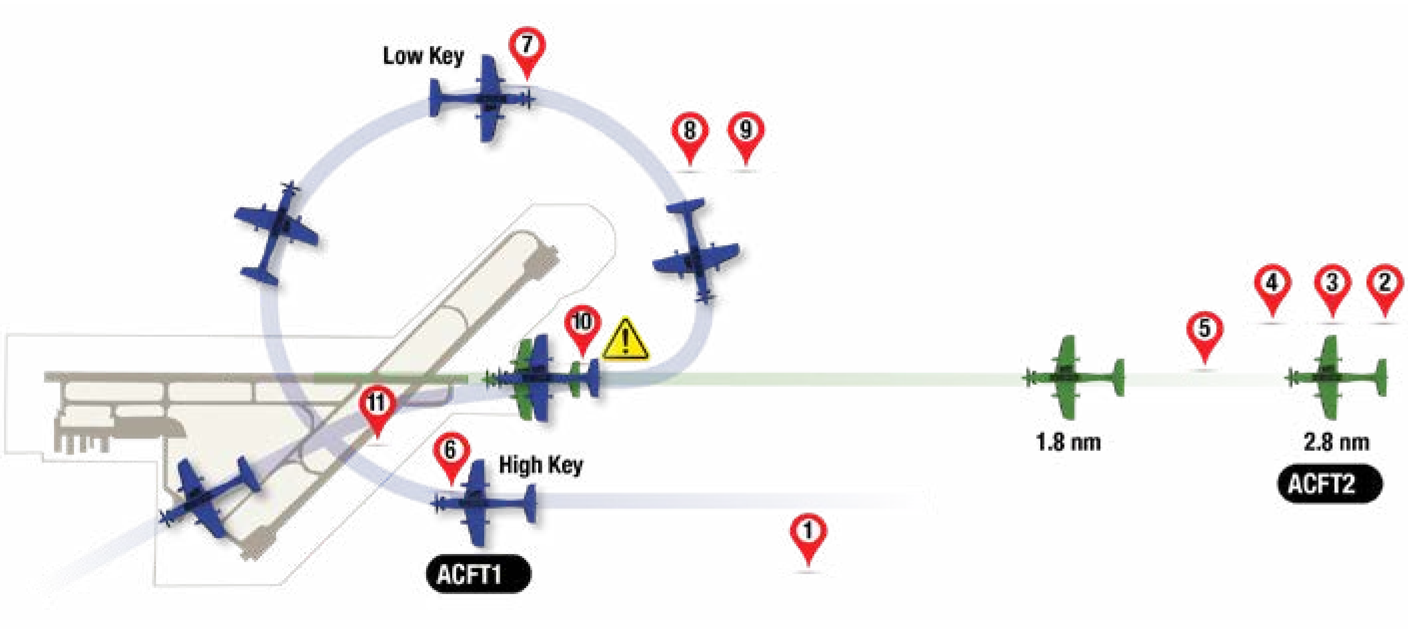
When asked why circuit operations were continued after the ADATS degradation, the tower supervisor said that two aircraft in the circuit was '... not defined as busy by anyone's imagination' but provided further qualification to this comment by stating that the co-ordination of instrument-approach traffic on a different runway added to the tower controller's workload.

Weather

The authorisation brief acknowledged that the weather was marginal for the intended operation. The investigation could not find any evidence of formalised weather limitations placed on flying disciplines such as PFLs in risk management plans, learning management packages, or standing instructions.

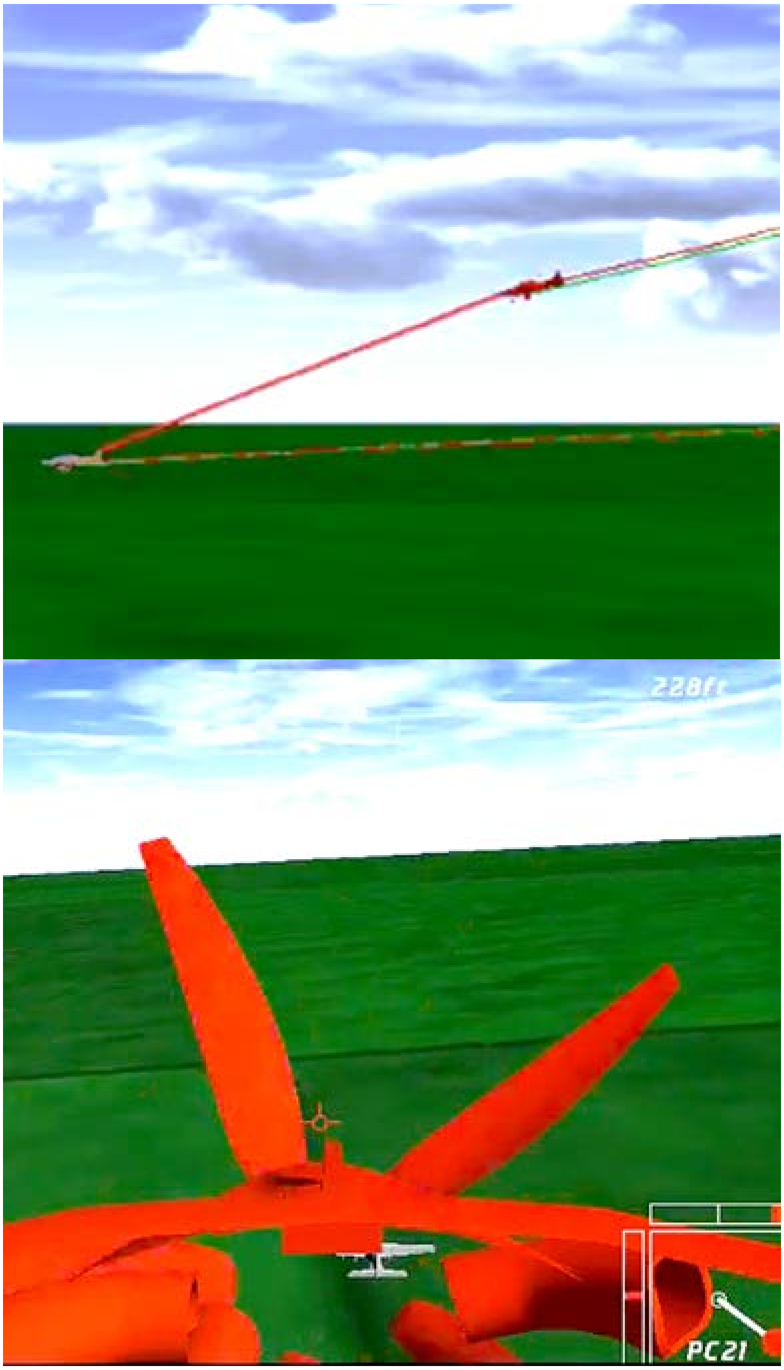
In the absence of defined weather limits, the QFI of ACFT 1 was left to judge the suitability of the weather for conducting PFLs once airborne, which very likely added to their cognitive workload during the event sortie.

Shortly after this, on the aircraft intercom, the student pilot of ACFT 1 said 'That was my bad sir, I didn't see him' to which the QFI of ACFT 1 replied 'I didn't see him either', and later, 'He must have been under the nose that entire time. I thought he was [on] two mile finals before!'



	Time	ACFT1	TWR CONT	ACFT2
1	05:41:11	"ACFT1 approaching High Key"		
2	05:43:18		"ACFT1, traffic is ACFT2 on a 2 mile final"	
3	05:43:24			"ACFT2 3 mile, 3 greens, touch and go"
4	05:43:32		"ACFT2 cleared touch and go, check wheels"	
5	05:43:35			"Cleared touch and go, ACFT2"
6	05:43:40	"ACFT1 High Key"		
7	05:44:12	"ACFT1 high base, 3 greens touch and go"		
8	05:44:15		"ACFT1 number 2, check wheels"	
9	05:44:22	"Number 2, ACFT1, then <Landing Gear Tone>"		
10	05:45:08		⚠ "ACFT1 Safety Alert, Go around Now."	
11	05:45:12	"Going around ACFT1"		

Figure 1. Timeline of events



Defence Science and Technology recreation of near collision

During the event PFL, ACFT 1 experienced an average wind of 35 kts from approximately 250 degrees magnetic, with a maximum of 40 kts shortly after reaching LK and minimum of 20 kts once aligned with the landing runway. This required a significant correction of angle of bank by the student pilot between HK and LK in order to maintain the ground track required to reach the runway (45 degrees, vice 30 degrees in nil wind). It also compressed the timeframe in which the PFL was conducted.

From HK to go around, this sequence was completed in one minute and thirty seconds. It is virtually certain that the additional instruction and supervision required in these conditions increased the cognitive workload of ACFT 1's QFI during the event sequence.

Human factors

Stress is an inevitable part of human life and, in small quantities, necessary to achieve optimum performance. While some stress can benefit human performance, too much stress is harmful and can result in errors. One small workplace stressor can become significant if an individual is under pressure from other sources.

More often than not, it is the sheer number of stressors being experienced by an individual or the number of times that the particular stressors are experienced – referred to as the dosage effect – which leads to that person actually feeling stressed.

At the time of the near collision event, the QFI of ACFT 1 had recently become a parent. This was combined with the duty-related stressors of needing to complete their dinghy drill, instrument rating test and continue their duties as a course manager, all of which were conducted during their parental leave.

Stress affects performance differently, depending on the nature of the task. When performing complex tasks, such as the PFL being conducted at the time of the near-collision, performance may rapidly decline under pressure.

For the event sortie, the QFI of ACFT 1 was presented with the additional workplace stressor of a student with whom they were unfamiliar and the environmental stressors of weather and multiple aircraft operating in same airspace.

Combined with the lack of situation awareness provided by the daily flying program and the lack of recency in PFLs, it is extremely likely that the QFI of ACFT 1 had a significantly higher cognitive workload than normal.

Defence aviation personnel are faced with the challenge of building a bridge between the reality of work demands and rules and regulations that cannot possibly cover every work challenge that can arise. The can-do attitude – working successfully under pressure and resource constraints – typifies most Defence aviation organisations and is a source of professional pride.

While the benefits of encouraging a can-do culture are numerous, it must be acknowledged that some safety-management strategies can be impeded because of a strong sense of not wanting to let the team down. Departure from standard procedures enables tasks to be achieved and reputations as capable operators to be maintained.

We know; however, from experience and the wider literature, that departures from approved procedures increase the risk of accidents. Individuals can misunderstand or underestimate the wider effects of decisions that made perfect sense in the local context in which they were made.

Conclusion

While this near-collision event may appear to have occurred solely due the misunderstanding of ACFT 2's position by ACFT 1's QFI, this investigation found that a combination of local conditions and organisational factors were contributory.

Problems at the organisational level were transmitted into the workplace, ultimately degrading the performance of ACFT 1's QFI, tower controller and tower supervisor.

The way in which PFLs and flapless approaches are flown in the PC-21 put aircraft in conflict in the circuit area, and the design of airspace and instrument approaches at RAAF East Sale add additional conflicts. Aircraft captains at RAAF East Sale are not provided with comprehensive information with which to build situation awareness prior to departure, and are largely left to rely on ATC and communications through the local operations frequency to arrange de-confliction airborne. The PC-21 datalink system, while designed to enhance situation awareness, comes with limitations and little guidance towards its use.

While formal authorisation processes are in place for students, they do not consider the combined stressors (life, duty-related, environmental, workplace) on QFIs.

There is no formal guidance regarding weather for specific flying disciplines at 1FTS. There was also no requirement for ACFT 1's QFI to conduct regular, structured SCT flying in order to maintain their own skills in complex flying techniques and no formal requirement for them to adhere to the same go-around criteria as students. A steep authority gradient existed in the cockpit of ACFT 1, resulting in a critical final check of the aircraft's clearance being missed.

The tower controller made incorrect assumptions regarding ACFT 1's intentions when allowing them to proceed beyond HK for the PFL, and allowed an ADATS degradation to distract them from their primary duty of maintaining a visual observation of aircraft in the vicinity of the aerodrome as the conflict between ACFT 1 and ACFT 2 developed. The TSPR also allowed the ADATS degradation to distract them from supervising the tower controller.

These local conditions, failed risk controls, and organisational influences resulted in individual actions that placed two aircraft and four people at risk of collision, with catastrophic consequences.

Director DFSB comment:

In this near-collision event we are again fortunate that there were no injuries to personnel or damage to aircraft and property. It's a great place to be when we're able to conduct a deep investigation into a near-miss rather than an accident.

We see in this Class B event that a range of factors led to the two aircraft coming into close proximity. Again, another case study in system safety whereby the latent failures that lie within a complex system have interacted in a specific way to cause the risk to be realised.

There were some personal stress factors for the pilot; a failure of an ATC system and the distraction it caused to the controllers; some difficult weather conditions and some of the challenges inherently associated with training ab initio students in a maturing pilot-training system, just to name a few.

