

AVIATION SAFETY

Spotlight

01 2017

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AVIATION SAFETY Spotlight

the aviation safety magazine of the Australian Defence Force

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Foreword

WELCOME to the first edition of *Spotlight* for 2017, which is also my first edition as Director DAAFS. I have been involved in aviation safety during my careers in both the RAF and the RAAF and I am proud to be appointed as the DAAFS Director. The next 12 months will be busy with the roll out of the DHARTS replacement – the Aviation Safety Management Information System (ASMIS) – and the continued development of the new Defence Aviation Safety Regulations (DASR). However, while these are important initiatives, the reason why aviation safety works is the personal commitment of everyone involved in aviation. The work done at all levels in developing safer maintenance procedures on the flight line or the willingness of experienced aircrew to openly report and learn when things go pear shaped are the reasons why our recent safety record is what it is. Our willingness to learn from mistakes is excellent but, as one of the articles discusses, we also need to ensure that when things work, we identify what we are doing well and look to further improve those behaviours.

Aviation is not a dangerous profession but it is an occupation that is unforgiving of complacency, arrogance or a failure to plan and while our ASMS is well advanced, it is the individual efforts of unit aircrew, maintainers and support staff that have the biggest impact in ensuring take offs equal landings.

Remember, Mission First Safety Always.

GPCAPT John Grime
Director,
Defence Aviation and Air Force Safety



INSIDE

- | | |
|--|--|
| 4 Phoenix Dawn | 30 FOD control starts with you |
| 8 I learnt about (combat) flying from that ... | 32 The pen is mightier than the sword |
| 16 Lightning, fumes and CRM | 35 Changes to Bureau aviation weather products forecast |
| 20 Airborne and unaware | 36 Jet blast dangers |
| 22 Only one aircraft required for an aviation tragedy | 38 A lack of oxygen or something else? |
| 24 Wildlife hazard management for a moving airfield | 43 ASMIS the aviation safety capability for the future |
| 28 The importance of workplace inductions | 44 Aviation Safety Training Courses |



PHOENIX DAWN

By FLT LT Luke Anderson

Covering the entire span of Australia's northern and eastern approaches is a nearly continuous chain of 452 volcanoes, known as the ring of fire. The chain stretches as far northwest as Peuet Sague, whose last eruptions in 2000 were enough to perturb the Indonesian Air Force and concern neighbouring Thailand. It connects the famous Krakatoa, continues with the active volcanoes of Papua New Guinea and less familiar names like Manam, Karkar, and Lamington, all the way through to New Zealand's venting Whakaari in the Bay of Plenty. Many of the volcanoes are currently dormant, but what do we really know about the ring of fire and how to factor it into our aviation safety planning?

Defence, following devastation in 2004 and 2011, is accustomed to and prepared for the volcano's tectonic cousin: the submerged pacific earthquake and tsunami. Similarly, we can consider a volcanic event:

- How likely is such an event?
- What are the warning signs?
- How much time will we have to respond?
- Will we be capable of safely providing air support to the consequent ground civil emergencies?
- Are the recent civilian treatments the most practicable option (2010 flight bans after the Eyjafjallajökull eruption, the sliding window bans after the 2011 eruption of Grímsvötn)?

There are several well-documented incidents and near-misses to help inform our risk management. In 1989, KLM Flight 867 (new Boeing 747-400 combi), en route from Amsterdam to Tokyo, suffered a quadruple engine failure (from compressor stall) while flying through a cloud of volcanic ash from Mount Redoubt (Alaska). The engines were able to be re-started in flight but the ash caused US\$80 million damage.

“Fine dust, rock, and sand from the cloud can choke engines. Given that the melting point of most volcanic cloud products is less than the operating temperature of most jet engines, the ash can filter through to the combustion chamber, melt into sticky goo and cause the engine to backfire (oversaturate with fuel) and flameout.”

In 1991, 16 separate jet aircraft reported airborne damage from ash clouds after the Mount Pinatubo (the Philippines) eruptions. This included a DC-10 having to shut down one engine and a double-engine failure on a Boeing 747-200. Dozens more aircraft and airport instruments suffered damage from ash fallout while on the ground. The fallout was so bad that a DC-10 at Cubi Point Naval Air Station was tilted backwards onto its tail by the weight of ash settling on its horizontal stabiliser.

Depending on the context, it is quite possible that certain aircraft in the ADF fleet will have a “more-than-rare” likelihood of encountering damage from volcanic ash; the likelihood of having operations suspended due to volcanic activity will be greater still.

The consequences of volcanic activity can be vividly demonstrated by viewing the *Air Crash Investigators* episode, ‘Falling from the Sky’.

In 1982, British Airways Flight 9 (a Boeing 747-200) en route from London to Auckland, on the Kuala Lumpur-to-Perth leg, encountered an ash cloud from Mount Galunggung (Indonesia) in what became known as The Speedbird 9 Incident. On an almost moonless night, at 10 kilometres above the ocean, the cabin of Flight 9 began to fill with smoke. Smoking was still legal on international flights in 1982, so nothing seemed too awry.

The aircrew were then treated to a lightshow: pinpoints of light danced around their windshields and wisps of light trailed from the leading edges of the control surfaces. Could this be St Elmo’s fire? When the aircrew looked at the weather radar, the arc in front of them appeared to be clear of the cloud structures normally associated with the electrical discharges that are St Elmo’s fire.

Looking for answers, the aircrew activated the landing lights. A delicate fog appeared to be surrounding the aircraft: perhaps this was high cirrus clouds? At this stage, some of the awake passengers start to grow more concerned by the white light pouring off the wings and the hint of what appears to be a burning electrical-system smell throughout the cabin. The chief steward began searching for a possible fire aboard.

The light show grew to include engines no. 1 and no. 4. By now the cabin was getting uncomfortably warm and passengers were suffering from smoke irritation. Disturbed by the light show around the engines, aircrew scanned their instruments but the instruments were all within normal limits. Then flames 20-to-40 feet long began sprouting from the exhaust of all four engines. Engine no. 4 was shut down after it was

observed surging. Not long afterwards the remaining three engines failed. Flight 9 was now a very heavy glider.

The aircrew began preparations for a crash landing. They radioed Jakarta control but their messages were garbled. Communication was eventually established by buddy-relay through a bystander airliner. The crew then began engine re-start drills with their current altitude and three minutes per attempt they had less than 10 attempts to re-start before crashing into the ocean. They later reported, “A Boeing 747 never loses all four engines, we questioned what it was that we had missed”. “We were almost certain that we would be held accountable for the failure of all four engines.”

Next a cabin-pressure warning sounded: all aboard may suffocate before any impact with the ground became a problem. Without engines to supply oxygen to the cabin this alarm was very real. The aircrew donned oxygen masks but the first officer inadvertently pulled too hard on his mask and tube and did without. The captain commanded a steep dive down to a safe altitude. Oxygen masks dropped in the

cabin: alarming passengers. The public address system failed and the steward had to regain calm in the cabin, under the effects of suffocation, while using a megaphone. Meanwhile the aircrew was attempting to reach the safety of Jakarta when they realised they needed to clear a 3500 metre-high mountain range.

At low altitude, the engines were able to be restarted. All but engine no. 2, which continued to surge, were restored. With the mountain range cleared and Jakarta approaching in the early daylight, the aircrew lost almost all visibility through their windscreen, which was completely pitted.

Finally, air traffic control informed the aircrew that the glideslope was not working on their instrument landing system and that only the localiser was available. The first officer attempted to overcome this by calculating expected approach altitudes and calling these out to the captain.

Flight 9 made a successful emergency landing.

Some key points to note

It is not easy to detect volcanic ash. Apart from the smell of sulphur dioxide, it can present like an on-board fire, it could just present like a St Elmo’s fire, when in reality large ash particles have quickly abraded the leading edges and windshield.