If we simply stopped at finding that the pilot of aircraft one hadn't recognised the preceding traffic, we'd miss a valuable opportunity to examine ways to improve a whole range of issues.

RUNWAY

EXCURSION

ON 8 DECEMBER 2020 at RAAF Base Amberley, an F/A-18F Super Hornet veered off the runway during the take-off sequence and both aircrew members ejected, suffering minor injuries. The aircraft sustained moderate damage.

The investigation found that substandard adherence to checklist actions prior to the aircraft lining-up resulted in a master caution and associated check-trim message on the left digital display indicator (DDI) as the throttles were advanced to afterburner for take-off. When the take-off roll began, the check-trim DDI diverted the pilot's focus from directional control, and subsequently the aircraft's deviation in heading went unnoticed/uncorrected for several seconds.

It is likely the pilot suffered an acute stress response followed by a short duration of impaired cognitive performance upon noticing the heading deviation.

During this period, a series of action errors were made in an attempt to correct and maintain directional control of the aircraft. Fixating on this task delayed the pilot retarding the throttles back to idle and allowed the aircraft to accelerate at full afterburner for eight seconds, reaching a maximum ground speed of 85 kts.

At this point the aircraft's right main landing gear departed the sealed surface of the runway. Two seconds later, the nose wheel impacted a runway edge light causing a failure of the nose-wheel-steering system. Without nose-wheel steering, the aircraft's heading diverged further to the right resulting in its full departure from the sealed surface.

Shortly after, the aircraft traversed a concrete mound housing the runway cable-arrest system. This caused the aircraft to momentarily leave the ground, which predicated the rear-seat weapons-system operator to initiate the command ejection of both crew from the aircraft.

After ejection, the aircraft continued to roll under its own inertia, at idle power, before coming to rest approximately 930 m from the point of departure and 200 m to the right of the runway.

Flight authorisation

The event aircraft was part of a planned four-F/A-18F aircraft formation tasked to conduct a fleet-support mission in the Eastern Exercise Areas. The Super Hornets were accompanied by a two-aircraft formation of EA-18G Growlers. The pilot of the event aircraft was the mission commander for the package and briefed the mission to the formations. Before proceeding to their aircraft the crew members were informed there were only three serviceable aircraft available for the mission, rather than four.

The environmental conditions were within limits and mission profiles/parameters were within the capabilities of the current and qualified aircrew. The formation was correctly constituted, briefed and authorised.

The investigation report notes that the crew had recorded less airborne hours in the past 30 days than was considered average for the previous year. The reduced hours were indicative of organisational norms and the result of a combination of factors including aircraft availability, COVID-19, and aircrew strength.

Loss of directional control

To determine the nature of the loss of directional control during this event, the investigation looked in detail at the pilot's inputs

It is noteworthy that the pilot, during interview, recounted the event in a different order to that which was digitally recorded. The pilot recalled hearing the master caution and then immediately retarding the throttles to idle.

and the aircraft's behaviour during the first 12 seconds of the take-off roll.

In the first four seconds, the pilot increased the throttle to afterburner and the check-trim caution enunciated. Immediately following the check-trim caution, the pilot's head position, as measured by the joint-head-mounted-cueing system (JHMCS), was observed to move down and left.

The helmet-mounted system does not track eye movement; however, the movement of the head down and left is likely indicative that the pilot was no longer looking out the front of the aircraft and was heads-in. It is highly likely the heads-in movement is in acknowledgement to the check-trim DDI caution. The pilot's head position remained heads-in for two seconds, during which time no rudder pedal inputs were made.

The crosswind conditions on the day, aircraft line-up position and asymmetric stores loading exacerbated the tendency for the aircraft to deviate right from runway heading (when uncorrected). Based on these factors, interviews with crew members and the observed left-rudder-pedal input after the head returns to heads-out, it is highly likely that the aircraft heading was already deviating to the right in the first two seconds of the take-off roll.

Other pilots who have flown the F/A-18F in similar configurations, confirmed that left-rudder-input is normally required early in the take-off roll to maintain runway direction.

Immediately after the JHMCS shows head movement back to the central position (heads-out), the pilot simultaneously introduced left rudder while disengaging the nose-wheel steering. Once disengaged, the nose wheel entered a free-swivelling mode and therefore, rudder-pedal input had no effect on nose-wheel angle.

The investigation considered that the immediacy with which the nose-wheel-steering system was disengaged (after the head returns to 'head out') is indicative of an acute stress response and represents an action error to counter an unexpected stimuli (caused by a mismatch in the expected versus observed behaviour of the aircraft upon looking up and out).

The investigation did consider two other alternatives. The first was if the initial disengagement of the nose-wheel steering was an intentional action in the execution of the loss of directional control checklist.

The investigation also considered if the nose-wheel-steering issue the pilot experienced on the previous sortie primed him to assume a nose-wheel steering fault, and therefore, paddle off nose-wheel steering.

While either scenario is conceivable; the investigation considered them less likely due to the immediacy with which nose-wheel steering was disengaged, even before any rudder-pedal inputs were made to confirm that nose-wheel steering was inoperative. Furthermore, the repeated disengage/re-engage attempts made by the pilot over the first eight seconds, in conjunction with the

selection of the take-off trim switch prior to selecting throttles idle, were not consistent with abort or loss-of-directional-control checklist actions.

It is noteworthy that the pilot, during interview, recounted the event in a different order to that which was digitally recorded. The pilot recalled hearing the master caution and then immediately retarding the throttles to idle. After this, the pilot recalled attempting to control heading with rudder pedal and differential braking inputs to no effect and only then, paddling off nose-wheel steering.

The pilot did not recollect the two additional nose-wheel steering paddle switch selections, pressing the nose-wheel steering engage button, or pressing the take-off trim switch. The inability of the pilot to accurately recall the sequence of events is a further indication that they may have suffered an acute stress response, which is known to impact upon memory recall.

Closer look at event timeframe

At 04h:28m:42s with left-rudder input, the pilot engaged nose-wheel steering for one second before disengaging it again. During this period, the nose-wheel angle responded to the rudder input and the aircraft made a brief correction back towards the runway heading, indicating that the nose-wheel-steering system was serviceable.

The aforementioned correction was only momentary because nose-wheel steering was disengaged again, returning the nose wheel to free-swivelling mode. While disengaged, the pilot pressed the paddle switch again; this had no effect as nose-wheel steering was already disengaged. This second selection of the nose-wheel steering paddle switch, when the system was already disengaged, was likely indicative of impaired information processing due to acute stress. The aircraft heading continued to diverge right for a further two seconds until nose-wheel steering was engaged for the last time at 04h:28m:45s.

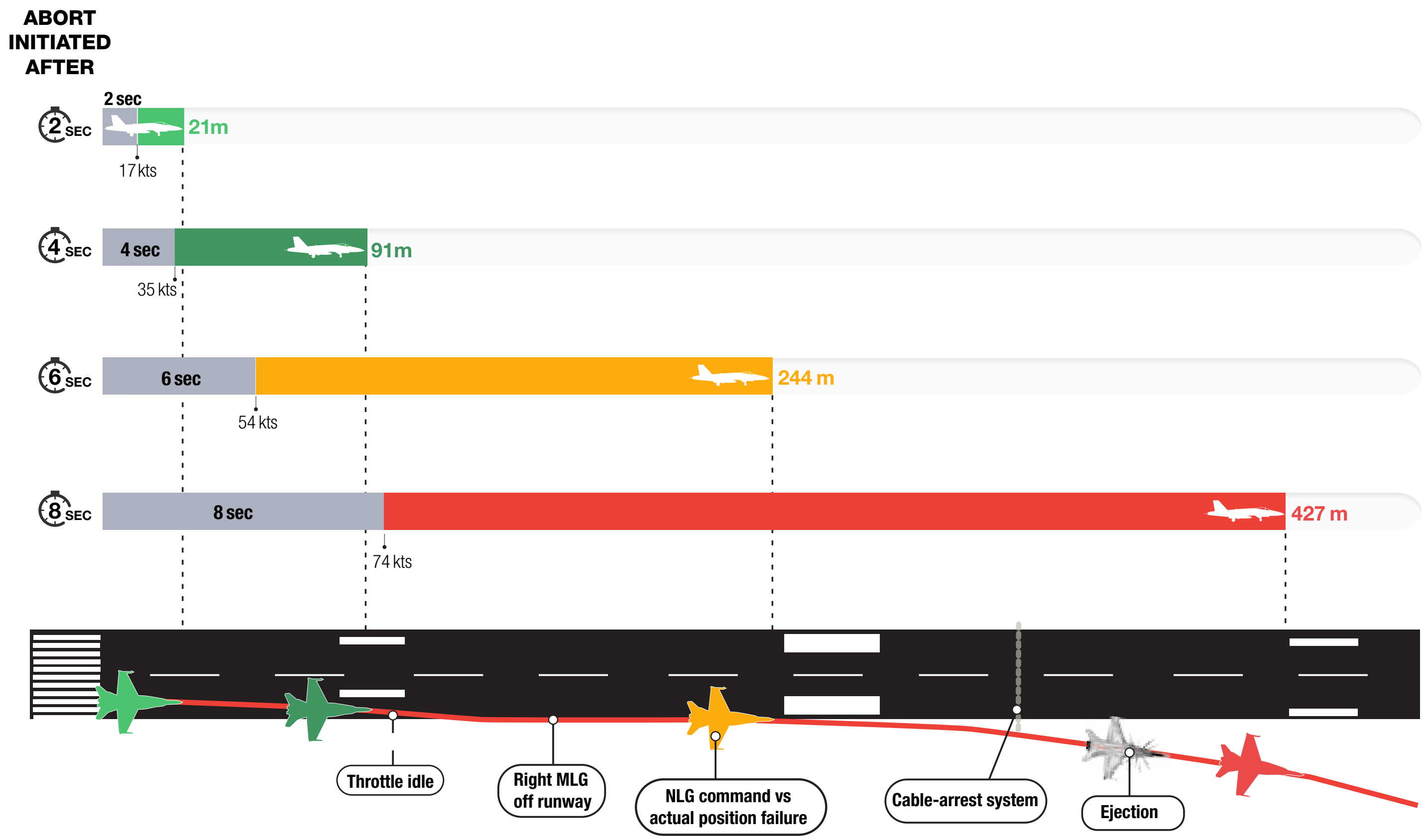
After this series of switch selections, the take-off trim switch was pressed at 04h:28m:45s. This switch selection, while the aircraft was still at afterburner, was not consistent with emergency-response boldface actions and the investigation considers it a prioritisation error detracting from executing an abort and maintaining directional control.

Acute stress response

Research indicates that 'recall of emergency procedures or of correct responses to unexpected aircraft states may be impaired by startle, by stress, or through incorrect interpretation of environmental cues'. The investigation is of the opinion that during the escalating directional-control problem, the pilot was experiencing an impaired information-processing loop caused by an acute stress response. Ideally, pilots in this situation would resort to a recognition-primed style of decision-making by executing ingrained boldface actions; however, it appears that this did not occur.

There was only one second where both nose-wheel steering was engaged and the pilot had left-rudder input. There were; therefore, seven seconds where the aircraft was deviating to the right uncorrected by nose-wheel steering, at full afterburner. The switch selections made over the eight seconds, as well as the inaction to retard the throttles to idle, is typical of impaired information processing, caused by acute stress.

At 04h:28m:46s (eight seconds after rolling), the WSO called 'abort'. The pilot responded to this call immediately by retarding the throttles to idle and verbalising 'aborting'. The investigation considers that this verbal prompt from the WSO to execute the abort was critical in breaking the pilot's information-processing loop; which was



Impact of abort decision on stopping distance

After ejection, the aircraft continued to roll under its own inertia, at idle power, diverging from the right-hand side of the runway, before coming to rest approximately 930 m from the point of departure and 200 m to the right of Runway 33.

likely at capacity due to attempting to maintain directional control.

Aircraft data indicates that as the throttles were retarded to idle, the auto throttle control engage button was activated despite being disabled (as the aircraft sensed it was still on the ground). As the location of this button is on the front of the throttle lever it was extremely likely an inadvertent switch selection made while retarding the throttle to idle.

At 04h:28m:48s, 12 seconds after commencing the take-off and concurrent with a small right-rudder pedal input (likely to avoid overcorrection in heading), the aircraft right main landing gear departed the sealed surface of the runway. At this point, the aircraft reached its maximum ground speed of 85 kts (157 km/hr). Despite the additional drag on the right main landing gear from the soft ground, aircraft heading was maintained. This premise is supported by the tyre marks on the runway that straighten and remain parallel to the runway for a period of approximately three seconds.

At 04h:28m:52s, 14 seconds after commencing the take-off roll, the nose landing gear departed the runway sealed surface, followed shortly afterwards by the left main landing gear. The aircraft then traversed a concrete mound associated with the cable-arrest housing and the aircraft momentarily left the ground (uncontrolled flight). Two further

attempts were made to re-engage nose-wheel steering, with no effect.

At 04h:28m:52s, the rear-seat weapons systems operator pulled the ejection-seat handle and initiated the command ejection sequence for the crew.

Additional information

During the investigation organisational deficiencies related to management, tracking and oversight of aircrew performance were discovered.

These deficiencies, while not considered a primary cause of the event, have the potential to impact aviation safety and reduce the ability of commanders to identify, track and address at-risk safety behaviour.

Director DFSB comment:

This was a high-profile event due to the fact that footage of it was broadcast on the news almost immediately.

I am ever grateful that the crew of our Super Hornet was uninjured and that the aircraft was able to be repaired and is flying again. I was also very pleased at the response from the team at Amberley following the event and the engagement that our investigators had from a range of stakeholders; many of whom work in Air Combat Group. The investigation report is of high quality and forensic in its analysis of huge swathes of data, and therefore highly credible.

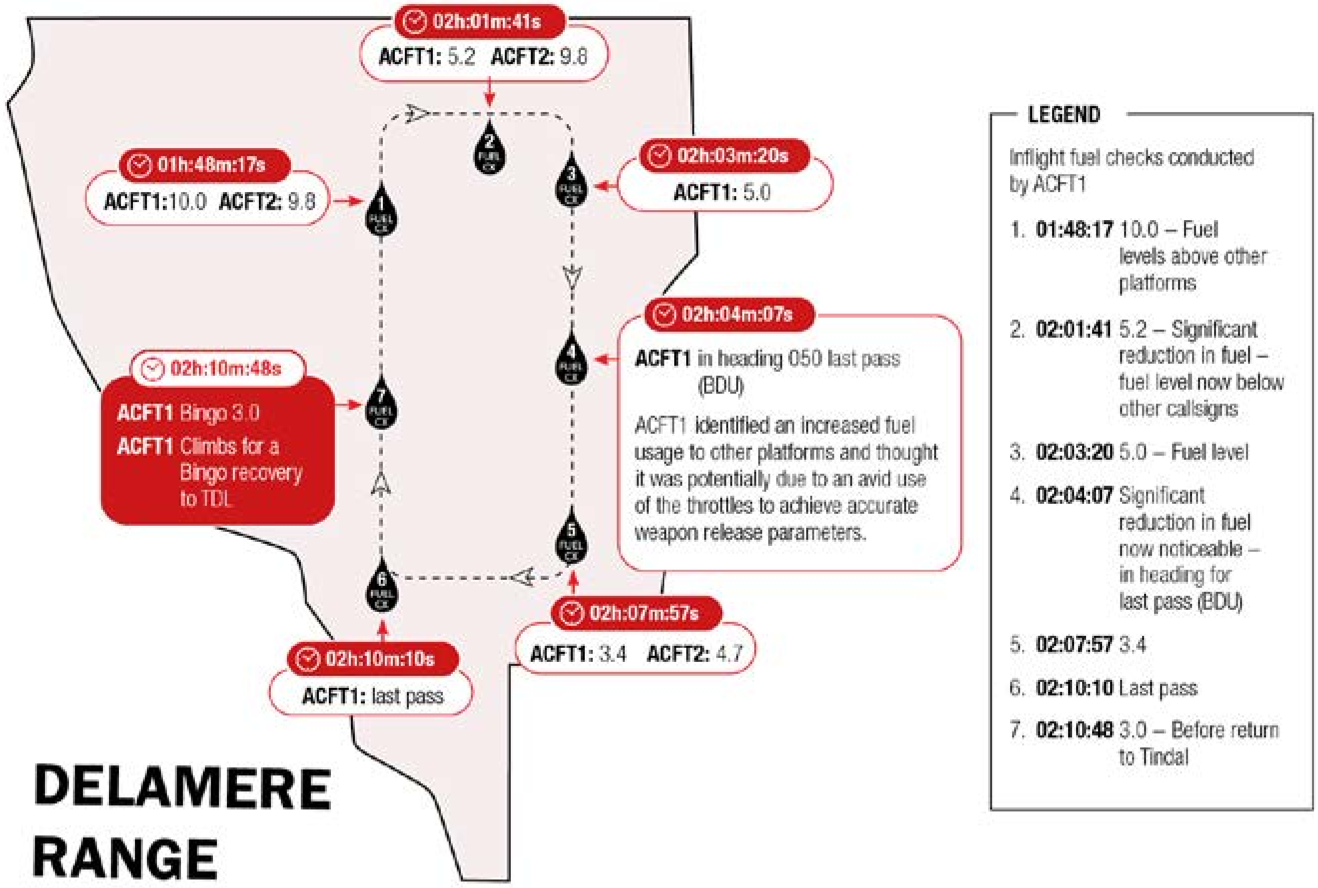
One of the most important discussion points that might come from this report is the 'acute stress response' of the pilot, which is a human response to which none of us is immune. In other words, when we're placed in highly stressful situations we're going to react in some unpredictable ways.

This is not a scenario or reaction that is limited to fast-jet aircrew and is a human factor that is worthy of deeper understanding.

Fuel leak

AN F/A-18A WAS the lead of a four-aircraft formation scheduled to conduct a currency and category work-up at Delamere Air Weapons Range, about 80 nautical miles (nm) SSW from Tindal in November 2020, when its aircraft captain (AC) noticed an anomaly with fuel usage.

About 40 minutes into the 17 November sortie, after conducting several standard procedural formation fuel checks, the AC of the incident aircraft (ACFT 1) noticed the aircraft rate-of-fuel usage was higher than anticipated and to that of other aircraft. This discrepancy in fuel usage was initially thought to be only marginally different from that expected and was attributed to an avid but acceptable use of the throttles to attain accurate weapon-release parameters.



Shortly thereafter, ACFT 1 received a bingo fuel indication. It departed the range as a single aircraft, rather than waiting to reform as a formation for their return to Tindal.

As ACFT 1 climbed out of Delamere range for Tindal, the HOME FUEL caution activated. On notification of ACFT 1's departure from the range and with previous knowledge of the fuel discrepancy, ACFT 2 departed the range to accompany the aircraft back to Tindal. The two remaining call-signs continued with scheduled training operations as a pair and returned to Tindal upon their completion.

When within visual range of ACFT 1, the pilot of ACFT 2 was clearly able to see a vapour trail (assumed to be fuel) emanating from the bottom of the right engine nacelle. This fuel trail was described as being similar in size and shape to the trail that accompanies a deliberate in-flight fuel jettison evolution.

Due to the confirmation of a likely fuel leak under the right engine, ACFT 1 transmitted a PAN call and referred to the emergency checklist to shut down the engine for an in-flight emergency. ACFT 1 then discussed shutting down the right engine with ACFT 2 and elected not to shut down and instead focused attention on the malfunction and returning safely to Tindal.

The squadron duty supervisor (DS) was informed of the intent/reasoning of ACFT 1 to remain in twin-engine flight and to not shut down or secure the leaking engine and subsequently endorsed the decision. The captaincy decision was also supported by the ASIT.

Observed vapour trail of ACFT 1

Authorisation

The mission for the event aircraft captain was a currency and category workup sortie. The pilot was a C-category, mission-qualified pilot working up to their B-category mission qualification.

The flight authorisation brief was attended by the formation pilots and the authorising officer (AO) after the formation mission brief. During the authorisation brief, the AO discussed tactical domestics, weapon carriage and weapon-release parameters and at its conclusion was content to authorise the sortie.

O-rings

Prior to the arrival of the investigation team and, in consultation with DFSB, the maintenance organisation carried out a preliminary inspection to ascertain where the fuel leak originated. This was determined to be at the base of the securing clamp, (6 o'clock position), between the interface of the main fuel pump (MFP) and the main fuel control (MFC). Once this was established and the aircraft deemed safe, it was placed into quarantine pending further investigation.

Subsequent inspection of the securing clamp and its attachment bolt revealed that the clamp was torqued to
30 inch lbs, which is below the directed torque of 105-115 inch lbs.

On discovering that the securing clamp was under torqued, DFSB released an immediate safety concern to check the torque of other securing clamps fitted to other F-404 engines in service.

In response, TAE released a Special Technical Instruction (STI) to determine the level of torque applied to the clamps securing the MFP to the MFC across the fleet. After implementing the STI, it was found that more than 50 per cent of the installed clamps did not achieve the designated criteria for their correct installation.

Due to the instigation of the STI, a selection of under-torqued clamps that had failed the STI criteria were removed from service and sent to DST for further analysis. The remainder of the clamps that had also failed the STI were re-torqued to 105-115 inch lbs in location and remain in service.

The forensic analysis carried out by DST of the under-torqued clamps did not reveal any damage or defect likely to have contributed to

The ASIT concurs with the DST finding that the damage incurred to the three O-rings is very likely the primary cause of the fuel leak, discounting the initial determination that the loose clamp was the most likely causal factor.

a reduction in the torque values found. These results, in conjunction with the high number of clamps found as being under-torqued but not found to be leaking fuel during the STI, indicated that other causal factors were likely to be present rather than those solely related to the clamp.

An internal inspection between the two faces of the MFP and the MFC was carried out and revealed damage to three separate O-rings, in addition to evidence of a used washer.

Subsequent forensic analysis by DST found that the damage sustained to the O-rings was likely due to contact with a foreign object. Consistent with DST's findings, the ASIT agrees that the used washer identified, had very likely made initial contact with the O-rings, causing damage, and interfered with the seating of the two mating surfaces, which in turn reduced the desired compression of the O-rings, leading to their eventual failure under pressure.

The ASIT considers that this washer was unknowingly introduced into the mounting face area during the MFC re-fitment and remained unnoticed during overall installation. The ASIT also considers that it is unlikely the used washer may have pre-existed in the same position, prior to the replacement of the MFC.

DST analysis also examined the age and composition of the O-rings against known specifications and concluded that the O-rings were considered to be new, dimensionally correct and manufactured using the specified material.

It was further concluded that the O-rings were likely to have been installed during the last fitment of the MFC. The ASIT concurs with the DST finding that the damage incurred to the three O-rings is very likely the primary cause of the fuel leak, discounting the initial determination that the loose clamp was the most likely causal factor.

Method of fitment of the MFC

To determine the methodology of the fitment of the MFC, the ASIT observed the MO conduct the removal and installation of the event MFC and found the fitment sequence and actions required, to be relatively difficult.

This was believed to be the result of working within a confined space, awkward handling of components and the need for a series of adjustments to allow for its eventual alignment. Exemplified by the need to position the clamp correctly while holding the MFC in place; all the while tapping the clamp with a non-metallic hammer so that the torque could be systematically applied to the clamp-bolt.

The maintenance actions and method for securing the MFC as described above are detailed in maintenance instructions. In addition, two tradespersons should be present to carry out this task for ease of effort but this was found to not always be the case or a mandated requirement.

When carried out with the aid of another tradesperson, the task should allow for correct fitment to enable the application of the final torque of 105-115 inch lbs to the clamp-bolt. Final installation is then to be confirmed by a mandated quality assurance (QA) check.

This event was considered predominantly attributable to the unintended consequences of conducting maintenance under a reduced level of quality control and supervision.

This QA inspection was previously performed as an independent maintenance inspection (IMI) under historical Technical Airworthiness Regulations (TAREG); to address the unique nature and critical maintenance relationship of fuel-system components, before being subject to changes under the Maintenance Improvement Productivity Program (MIPP) 18 in 2014.

During interview, the maintenance certifier (MC) described that the installation of the event MFC as the first time he had conducted the task and that it was carried out at night under torchlight within the ordnance loading apron (OLA), indicating a reduced level of experience.

The MC also recalled the requirement to remove and reinstall the MFC after its initial placement onto the MFP. This was due to the clamp not being pre-prepositioned onto the exterior of the MFP before installing the MFC in place.

Prior to refitting the MFC, the MC said a visual check was conducted of the interface between the two components to confirm the O-rings were present.

The MC did not recollect that an additional physical check of the O-rings had been conducted and therefore could not confirm whether the O-rings had either become dislodged or damaged during the subsequent removal and re-fitment of the MFC.

There was also no evidence provided to confirm that a foreign object check (FOC) was carried out of the entire area between the two components.

Following the installation of the event MFC, an engine functional check and fuel-leak inspection was performed as part of a high-power ground run.

There were no leaks identified during this high-power ground run. Furthermore, an air test was carried out and the aircraft was assessed as serviceable on 26 October 2020, six days after fitment of the MFC, again with no apparent fuel leaks.

Conclusion

The ASIT found that a combination of factors, implemented by an individual tradesperson on a task for the first time, contributed in part to the eventual in-flight fuel leak. The ASIT found the fuel leak occurred due to a technical failure of the O-rings. This was exacerbated by evidence of foreign object debris in the form of a washer, which was missed during the installation of the MFC.