The electrostatic discharge caused by the friction of colliding ash particles with the aircraft has been known to disrupt radio communications with ground stations. Most weather radars, optimised to detect water particles, will not detect an ash cloud. Part of your preventative measures must include regular communication with meteorological and geological survey agencies for advice on active volcanoes and the movement of known ash clouds.

Fine dust, rock, and sand from the cloud can choke engines. Given that the melting point of most volcanic cloud products is less than the operating temperature of most jet engines, the ash can filter through to the combustion chamber, melt into sticky goo and cause

the engine to backfire (oversaturate with fuel) and flameout.

The crew of Flight 9’s crew resource management was outstanding, dividing tasks while troubleshooting the engine failure and managing the partial ILS landing. The airmanship by the second airliner to relay mayday calls was also commendable.

Some operating wings in the ADF have developed their own bow tie analysis for flight into volcanic ash (VA). Preventative controls include VA forecasting, route planning procedures, and crew training. Recovery measures include on-board aircraft detection systems, boldface checklists, life-support equipment, post-flight maintenance inspections, and pre-authorised diversion procedures. No need for a mountain of paperwork. For better or worse, smoking on airliners is now banned on most international flights.

Note: This article was submitted through DDAAFS Aviation Safety Officer (ASO) training and published with permission.



I learnt about (combat) flying from that ...

... How do we learn from the things we do right?

By Lt Col Nick English, AAC
First published in *Air Clues* Issue 19

During January 2014, on an operational mission in Afghanistan I was the aircraft commander and my co-pilot was the handling pilot; when we suffered one of those aircraft failures that is every rotary pilot's worst nightmare – a tail rotor drive failure in flight.

A UK Civil Aviation Authority (CAA) analysis in 2003 of 344 tail rotor failure occurrences found that, while failure in transit accounts for 27 per cent of occurrences, they account for 56 per cent of fatalities. From their historical analysis, the overall failure rate was about nine per million flying hours.

Through a combination of luck, training and teamwork the aircraft was safely landed (crashed) in the desert, the crew were combat recovered and the aircraft was extracted in less than 24 hours. What follows is an account of the entire operation from the aircraft emergency to the immediate response and culminating with the aircraft recovery.

We sometimes find it difficult to look closely at successful outcomes to find the factors that led us there and then make sure that we reinforce them in our routine operations. It is just too easy to look for faults. Understanding success will help us to safely develop and reinforce the agile and adaptive performance we need to fight and win.

This particular sortie was a combat Intelligence, Surveillance Target Acquisition and Reconnaissance (ISTAR) mission in support of the US Marine Corps in Northern Helmand as they prepared to withdraw a large number of forces back to Camp Bastion. By mid-morning, it was already our fourth mission of the day and we were extremely comfortable with both the aircraft and the operating conditions.

Following a standard low-level departure from Camp Bastion, we climbed away to the east aiming to show presence over an ongoing Afghan National Army operation. Real aircraft failures never manifest in the clean way they do in simulator emergency sorties and, having reached medium level and checked in with the area Joint Terminal Attack Controller (the controller in a Land HQ that controls air fires and deconflicts battlespace) one of our tactical radios started beeping as if it was continuously trying to transmit.

That was unusual and annoying so, with some choice words, I turned my attention to isolate the troublesome radio. Seconds later Charlie (the handling pilot) asked me if I could feel a vibration through the floor. My attention drawn to it, I could feel it through my feet and it felt like 30 mm cannon hydraulic cavitation where the cannon twitches in a feedback loop but settles down when you move it.



“As I went to press the jettison button, I momentarily paused as the thought popped into my head ‘I am going to get hung if this isn’t a tail rotor failure and it’s something simple I am missing’. Luckily this thought lasted only a second or two before ‘I don’t care’ overtook it.”