Certain pre-conditions existed leading up to the event; such as operating at night under reduced lighting conditions with a set of less-than-optimal maintenance instructions, which contributed to the maintenance error. The confined space of the engine bay also reduced task visibility, increasing the risk of human error. This factor was exacerbated by the lack of oversight in location.

The reduced application of risk-control measures in support of the task meant that the maintenance team did not identify and treat the hazards introduced by poor lighting and sub-optimal supervision in the OLA.

In addition, the absence of a FOC before component closure foreign object, considered as being instrumental to the outcome and representing a failed barrier.

The presence of hazards, including the reduced level of experience of the tradesperson for the task required and a reliance on sub-optimal maintenance instructions to address critical maintenance tasks, should have necessitated a requirement to perform an increased level of supervision; thereby, ensuring a more efficient means of hazard reduction.

Notwithstanding the benefits realised from maintenance licensing changes incorporated under DASR, there remains evidence of a quality management system that is under-resourced when required to carry out an efficient oversight and enforcement program.

This event was considered predominantly attributable to the unintended consequences of conducting maintenance under a reduced level of quality control and supervision.

Any reduction in surveillance measures is considered detrimental to safe flight operations, particularly when conducting critical maintenance tasks and inspections on flight-safety critical components.

Director DFSB comment:

With the Classic Hornet now gracefully retired after a stellar life in the RAAF, it might seem that this report has limited relevance – not so. The key issue for this significant fuel leak event was related to some maintenance practices, in particular to the fitment of the main fuel pump to the main fuel control (MFC); and also FOD control. These issues pertain to the maintenance of any aircraft and the inevitable management of maintenance tasks, inspections, independent inspections and documentation.

As for many of DFSB's investigations we are deeply grateful for the expertise provided by the clever people at the Defence Science and Technology Group (DSTG) who are able to forensically examine components of a system and determine a range of important findings. As one example, DSTG was able to determine that the O-rings had been replaced on the previous MFC servicing even though the use of that item was not tracked in the maintenance system.

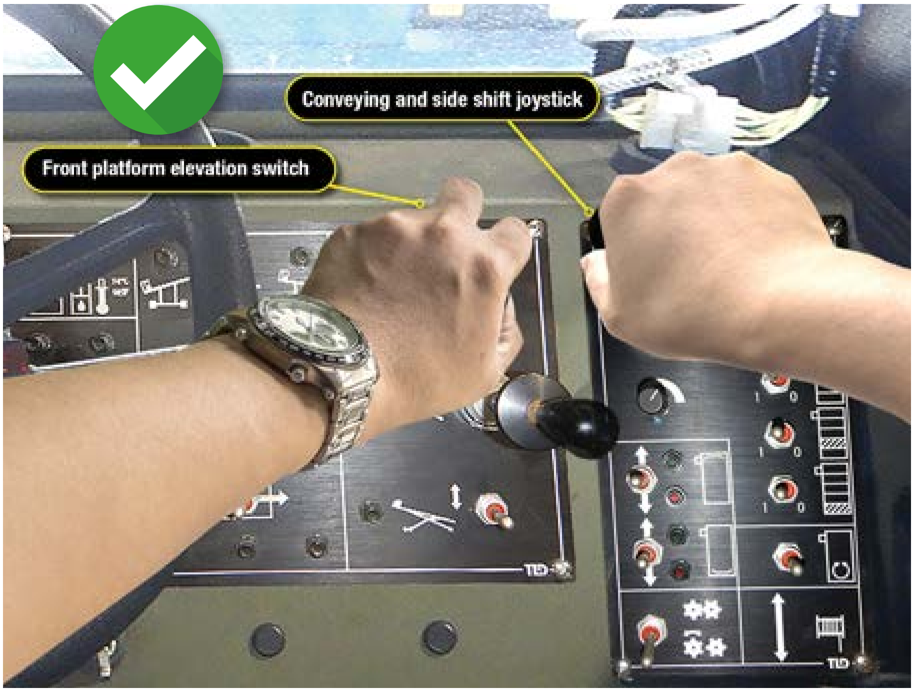
Dropping your bundle

IN EARLY MARCH 2021 an aircraft load team (ALT) was unloading cargo at RAAF Base Townsville when a heavy pallet departed the rear of the PFA-50 aircraft loading truck and fell onto the apron.

Task details

On 4 March the unit Air Base Command Post was tasked to provide air-movement support for a C-17 arriving at RAAF Base Townsville on 8 March. The mission, in support of an exercise, entailed disembarking 12 passengers and unloading four units of palletised cargo – the latter using the PFA-50 aircraft loading truck via the rear cargo ramp of the aircraft.

The C-17 arrived on schedule and the unload of passengers went as planned; however, while unloading cargo from the rear ramp of the aircraft, a 4100 lb (1860 kg) pallet unintentionally departed the rear of the PFA-50 and fell approximately 1.5 m before landing inverted on the



Correct switch selection for cargo deck adjustment

Incorrect switch selection for cargo deck adjustment

apron. There were no injuries to personnel and negligible damage to the load and hard standing was noted.

Additional squadron air-movements personnel recovered the inverted pallet without further incident and there was no impact on the schedule of the visiting C-17.

Cargo transfer

The movement of cargo inside and on or off an aircraft will (dependent on weight and loading) cause changes to the aircraft's on-ground pitch that rotates about the centre of gravity. This results in dynamic changes to the height of the aircraft ramp as cargo is traversed within the aircraft.

The design of the PFA-50 also makes it susceptible to centre-of-gravity changes when transferring cargo on or off the cargo deck. This results in both the aircraft ramp and the PFA-50 cargo deck changing their relative heights, independently of one another, as cargo is traversed.

In order to counteract the dynamic height changes to the aircraft ramp and PFA-50 cargo deck, the PFA-50 operator is required to actively monitor the situation and adjust the pitch of the deck relative to the aircraft ramp. This is achieved by manually switching the momentary front platform-elevation switch on the deck adjustment panel.

Further adjustments are often required while cargo transitions across the threshold of the aircraft ramp and PFA-50 cargo deck in order to ensure a smooth transition that minimises potential damage.

Pallet unload

The first (event) pallet transitioned from the edge of the aircraft ramp to the PFA-50 cargo deck. At the ramp threshold, the PFA-50 operator initiated the powered rollers on the cargo deck in order to draw the pallet onto the PFA-50, which negated any further manual handling of the pallet by the aircrcaft load team. Receipt of the first pallet onto the PFA-50 did not require any pitch adjustments to the cargo deck.

Due to the weight of the second pallet and its position towards the rear of the cargo bay, the aircraft's pitch altered and the ramp height changed relative to the PFA-50 cargo deck.

The relative positions of the aircraft ramp and cargo deck allowed the aircraft load team to push the second pallet partially across the threshold of the aircraft ramp and PFA-50.

In order for the powered rollers of the PFA-50 cargo deck to adequately grip and move the second pallet, an adjustment to the cargo deck was necessary. The PFA-50 operator adjusted the cargo deck height using the platform-main-elevation switch. Use of this switch automatically raises the front and rear pallet stops. In this circumstance, the rear pallet stop was already in the raised position to prevent cargo traversing off the rear of the cargo deck.

The mechanism used to raise the forward pallet stop is sufficiently robust that it was able to lift the second pallet, thus removing it from contact with the powered rollers of the PFA50 cargo deck. This prevented the load from traversing any further onto the PFA-50.

As the first pallet was still being traversed to the rear of the PFA-50 by the powered rollers and, in order to resolve the stalled second pallet, the PFA-50 operator stopped the cargo deck powered rollers. The first pallet was halted near zone three (short of its intended position at zone five).

The PFA-50 operator used the front pallet-stop switch to lower the front pallet stop in order to continue receiving the second pallet. Simultaneously, and unintentionally, the PFA-50 operator also selected the rear pallet-stop switch, thus lowering the rear pallet stop as well.

Upon lowering the front pallet stop, the PFA-50 operator re-engaged the powered rollers to bring the stalled second pallet onto the PFA-50 cargo deck. As none of the roller zones on the cargo deck had been isolated, this recommenced movement of the first (event) pallet towards the rear of the PFA-50.

With both pallets being traversed rearward on the cargo deck, the second pallet passed the PFA-50 operator's position at approximately the same time as the first pallet was passing over the lowered rear pallet stop. The first (event) pallet then departed the rear of the PFA-50 cargo deck and fell approximately 1.5 m before landing inverted on the apron.

Significant findings

While attempting to marry the ramp of the C-17 with the PFA-50 cargo deck, a decision error (knowledge-based mistake) was made by using an improper technique causing the pallet to become lodged atop the raised front pallet stop. When engaging the switch to lower the front pallet stop and release the pallet, a second switch was inadvertently selected, which also lowered the rear pallet stop. This action error (slip) was not detected or captured before the pallet departed due to degraded management and coordination of the unload evolution.

The errors executed by the PFA-50 operator are assessed as having two related causes. Firstly, it is highly likely that the improper technique (skill-based error) applied by the PFA-50 operator was due to inadequate experience and knowledge of the correct operation of the machine. Secondly, the inadvertent switch selection (action error) is moderately likely to have been exacerbated by an acute stress response upon noticing the second pallet become lodged atop the front pallet stop. Hindered communication between team members is likely to have contributed to the perceived stress and switch selection response by the PFA-50 operator.

The investigation found that the aforementioned local conditions were not considered or informed by a robust immediate risk management (RM) assessment (PBED). Importantly, the baseline risk controls and detail surrounding how air-movements personnel should conduct an activity were absent. The absence of this detail indicated a lack of deliberate RM practices at the organisational level, and this circumvented the capacity for effective immediate RM by workers.

Previous similar events and a trend of damage incurred across the PFA-50 fleet indicated that latent conditions have remained untreated for some time. This evidence

... it is highly likely that the improper technique (skill-based error) applied by the PFA-50 operator was due to inadequate experience and knowledge of the correct operation of the machine.

… the investigation found a lack of awareness of risk-management principles and the application of deliberate and immediate risk management.

suggests that Combat Support Group (CSG) has found it difficult to identify or learn from past events and apply system-level changes to prevent recurrence. In fact, it is believed a person of similar experience and knowledge, and in similar circumstances, is likely to make the same error demonstrated in this event.

The diversity of work categories and geographically dispersed organisation in which CSG operates validates the importance of consistent standards across the group.

Assurance provided by a squadron is generally effective; however, had been diminished by travel restrictions and the requirement to support Operation COVID-19 ASSIST. Additionally, the aircraft load team was smaller than prescribed for the task and made more challenging by the LOADSUP being unauthorised. Finally, the regulatory environment surrounding Aviation Support Systems has, over time, removed key risk controls that may otherwise have prevented this event and may warrant re-implementation.

Director DFSB comment:

This investigation highlights that many of the services provided to enable safe aircraft operations are a vital part of the aviation system. In this case, we learn that the incorrect operation of a PFA-50 loader could have significant consequences for the people in and around the aircraft during unloading and the safety of the aircraft itself.

It can be tempting to view jobs in these supporting functions as having little direct relationship to aviation safety but certainly from an Air Force perspective almost everything that is done on the ground has an impact in the air.

It's this philosophy that underpins the 'Air Aware' program being implemented by Combat Support Group, which supports the Chief of Air Force's approach to identifying every member of the Air Force as an Aviator. We all have a very important responsibility when it comes to safety and the link that has with the preservation of capability.

Entangled!

A C-130J HERCULES WAS conducting simulated Air Sea Rescue Kit (ASRK) dispatch training in Jervis Bay in mid-June 2020 when, during the deployment of an ASRK from the cargo ramp and door, one of the loadmasters became entangled in the deployment rope. The multi-role harness (MRH) restrained the entangled loadmaster, preventing them from being dragged out of the aircraft.

The loadmasters immediately debriefed the event and elected to continue the ASRK serial without reporting the event to the aircraft captain. The flight continued without further incident.

The entanglement was reported to the aircraft captain the following day, recorded as a Class-B event in Sentinel's Aviation Safety Reporting system and the Defence Flight Safety Bureau (DFSB) duty officer was notified. Commander Air Mobility Group subsequently appointed an Aviation Safety Investigation Team (ASIT) to investigate the entanglement.

Early in the investigation, the ASIT raised an Immediate Safey Concern upon identifying that the current routing of the static line would continue to pose a danger for loadmasters. Investigators and 84WG loadmasters worked together to quickly create a better way to prepare the load.

Figure 1 (page 32) shows the ASRK entanglement zone as it was during the incident. Figure 2 (page 32) depicts the amended rigging procedure which ensures that the tie-down rope is no longer able to flap around in the airflow and no longer poses an entanglement risk.