As I actioned the gun to investigate this new higher-priority fault, the aircraft suddenly yawed to the right. Charlie instantly (and correctly) identified that we had suffered a tail-rotor failure in flight announcing it initially in a confused voice and, within seconds, with absolute certainty.

In the space of 30 seconds I had been diagnosing a radio fault, thinking about a gun vibration, experienced a rapid yaw in the aircraft and my pilot was telling me we had suffered a tail-rotor failure. It took about 10 seconds for my brain to process this highly unusual fact. Tail rotors never fail.

Nevertheless, the aircraft was definitely not flying properly and Charlie, with his hands on the controls, was absolutely convinced. We were lucky that in those first 10 seconds, Charlie’s immediate reaction to take off power to control the yaw saved our lives. We were flying at maximum all-up mass pulling maximum power and came within seconds of a complete and catastrophic loss of control.

Apache has a helmet-mounted display and flight instruments are continuously available to you in front on your eyes. It is like having a head-up display mounted to your head and always available. As soon as I processed that it was a tail-rotor failure, emergency conditioning kicked in and I was instantly drawn to airspeed – lose

your airspeed and you will irrecoverably spin and crash in a burning wreck. As I prompted him, Charlie rapidly recovered the airspeed and dropped the power further resulting in a flight profile that resembled a rapid descent into the heart of the active Taliban insurgency.

It was at this point that our first crucial decision was made. The immediate actions are to enter auto rotation and conduct an engine-off landing but, instead of adopting the expensively conditioned behaviour, we continued to attempt to fly the aircraft. This felt instinctively right and, in retrospect, probably saved our lives. Had we attempted a double engine-off landing with no tail rotor into a populated area we would undoubtedly crashed: had we survived it would have been like a scene from *Black Hawk Down* without much prospect of rescue. Interestingly we displayed an adaptive rather than conditioned behaviour. Despite high stress levels we rapidly and intuitively selected an alternative (and better) course of action.

At this point, the world was not looking good: we were heading downwards rapidly and despite having turned away from the threat towards more open terrain we weren’t going to get very far. About 28 seconds after the failure, I transmitted a mayday call on the mission primary frequency to my wingman who was in front of us and oblivious to our sudden and rapid change of flight profile. I remember looking at his tail as I transmitted, feeling real relief that I could just focus on our aircraft as I saw him turn back. Seconds later he relayed our mayday call to US Marine Corps Tactical Airspace.

Control and everyone airborne in South Western Afghanistan was now aware of our predicament.

Listening back to the cockpit voice recorder you can hear in our voices that, while we were still flying, it wasn’t going to be enough. I knew that we needed to get mass off the aircraft to reduce the rate of descent; it felt that if we could

keep flying then at least we might have a chance to think our way out of the problem. Spotting a wadi (Arabic and Hebrew term for valley) coming up, I decided to jettison all the external fuel and stores.

One of the side effects of the fully justifiable quest to make aviation as safe as possible is that we try and learn from every event in training that doesn’t go as it might. One of the unfortunate side effects of this is that we tend to focus on negative events more than positive ones. As I went to press the jettison button, I momentarily paused as the thought popped into my head ‘I am going to get hung if this isn’t a tail rotor-failure and it’s something simple I am missing’. Luckily this thought lasted only a second or two before ‘I don’t care’ overtook it.

In hindsight, it was a salutatory lesson on the unintended consequence of trying to eliminate errors. While our just-culture model absolutely seeks to create a blame-free learning culture, it often doesn’t feel like that to those who are having their professional judgement called into doubt and subjected to the magic of hindsight. By relentlessly pursuing learning from errors, we must be careful not to condition doubt into

our people that may inadvertently kill them through inaction. Despite being very experienced on type, both as a commander and operationally, it hit me and I delayed a potentially life-saving decision: I wonder what it does to our more junior pilots and commanders?

Having dropped the stores on the edge of a wadi and remarkably managing to miss any innocent civilians, the change in performance was marked. We no longer felt like we were imminently crashing and had time to think. I was still not 100 per cent convinced that we had suffered a tail rotor failure: the aircraft was still flying, albeit in a horrible left wing low, nose-down configuration and we were still alive. I think part of me was still hoping that there was a simple failure lurking there that would avoid having to confront the reality of suffering a low-survival failure.

At this point my capacity re-emerged from somewhere under my seat, I called control to update my mayday, give the position of the stores for denial and nominated UGLY 53 as the on-scene commander. This was relayed by a flight of USMC CH53s returning from an air assault mission to the west that immediately, and without being tasked, started converging on our position. We now systematically checked that the controls were really responding as they should for a tail rotor failure. I even managed to get my flight reference cards intending to eliminate any hydraulic or control problems.

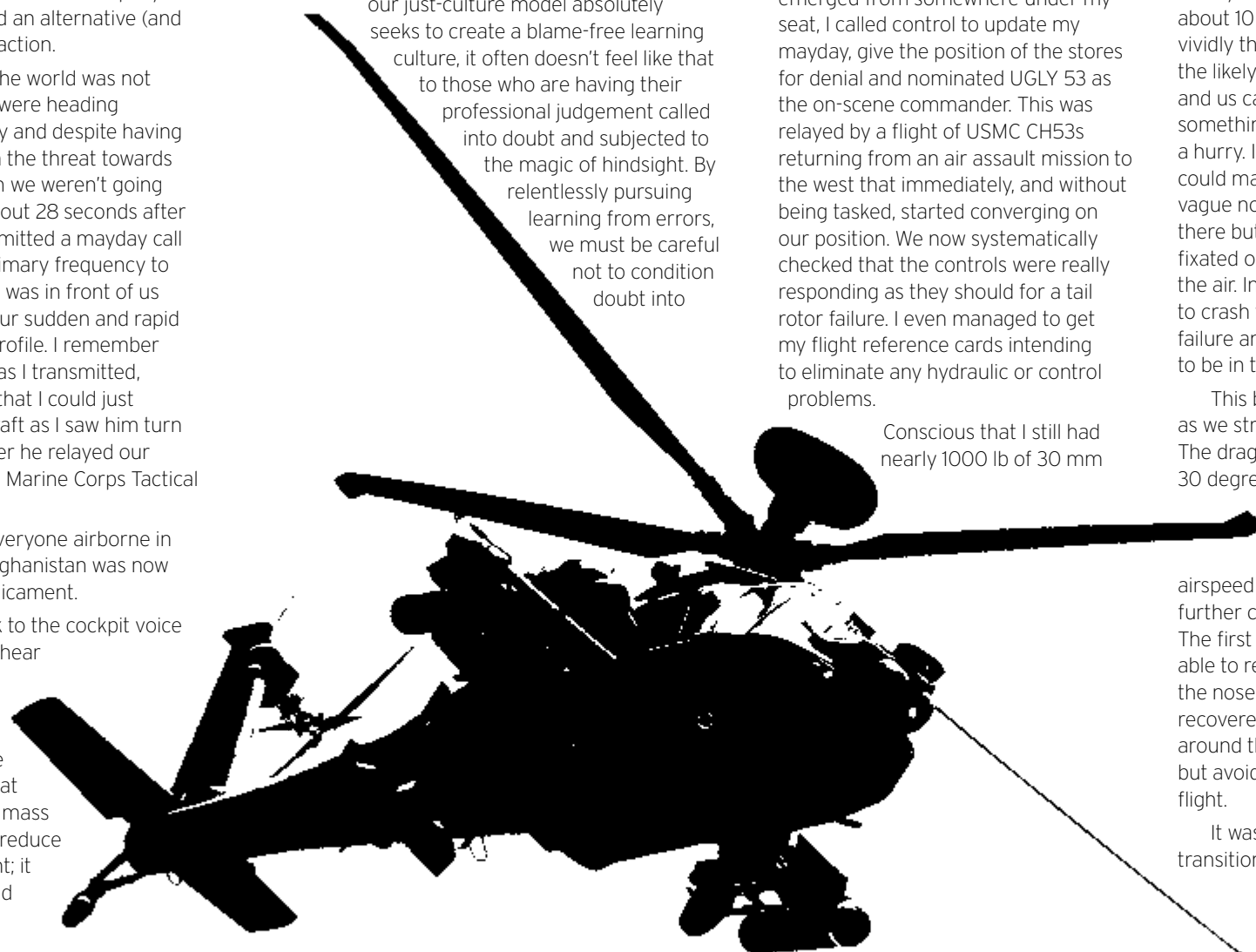
Conscious that I still had nearly 1000 lb of 30 mm