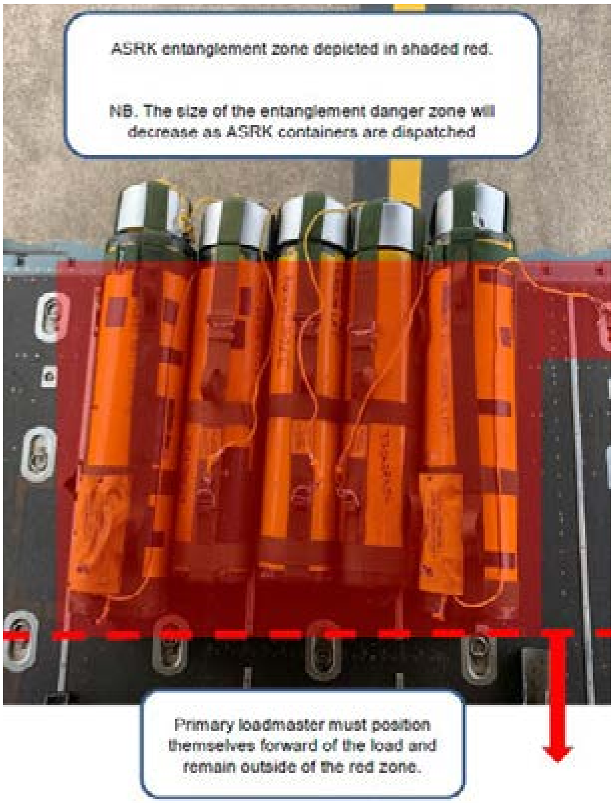


Figure 1. ASRK entanglement zone

Figure 2. Amended ASRK rigging procedure

The event flight was programmed as an instructional C-130J SAR techniques-and-procedures sortie. There were three pilots on-board – the aircraft captain and two co-pilots conducting SAR training from the right-hand seat – and six loadmasters. The loadmasters' role/disposition in the rear cabin space during the event sequence was:

- two loadmasters conducting their final assessment as part of the Loadmaster SAR Course (LMs 1 and 2)
- one loadmaster who had recently finished Loadmaster IQ Course and was undertaking progression to IQ training (LM 3)
- an ITP loadmaster seeking to regain their CQ, IQ and loadmaster categorisation (SPVR 1)
- a CQ-qualified loadmaster assessing SPVR 1 and ultimately, LMs 1 and 2 (SPVR 2)
- an IQ-qualified loadmaster who was supervising LM 3 (SPVR 3).

Flight authorisation

During the authorisation brief, it was established that the aircraft captain would fly the sortie from the left-hand seat while the other two under-instruction QFIs would rotate through the right-hand seat. When discussing sortie conduct, the authorising officer reiterated the importance of the aircraft captain ensuring it was clear to all who was supervising whom, and who was in charge of the cargo compartment for each evolution.

'Make sure you know who's checking who checking who, or that whoever is at the top of the tree, that they are on the hook to make sure it all is safe,' he told the aircraft captain.

Given the number of people in the cargo compartment conducting different elements of loadmaster training, a breakdown in command and control posed the biggest threat to flight safety.

Loadmaster 3 was to be supervising one of the two loadmasters under assessment (LMs 1 or 2) while either SPVRs 2 or 3 was supervising LM 3. The supervisor not supervising LM 3 was to supervise the other loadmaster under assessment. SPVR 1 was to be acting as a passenger only.

During the authorisation brief, the authorising officer reinforced that command and supervision needed to be specifically discussed at the crew ramp brief.

The event

Approximately three minutes prior to the first ASRK drop, LMs 1 and 2 started the drop checklist. This included removing the restraints from the ASRK (except for the vertical restraint) and opening the cargo ramp and door. When the one-minute warning was given, LM 1 removed the vertical restraint and safely secured it in the aircraft before moving the ASRK aft with LM 2. LM 1 remained kneeling beside the ASRK. When the green light was activated, indicating the release, LM 2 began to dispatch the ASRK.

As the last segment of the ASRK departed the aircraft, LM 1 was believed to have tripped, receiving a sudden jolt aft towards the open cargo ramp and door.

This trip/jolt was caused by the static line from Container

No. 5 of the ASRK becoming entangled around the lower part of their leg. LM 1's rearwards movement was halted by their MRH while their legs were over the end of the ramp. The force of the departing ASRK caused the remainder of the ASRK static line to untangle as it departed the aircraft.

SPVR 1 and LM 2 helped LM 1 back to their feet before the cargo ramp and door were closed. The event had been filmed by SPVR 2 while they remained seated in the Loadmaster Crashworthy Seat.

After the entanglement event occurred, the supervisors/loadmasters discussed what they thought had happened. The supervisors thought LM 1 had slipped on a tie-down ring while on the ramp.

SPVRs 1 and 2 said to LM 1 that the MRH system is designed to ensure there is no risk of departing the aircraft in flight and that tripping over a tie-down ring can happen. LM 1 said that the trip had left them with a sore leg but they were able to continue with the serial. SPVR 2 clarified with LM 1, that if they were not up to it, then the remaining serials should be cancelled. LM 1 confirmed they were able to proceed with the rest of the serials. None of the loadmasters discussed the event with the aircraft captain at any point in the mission.

During the return flight, SPVR 2 remained in the rear of the cabin, while the other loadmasters went forward to the cockpit to witness the coastal flight home. During this transit, SPVR 2 reviewed the film of the event sequence that they had taken on their personal phone and realised that LM 1 had, in fact, been dragged to the cabin floor by the ASRK's static line and had not tripped as originally thought. Upon realisation of the seriousness of the event, Supervisor 2 suffered a vasovagal reaction, feeling nauseous and lightheaded. The aircraft captain was not informed of the film footage, nor the symptoms experienced by SPVR 2 during the transit flight.

While the aircraft taxied-in, SPVR 2 remembered they were to attend a squadron executive meeting that was about to start. SPVR 2 understood that this event was a lot more serious than the crew initially thought but prioritised attending the meeting over discussing the matter with the aircraft captain. They left the aircraft to attend the meeting, with the intent of informing the aircraft captain about the film at a later time.

The pilots finished shutting down the aircraft and debriefed the pilot-specific aspects of the mission on the flight-deck. Thereafter, no formal crew-debrief took place. SPVR 3 mentioned to one of the co-pilots that LM 1 had fallen over on a tie-down ring, which was later relayed to the aircraft captain. The aircraft captain believed the tripping event to be minor and that the matter did not require any further discussion.

Post-flight activities

SPVR 2 was unable to meet with the aircraft captain to discuss the entanglement before the aircraft captain departed the workplace at the end of the day. SPVR 2 believed the event should be discussed in person, as opposed to over the phone and elected to go home with the intent of discussing the event the next day. Once home, SPVR 2 reviewed the video numerous times in order to make sense of what had happened and how it had happened.

The next day, SPVR 2 met with the flight's authorising officer and showed them the footage.

The authorising officer directed SPVR 2 to immediately find the aircraft captain to de-brief them about the event. Once the aircraft captain was fully briefed on the entanglement event, an Aviation Safety Report (ASR) was raised.

Injuries to LM 1

LM 1 sustained minor soft-tissue injury as a result of the entanglement. Clinical examination and ultrasound investigation confirmed that a subcutaneous haematoma did not extend to any underlying blood vessels or nerves. There was no damage to the limb muscles and no deep vein thrombosis (DVT).

Director DFSB comment:

When I first viewed the video of this entanglement incident, I had chills down my spine, and I remember audibly gasping as the line from the ASRK wrapped around the leg of the loadmaster and pulled them to the ramp floor.

Fortunately there was not a worse outcome and that the injuries to the trainee loadmaster were relatively minor. However, if we simply moved on without a thorough investigation we'd have missed the opportunity to learn lessons and prevent the same thing happening again.

As a result of the investigation and the co-operation we received from Air Mobility Group, we were able to quickly identify an alternative routing for the static line such that a loadmaster would never stand aft of that line and therefore could never be subject to a repeat of this event.

This change has been applied to C-130 and C-27 ASRK operations and also has some relevance to C-17 operations too. It is a great example of how a comprehensive investigation on one aicraft can improve safety on others.

Airspace incursion

ON 7 MARCH 2020, two Mustang aircraft took off from Point Cook aerodrome to conduct a practice display in the overhead, then transited to Tyabb aerodrome, entering a Temporary Restricted Area (TRA) without ATC clearance.

The first Mustang, MSTG 1, is owned by the RAAF Museum and was operated by a RAAF Museum pilot; the second aircraft MSTG 2 is civilian owned and operated.

The transit to Tyabb was planned using the Melbourne Visual Flight Rules (VFR) Coastal Route at 1500 ft above mean sea level (AMSL). The aircraft conducted a practice formation display before departing Point Cook, to the east, at approximately 1300 hrs.

They followed the Melbourne VFR Coastal Route, which tracks along the Port Philip Bay coastline, from Point Cook around to Mornington, where the formation turned left

(easterly) towards Tyabb aerodrome. As they transited past Albert Park Lake, the formation entered a TRA without ATC clearance. The TRA had been established for a Roulettes' media event overhead Albert Park Lake. Melbourne ATC was unable to communicate with the Mustang formation; however, was able to alert the Roulettes, who terminated their manoeuvre and held in a safe area until the Mustang formation had cleared through the TRA.

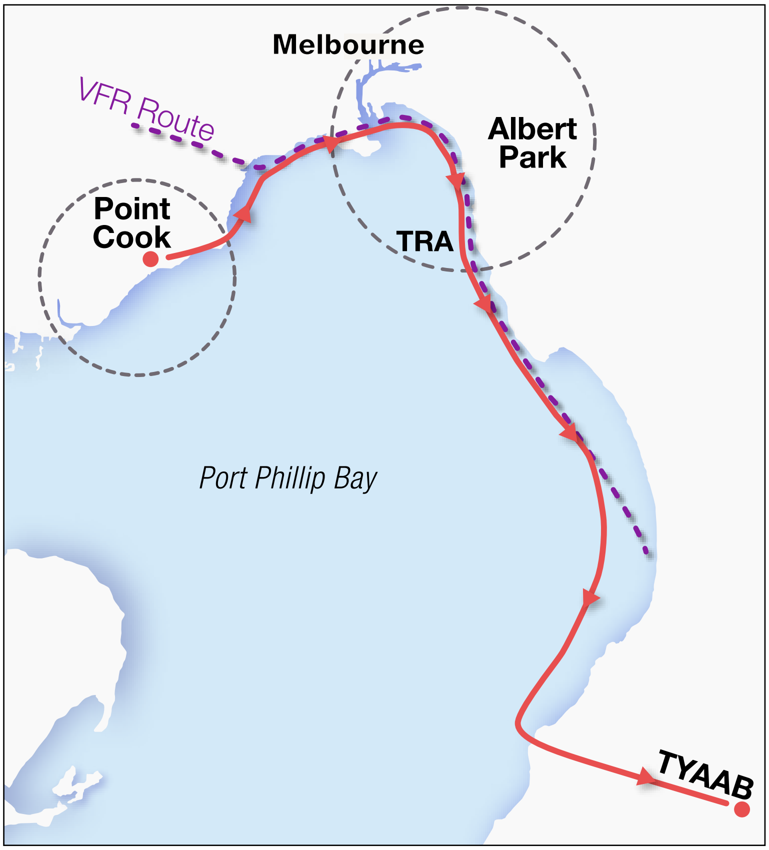
The Mustangs were informed of their incursion when they landed at their destination. An Aviation Safety Report (ASR) was subsequently raised by the RAAF Museum Operations Officer (OPSO).

RAAF Roulettes

The RAAF Roulettes were conducting a media event in support of the Formula One (F1) Grand Prix, scheduled for the following weekend. The six-aircraft formation of PC-21s was carrying out a practice flying display overhead Albert Park Lake with three passengers on-board: a media representative, a F1 Grand Prix driver, and Roulette 7.

The Roulette display commenced at 1315. For part of the display routine, Roulette 5 and 6 separated from the formation and held over-water within the TRA, at approximately 2000 ft AMSL, while the remainder of the formation commenced a corkscrew manoeuvre.

Melbourne ATC advised the Roulettes of 'fast-moving aircraft' prior to the Mustangs' TRA incursion, thereafter ATC issued a safety alert. Roulette 1 identified two fast moving silver aircraft and directed Roulettes 1 to 4 to terminate the corkscrew manoeuvre and hold in formation until the conflicting aircraft were clear. Once the Mustangs were clear to the



Approximate planned track of the Mustangs

south of the TRA, the Roulettes continued with the planned display routine.

Mustang mission objectives

RAAF Museum aircraft, including the Mustang, CT4-A, Winjeel and Harvard aircraft were planned to participate in the Tyabb Air Show 2020, in accordance with the Public Events of Significance Calendar.

The Museum Mustang was to conduct a formation display with a civilian-owned and -operated Mustang.

Formation flying with civilian aircraft is allowed, provided the requirements are met. To facilitate the workup and authorisation of this display the civilian Mustang pilot flew to Point Cook, from Tyabb, on the morning of the TRA incursion.

All of the participating RAAF Museum aircraft were to pre-position at Tyabb on 7 March after their respective practice displays at Point Cook. First to practice their routines that morning were the RAAF Museum CT4-A, Winjeel and Harvard. The RAAF Museum OPSO then authorised the Mustang practice (and transit to Tyabb), and observed their display rehearsal. The Mustang formation then transited to Tyabb and the remaining Museum aircraft proceeded to Tyabb later that day.

Mustang aircraft information

The RAAF Museum CAC CA-18 Mustang is an original aircraft, manufactured by the Commonwealth Aircraft Corporation (CAC) in 1949. It operates under a CASA Special Certificate of Airworthiness in the limited category, and is currently assigned a Permit Index 18, with a civilian registration.

The civilian-owned Mustang is privately owned and operated. On the transit from Tyabb to Point Cook, it experienced degraded communications on the Moorabbin frequency and, on landing, requested the RAAF Museum maintenance staff look at its radio equipment.

The RAAF Museum maintenance staff concluded that the issue was likely a function of the high ambient noise in the Mustang cockpit. To help rectify this problem, maintenance staff covered the microphone with heat-shrink, which was then modified with a small square hole in

the face of the microphone adjacent to the pilot's mouth, in order to provide better sound masking.

RAAF Museum pilots are not required to hold a military category; instead, they must hold suitable CASA licences and qualifications. RAAF Museum SI (OPS) 2-1 *Aircrew Flying Qualifications and Recency Requirements* is derived from CASA regulations and requires RAAF Museum pilots to undertake three take-offs and landings on aircraft type in the past 90 days. There is an extra recency requirement (in addition to CASA requirements) of 60 days for Mustang pilots with less than 25 hours' type experience.

The incident pilot had met these requirements at the time of the incident sortie.

RAAF Museum

The RAAF Museum is located at Point Cook, within RAAF Base Williams. The role of the Museum is to collect and preserve RAAF heritage aircraft and memorabilia, part of which forms the display (both static and flying) of the heritage aircraft collection to the public.

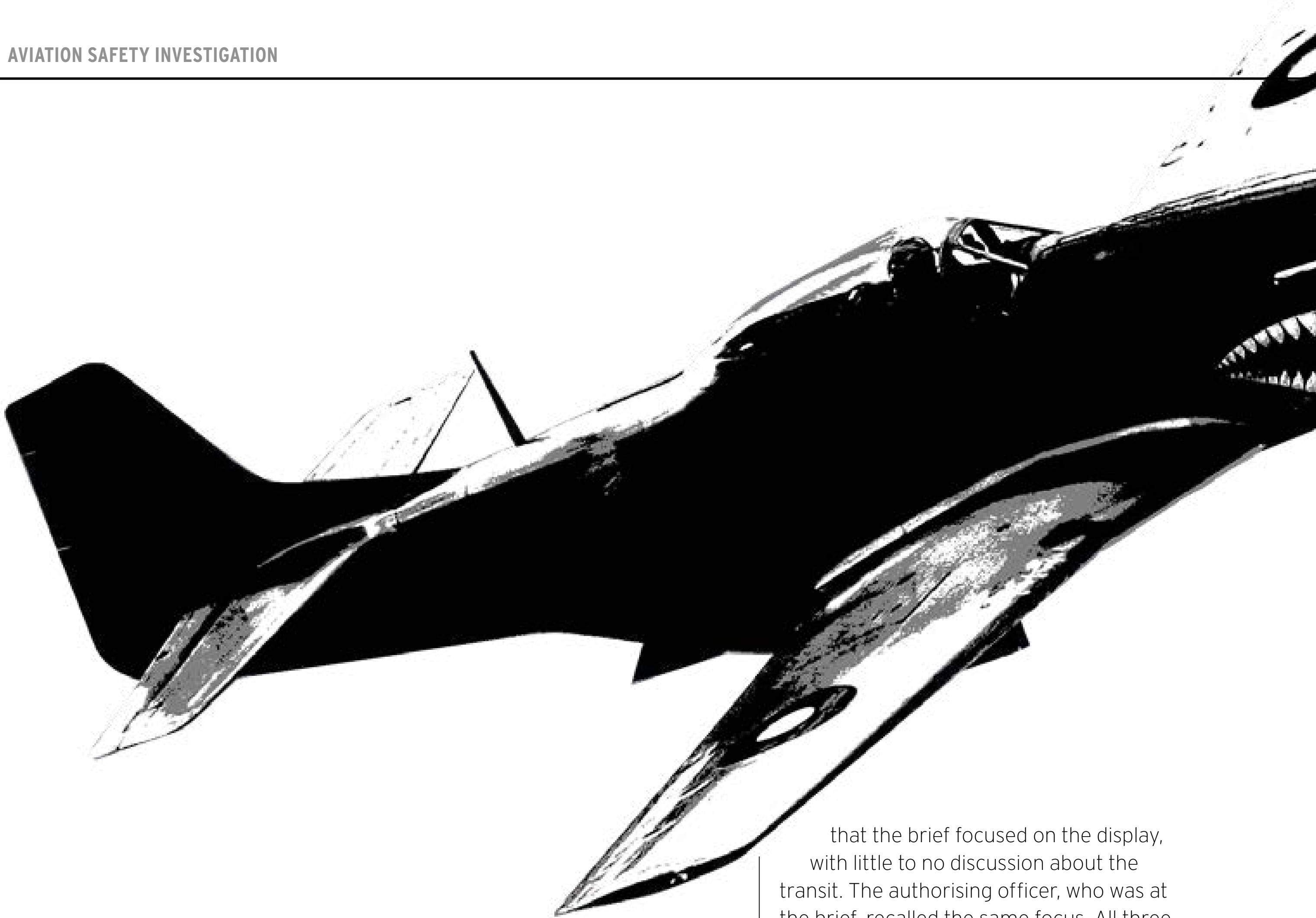
RAAF Museum operations are comprised mainly of three Interactive Flying Displays per week, initial- and continuation-training activities, and flying displays in support of air shows and other public events. The Museum has an annual flying rate of effort of approximately 210 hours, spread across seven aircraft types.

Airspace

The Melbourne VFR Coastal Route runs from Carrum (6.5 nm south of Moorabbin) to Laverton (4 nm north of Point Cook) and is used by VFR aircraft to skirt the Melbourne Control Zone. When transiting the VFR route, aircraft are directed to listen out on Melbourne Radar frequency and to make a radio broadcast when entering the route.

Mission planning

The two Mustangs were to be flown (in formation) for the Tyabb Air Show. To comply with AirA Museum SI (OPS) 3-403, *Use of Civilian Pilots and Aircraft in Museum Flying Displays* the civilian Mustang was flown from Tyabb so that the pilot could brief and fly the practice display with the RAAF Museum aircraft for the authorising officer (RAAF Museum OPSO).



When the civilian pilot arrived at Point Cook, MSTG 1 was already airborne, practicing a display with a formation of RAAF Museum training aircraft. Once this was complete, the two Mustang pilots commenced their flight planning and display preparation.

Both the museum and the civilian pilot recall that the bulk of their flight planning was spent on the formation display but they did download meteorological and NOTAM information for the transit to Tyabb, including Moorabbin and Avalon airfields. However, neither pilot retrieved the Melbourne Head Office NOTAMS. Both pilots told the ASIT they felt the number of Head Office NOTAMS, plus the area list, were excessive and it was difficult to filter out the relevant information required for their display practice and transit flight. As a result, neither pilot was aware of the TRA.

The pre-flight brief comprised a board-brief, outlining the display parameters, which was complemented by a walk-through of the routine on the hard standing. Both pilots recall that the brief focused on the display, with little to no discussion about the transit. The authorising officer, who was at the brief, recalled the same focus. All three acknowledged that transits were perceived as low-threat and that little emphasis was placed on them during planning and briefing.

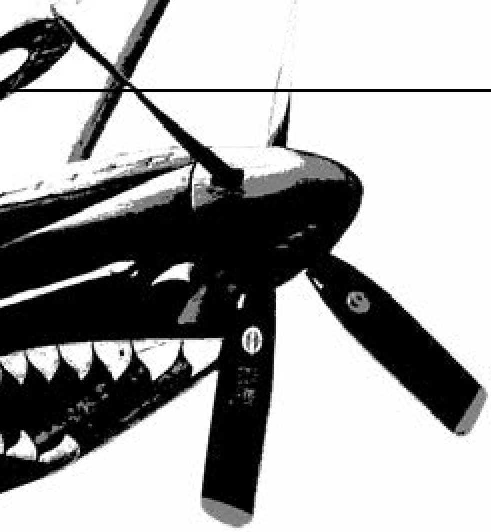
The ASIT identified that a number of reserve pilots left the regular Air Force more than 10 years ago and since then, have not assimilated contemporary safety attitudes and behaviours.

Communications plan

During the ASIT interviews, the majority of pilots described the airspace along the Port Phillip Bay coastline as busy. There are four major aerodromes with controlled airspace within the region: Melbourne, Avalon, Essendon and Moorabbin. Within that coastal airspace, there are also a number of smaller aerodromes, restricted areas and danger areas, which add to the congestion.

The ASIT confirmed that the majority of RAAF Museum pilots would follow the coastal route procedures by monitoring 135.7 VHF (frequency), which afforded them the most accurate source of traffic information in the area. It was noted that Moorabbin airspace was described as particularly busy, with a requirement to check-in early for clearance.

When questioned, the pilots said they were aware of the Melbourne 135.7 VHF frequency;



however, having taken into consideration the MSTG 2 had only one radio and had encountered communications issues during the previous transit flight, they decided to switch directly from Point Cook to Moorabbin frequencies. The intention was to reduce the likelihood of further communication issues delaying their clearance through Moorabbin airspace.

The ASIT noted that the RAAF Museum Mustang has a second VHF radio, which would have allowed the incident pilot to maintain, at least, a listening-watch of 135.7 VHF during the formation transit. Had 135.7 VHF been monitored, the incident pilot would likely have heard ATC calls relating to the active TRA and would have been able to take appropriate action to avoid any potential conflict with active airspace/other aircraft.

Flight authorisation

The RAAF Museum OPSO was the authorising officer for the flight. On the morning of the incursion flight, the OPSO was also preparing for their own participation in the Tyabb Air Show as part of the training aircraft formation. The OPSO attended the Mustang flight brief, and conducted the authorisation brief subsequent to that.

The OPSO and the incident pilot recall that there was a significant focus on the display practice, but little on the transit portion of the flight. Neither the OPSO, nor the incident pilot, had read Head Office NOTAMs, and, as such, were both ignorant about the existence of the TRA.

The RAAF Museum has a published checklist for the flight-authorisation briefing process; however, the OPSO does not recall referring to it. Regardless, the checklist is specifically for flying displays and formation flypasts and does not include specific reference to transit flights. The ASIT interviewed a number of Museum pilots and found that authorisation briefs do not routinely follow the Flying Order Checklist.

Conclusion

The ASIT found that the TRA incursion occurred as a result of sub-optimal planning, primarily as the incident pilot did not download or read the appropriate NOTAMs and was not monitoring the correct radio frequency to hear ATC alerts.

The ASIT determined that the local contributing conditions included insufficient focus on transit flights and sub-standard reporting and investigation of safety events. The RAAF Museum had three other airspace incursions in the preceding 18 months. Had these previous incursions been adequately investigated, it is likely that this incident would not have occurred.

RAAF Museum flying operations is a small and niche operation that depends largely on reserve pilots. The ASIT found that the structure and staffing of the RAAF Museum likely contributed to a stagnant safety-culture growth, particularly around safety reporting and investigation.

The ASIT identified that a number of reserve pilots left the regular Air Force more than 10 years ago and since then, have not assimilated contemporary safety attitudes and behaviours.

Furthermore, the ASIT identified a number of potential barriers to comprehensive and effective oversight, including organisational construct, geographical location and selection of personnel.

Director DFSB comment:

This incident reminds us of the importance of the basics of flight preparation, no matter how much experience we've accumulated in our flying careers.

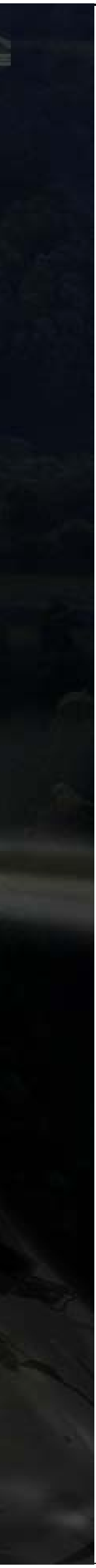
The aircrew members who have the privilege to fly the RAAF's collection of heritage aircraft are always highly experienced and are operating a range of aircraft that have various vices not found in a modern fleet.

A key finding from the investigation related to sub-optimal planning whereby the pilot didn't download or read the NOTAMS and was not on the correct radio frequency, which is clearly an avoidable situation.

The report made some organisational recommendations to bolster the staffing of the RAAF Museum in order that greater flying supervision could be provided. It was pleasing to see the formation of 100SQN that now incorporates flying and maintenance operations at both Point Cook and Temora.

100SQN has a WGCDR Commanding Officer and a range of other key staff such as Executive Officer, Operations Officer and Senior Engineering Officer, which significantly exceeds the staffing recommendations made by the DFSB report.

Close call at night



TWO MULTI ROLE Helicopters (MRH-90) almost collided in late 2020 during a day/night training exercise in the Townsville Field Training Area.

On 11 November 2020, three MRH-90s were conducting a series of tactical flying training sorties in combination with Tiger Armed Reconnaissance Helicopters (ARH) and Chinook (CH-47F) helicopters as part of Exercise Vigilant Scimitar 2020 (Ex VS20).

Towards the end of the night mission, while in tactical formation and using night-vision devices (NVD), MRH-2 took evasive action to avoid a separation breakdown with the MRH-90 formation lead (MRH-1). After completion of this manoeuvre, the two MRH-90s' tracks converged, resulting in the trailing MRH-2 passing in front and slightly below MRH-1 at 40 ft (12 m). MRH-2 then repositioned within the formation and the mission continued as planned with minimal debriefing in the aircraft and no debriefing within the formation. Each of the incident aircraft was carrying eight passengers.

The event was originally raised and investigated as a Class C Aviation Safety Report (ASR) because the closest proximity of the two aircraft was estimated to be between 100 and 150 ft. A subsequent review of the aircraft flight data recorder by the Defence Flight Safety Bureau (DFSB) revealed the breakdown in separation was more serious than originally estimated. Considered a near collision by DFSB and Headquarters, the event was upgraded to a Class B ASR on 24 February 2021.

The conduct of tactical missions are complex and include an element of managed risk. While the exercise concept of being deliberate, measured and safe was a benchmark tool used during planning and exercise conduct, the investigation identified several systemic issues that undermined this concept and contributed to the near-collision event.

The combination of very low illumination, NVD performance limitations and the preceding aircraft's lighting, required the full attention of the flying pilot (FP) of MRH-2 in order to maintain safe separation from MRH-1. However, the low levels of currency, recency and proficiency of MRH crews, especially in NVD formation flight and mission execution likely led to the FP of MRH-2 losing situation awareness of MRH-1.

It is believed the successful modification to the day mission RV, whereby the aircraft captain of CH-1 elected to depart the RV in a direction that was un-briefed but nevertheless aligned the formation to track towards the location of the countermeasures-dispensing serial, provided a level of confidence in modifying procedures at night and without consultation with the authorising officer.

Background

The event mission crews reported that the weather conditions were 'scattered cloud' and 'zero per cent moon illumination' and that it was 'very dark'.

Night Vision Devices

For the event mission, the MRH-90 pilots used the Thales TopOwl Configuration 3 (Config-3) Helmet Mounted Sight and Display (HMSD), which is a Type II aviator night-visioning system (ANVIS).

The risks associated with TopOwl performance, especially in low illumination, were not adequately understood or detailed as part of aircrew training.

As is often the case, there were a range of contributing factors that set the conditions for the MRH-90 formation's near collision.

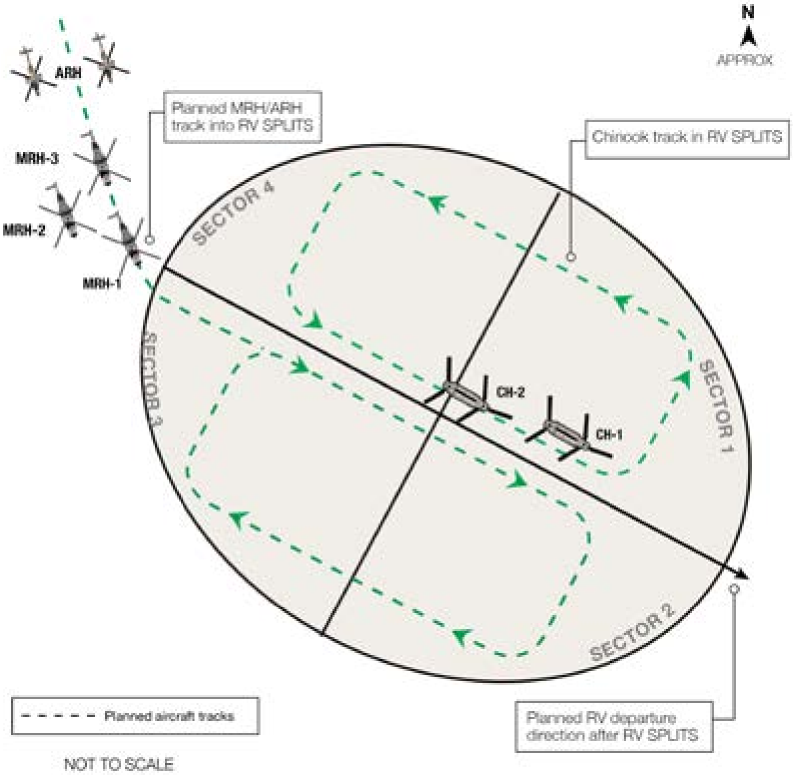


Figure 1. Aircraft tracking at RV Splits

While NVDs significantly enhance night capability, they are not without their limitations. NVD performance is affected by environmental conditions, particularly low levels of illumination, as was experienced during the event mission.

Mission execution

The event mission was tasked to insert and extract infantry into Landing Zone (LZ) Magpie located within Impact Sector North of the Townsville Field Training Area. Thereafter, a formation countermeasures-dispensing serial was planned before returning to Townsville Airport.

The day insertion of infantry elements was conducted with Chinook and MRH packets moving to allocated holding areas in the vicinity of LZ Magpie with co-ordination provided by the ARH. The extraction serials from LZ Magpie involved individual lift (MRH and Chinook) packets landing and departing the landing zone, which was followed by an airborne formation rejoin, planned at RV Splits.

The chinooks, as formation lead, were first to arrive at RV Splits and occupied their designated sectors. Shortly after, the MRHs completed their extraction from LZ Magpie, and conducted a rolling RV with the ARHs prior to occupying their assigned sectors in RV Splits.

Due to the packet's position in the RV pattern, the aircraft captain of CH 1 elected to depart the RV in a direction that was un-briefed but nevertheless aligned the formation to track towards the location of the countermeasures-dispensing serial. The MRHs and ARHs confirmed that they were visual with all traffic as the Chinooks turned left and passed behind the MRH and ARH to establish on track.

Once the RV and countermeasures-dispensing serial were completed the formation returned to Townsville Airport via Lavarack Barracks (to disembark troops), arriving at 1741, which was later than the planned arrival time of 1730.

The MRHs and ARHs subsequently shut down and refuelled, while the Chinooks conducted a hot refuel before parking at Hamel Lines without shutting down. A short radio update was conducted between all aircraft immediately prior to taxi for the night mission.

Night mission

The night mission departed Townsville Airport as planned at 1900, for what was to be a repeat of the day mission. The mission largely followed the construct of the day mission, until the formation rejoin at RV Splits, which is the focus of this investigation.

With the Chinooks established in Sectors 1 and 4 of RV Splits at 80 KIAS, the combined MRH and ARH packets tracked towards RV Splits at 110 KIAS to occupy Sectors 2 and 3. Approaching RV Splits but not yet established in Sectors 2 and 3, MRH-1 visually acquired the Chinook packet in the east of Sector 1, about to turn left for the outbound portion of their hold as shown at Figure 1.

MRH-1, while approximately 2 nm from the Chinook packet, identified an opportunity to achieve efficiency by having the Chinook packet depart the RV on track to the countermeasures-dispensing serial via a right turn, rather than remaining in the hold at RV Splits.

MRH-2 was following MRH-1 at approximately 10 RD in the staggered trail right position and stepped up in height reference MRH-1. The co-pilot of MRH-2, was the FP in the right seat looking cross-cockpit to maintain formation.

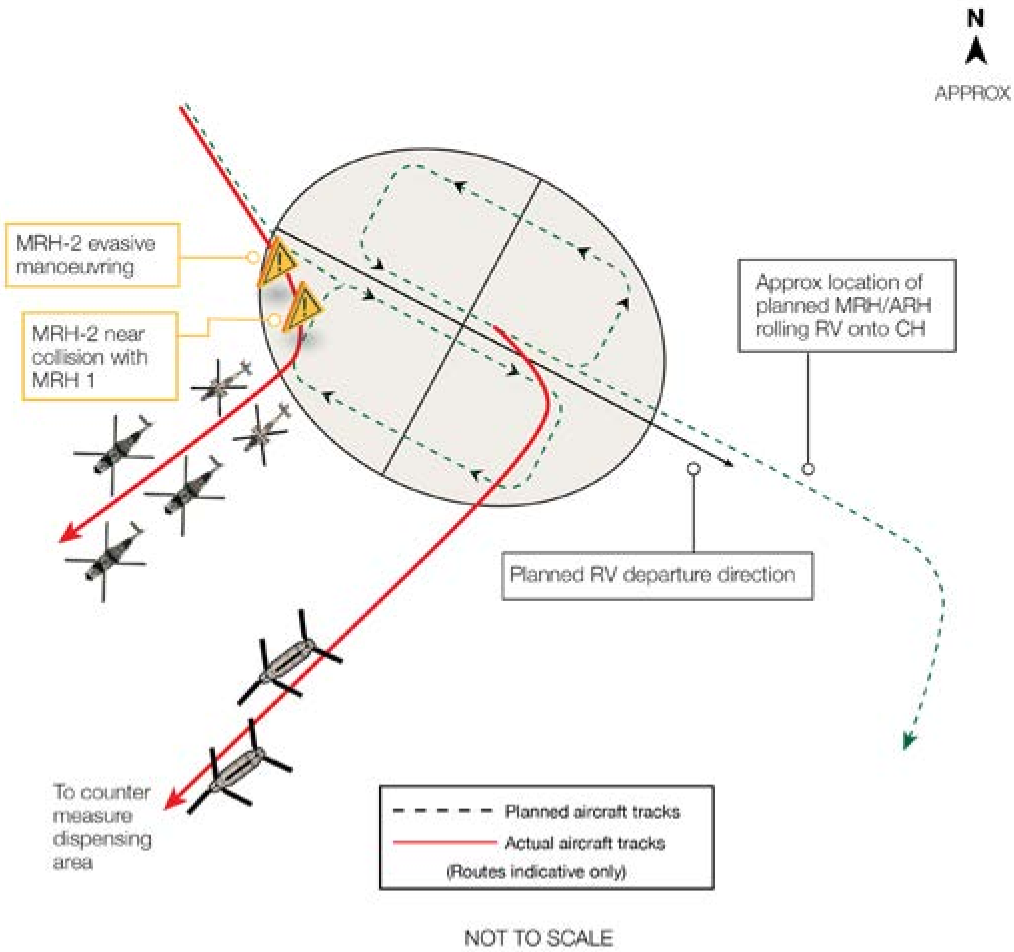


Figure 2. Night mission aircraft manoeuvring into and out of RV Splits

To achieve the efficiency opportunity identified above, the aircraft captain of MRH-1 assessed that the MRH/ARH packet would enter the point RV with appropriate formation sequencing to continue the subsequent rolling RV. To convey the opportunity, MRH-1 called "ready, request right turn for rejoin" on the formation common frequency. This change to the RV procedure was not in accordance with the SOP or mission orders/authorisation.

CH-1 acknowledged the radio call and sought clarification of the right-turn transmission from MRH-1, and once received, turned right to depart the RV maintaining 80 kts indicated airspeed (KIAS), continuing the right turn to track south-west, as shown in Figure 2. As the MRH were gradually decelerating from 110 KIAS entering the RV, this change in procedure introduced dissimilar speeds between the packets and created a closure rate between the MRH packet and the Chinook packet of approximately 30 KIAS.

Night mission aircraft into and out of RV Splits

To conduct the rolling RV, MRH-1 commenced a right turn at approximately 12-degree angle of bank and decelerated to approximately 65 KIAS.

Although NVDs significantly enhance night capability, they are not without their limitations. NVD performance is affected by environmental conditions, particularly low levels of illumination, as was experienced during the event mission.

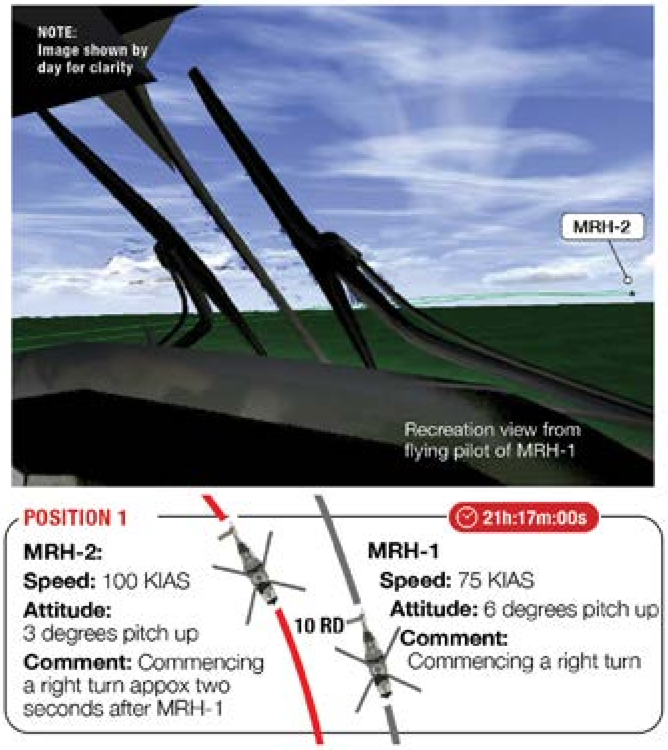


Figure 3. Position 1 of event sequence

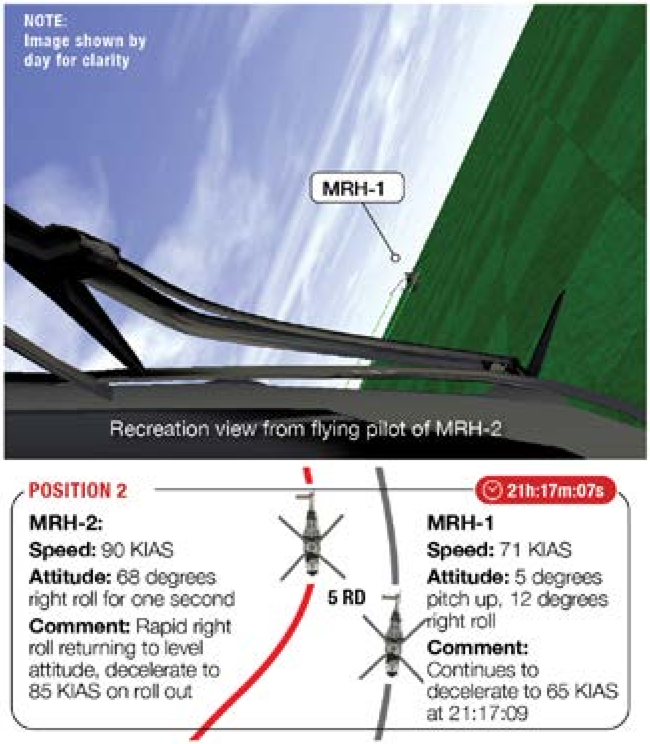


Figure 4. Position 2 of event sequence

MRH-1's deceleration was unannounced within the MRH packet or the formation. The FP of MRH-2 identified the right turn soon after its commencement but did not identify the deceleration. Figure 3 shows the positioning and speeds of both MRH at the commencement of MRH-1's right turn, referred to as Position 1.

To remain in position, the FP of MRH-2 maintained the right turn and adopted a nose-up attitude of approximately 8 degrees. As a result of this attitude change, the aircraft's infrared (IR) searchlight (which was turned on and down) illuminated MRH-1, which was recognised as a bloom; described as a rapid transition from seeing only the IR formation lights of MRH-1, to seeing the entire aircraft. The FP identified the roof of MRH-1, and understood this to be MRH-1 in a nose-up attitude, while also turning right towards MRH-2. It is highly likely that this bloom allowed the FP of MRH-2 to recognise the closure rate (approximately 25 KIAS) and spatially understand the positioning of the two aircraft.

As the FP of MRH-2 identified the rate of closure they took avoiding action, increasing the angle of bank to the right (up to 68 degrees for one second, depicted at Position 2 of Figure 4). The FP's stated intention for this decision was to 'go blind turning away from the preceding aircraft, rather than going blind turning towards' by the use of the arc.

During this manoeuvre, the FP of MRH-2 lost visual contact with MRH-1 due to the high angle of bank and being positioned slightly above MRH-1. While the FP of MRH-2 announced that they were blind on the ICS, no blind call was transmitted on the intercom or formation common frequency and therefore the crew, as well as MRH-1, was not aware of the manoeuvring of MRH-2 and maintained their constant right turn and decreasing speed to 65 KIAS.

During the avoidance manoeuvre, the aircraft captain (NFP) of MRH-2, who was in the left seat, was focused on the configuration of the aircraft countermeasures-dispensing system, in preparation for the next planned serial. As such, the aircraft captain of MRH-2 was not monitoring MRH-1 prior to the avoidance manoeuvring.

The aircraft captain of MRH-2 did not acquire visual contact of MRH-1 during avoidance manoeuvring, only regaining visual contact with MRH-1 as it passed overhead (approximately 15 seconds after the initial avoidance manoeuvre).

Following the high angle of bank, the FP of MRH-2 rolled out of the turn, re-establishing the aircraft to approximately straight and level flight.

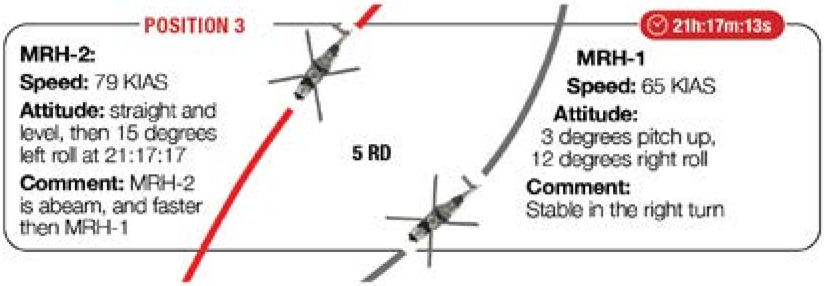


Figure 5. Position 3 of event sequence

The FP was under the impression that the new aircraft track would now be paralleling that of MRH-1. The actual track is depicted at Position 3 of Figure 5.

Considering the performance of TopOwl Config 3 and the now displaced angle of MRH-1 across the cockpit shown in Figure 5, the FP of MRH-2 could have, from that position, regained visual contact of MRH-1.

Evidence indicates that the left-side aircrewman of MRH-2 maintained visual contact with MRH-1 throughout the event and passed MRH-1's position to the pilots and right-side aircrewman, via the intercom system. Interviews with the pilots of MRH-2 suggest that these communications were likely not perceived due to the high pilot workload and were not comprehended. As a result, no additional avoidance manoeuvring was initiated that could have further separated the aircraft.

Near collision

MRH-2's avoidance manoeuvre served to increase the separation between the two helicopters but for only approximately 15 seconds, as the two tracks merged again and MRH-2 proceeded to pass below and in front of MRH-1, closing to approximately 40 ft separation as depicted at Position 4 of Figure 6.

The pilots of MRH-1 and MRH-2 became aware of the other's position when the aircraft crossed paths as depicted at Position 4 of Figure 6. At this point of the event sequence, the right-side aircrewman of MRH-1 stated 'there's an aircraft below us', which coincided with the co-pilot of MRH-1 (right seat and NFP) sighting the aircraft and stating 'f..k me' (Figure 6 is a recreation of this pilot's view at this moment).

The ASIT considers that this explicit language is as a direct result of the proximity of MRH-1 and MRH-2 at the time of the event. Evidence indicates that the aircraft captain (NFP) of MRH-2 recognised MRH-1 position as it passed above and behind their aircraft.

As MRH-2 inadvertently established itself on the left-hand side of MRH-1, the right-side aircrewman of MRH-2 quickly identified MRH-1 and communicated its position to the pilots as at the '2-30 high' (clock code reference). The FP of MRH-2, while unsure of how they were now on the opposite side of MRH-1, identified the lead aircraft and re-established MRH-2 in the arc of freedom, to the left, and rear, of MRH-1.

MRH-2's avoidance manoeuvring was discussed, initially among the crew and then within the wider formation; being described as a bug out. Among the crew of MRH-2, the minimum distance between the two aircraft was estimated by the right-side aircrewman to be approximately 80-100 ft, whereas the aircraft captain estimated 40-50 ft. Based on this discussion the crew came to a consensus that they were 'happy to continue' and 'carry on' with the mission. This decision was very likely influenced by a known difference in visual acuity between NVD used by the MRH-90 pilots and those used by aircrewman.

Evidence suggests that the crews' discussion regarding the near-collision event did not include consideration of the time and positions of the two aircraft, when observing the near-collision event.

Figure 6. Position 6 of event sequence — near collision between MRH-1 and MRH-2

The ASIT considers this influenced the distance estimation of both pilots and aircrewman and therefore a shared mental model of the event among the crew. Combined with the known differences regarding NVD, the crew very likely minimised the event's significance.

The manoeuvring of MRH-2 was witnessed by MRH-3 and the ARHs, albeit from a distance and with limited detail. This manoeuvring prompted discussions in MRH-3 and ARH-2 regarding the proximity of MRH-1 and MRH-2 including a discussion on which navigation lights now corresponded with each aircraft.

After discussing the situation among the crew, MRH-1 sought a formation consensus regarding the continuation of the mission by asking (on the formation common frequency) 'before we launch into flares, can we just confirm we're all happy post that, ah, bug out?'.

The remaining MRHs replied that they were 'good' and 'happy' to continue; however, evidence suggests that there was a degree of confusion regarding why, and what MRH-1 was raising as an issue.

Regardless, it is highly likely that further discussion regarding the event details or significance, did not occur within the formation, including any additional discussions with the AMC.

It is likely that this lack of discussion regarding the event resulted in its significance not being commonly understood by the formation or the AMC. The countermeasures-dispensing serial was completed without further incident.

RV modification

A modification to the RV departure track had been successfully executed during the day serial prior to the event mission. Evidence suggests that this debrief did not consider the changed procedure to be unsafe or prompt discussions regarding compliance with the SOP.

This change to the day mission RV procedure and a lack of critical analysis following that mission, reinforced among the formation, that the modification of procedures airborne was acceptable and likely encouraged to achieve efficiency. This likely affected both MRH-1 and MRH-2's willingness to modify the night mission RV in order to achieve efficiency.

Flexibility through the modification of SOP is allowable; however, 'where the mission dictates a change... it is to be briefed at the aircrew briefing'. This implies that if changes to SOP are considered necessary, they would be approved by the AMC prior to the mission.

Given the reduced exposure to dissimilar type formation, it is highly likely that the MRH-90 crews were not at a level that would allow for modification of SOP during the event mission. For the event mission, the AMC was not consulted and did not approve the changes to the departure track of the RV.

Mission debrief

A post-mission debrief was conducted at the conclusion of the night mission. Due to duty-day limitations, the authorising officers of each aircraft type were not in attendance. The night RV procedure was discussed, focusing on the efficiency gained by the early identification of preceding aircraft formations and associated ready call. The consensus among crews regarding their proficiency was that they 'should be able to change' procedures while airborne.

During the debrief, MRH-2's manoeuvre as part of the RV was discussed, including the distances between MRH-1 and MRH-2. These accounts varied between members of the crews involved. The consensus between formation members was that the event was a "bug out executed poorly" and as such, was given "not a lot of gravity to the debrief".

Evidence indicates that the event was not discussed in terms of a near collision and the formation members did not consider an immediate requirement existed to inform the authorising officers or command. This event was raised as a safety point in the mission-debrief document annotated as 'Bug out executed poorly'.

Raising a safety concern

While the event was discussed by command and safety representatives on 12 November, it is likely that vague and differing distances being reported by crew members resulted in the initial consideration of the event as not a near collision.

The variance in proximity assessments by the event crews prompted the Brigade Safety Cell to request support from DFSB to clarify the distances between MRH-1 and MRH-2. Upon interrogation of the data, a near collision was identified. The ASR was subsequently reclassified to Class B, and an ASIT was appointed.

Director DFSB comment:

A continually recurring theme we see from many accidents and serious incidents is the high levels of complexity that exist in modern aircraft and missions. In this case, there was a large formation of different helicopter types that were operating at night with night vision devices. Just getting the formation together and heading towards the target is a complex feat in itself, which is where things went wrong.

These scenarios are an essential part of building up a capability but with increased complexity comes increased risk. As the report found, there's never one simple contributing factor that if removed would make the whole issue disappear, so at the risk of oversimplifying the systemic issues at play here, I offer the advice that when the boss says 'crawl – walk – run' it can be interpreted at the coalface as closer to 'run! Sprint! Sprint faster!'.

Emphasising the ability for us to say 'no' and empowering your people to speak up is a vital part of keeping us safe.

As a final post-script to this event and subsequent report, I find it truly chilling how much this close call reminded me of the tragic events of 12 June 1996 when two Blackhawk helicopters collided and the lives of 18 soldiers and aircrew were lost.

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