ammunition on board and that we needed to be as light as possible if we were going to maintain flight, I elected to fire the ammunition into any safe areas I could find. I slaved the gun to my helmet, selected 100 round bursts (10 seconds of fire) and started firing into the empty gaps between compounds. It was going well until I spotted a gap in the compounds to the left. As I fired to the left, it became immediately obvious that this was a bad idea. The torque created by the recoil was now working against rather than with the vertical stabiliser and tried to spin us into the ground. After some pretty vociferous prompting from Charlie, we decided not to try that again. It was at this point that UGLY 53 calmly notified me that my tail rotor was not turning.

This crucial piece of information instantly dispelled any doubt – external confirmation that we were indeed in a very bad place. The voice recorder is very telling. Neither of us spoke for about 10 seconds. I remember very vividly that this was the point at which the likely consequences for our families and us came sharply into focus. Not something I would wish to repeat in a hurry. I was still convinced that we could make Camp Bastion and I had a vague notion of a plan for when we got there but to be honest we had become fixated on just keeping the aircraft in the air. In reality, we were always going to crash from the moment we had the failure and it was almost certainly going to be in the desert.

This became abundantly clear as we struggled to maintain height. The drag created by flying with about 30 degrees of yaw and 20 degrees left wing low is immense and continuously tried to slow the aircraft down. As airspeed is lost, the drag gets worse, further compounding the problem. The first time this happened, we were able to remove some power and get the nose right down until the airspeed recovered, essentially pirouetting around the nose which cost us height but avoided departure from controlled flight.

It was at this point that I mentally transitioned from ‘get back to Bastion’



to 'engine-off in the desert'. I cleared my cockpit of loose articles and locked my harness. We were attempting to adjust our track back towards Bastion when the airspeed started to decay again. By this point, we were only 400 feet above the desert. Charlie managed to get the nose down but the airspeed just didn't respond. After a couple of seconds he said: "I'm losing it, go for the engines".

As we were now 35 degrees nose down, 45 degrees angle of bank and yawing right, I was pretty much looking straight down at the desert and had already concluded that beyond this point lay loss of control and burning wreck. As I pulled the engines back, the low rotor speed warning sounded immediately and we yawed violently left. Charlie managed to flare and level the aircraft but something prompted me to take control.

This is not what I practice or brief when I fly as usually the consequence of the commander taking control is loss of your capacity and making the situation far worse. Even after much thought, I still don't know what prompted me to take control from Charlie. Perhaps my mind was playing the sequence of events through and detected an anomaly. Either way Charlie very calmly and confidently replied 'you have control'. Note to self – practice taking control of an aircraft in about the worst flight condition possible in the simulator before attempting it for real.

In the 20 seconds or so that it took for us to arrive on the ground many things happened very quickly (it felt like five seconds). We achieved an autorotation configuration and recovered our rotor speed no doubt helped by the 45 degree attitude change. As the ground rapidly approached, a second key bit of adaptive behaviour saved our lives.

When I had refreshed back onto Apache following a staff appointment, the simulator flight model had just changed. The dynamics of a tail-rotor failure meant that landing from an engine off configuration was extremely difficult if not impossible. The engine-off manoeuvre taught always resulted in a loss of control and the 'red screen of death'.

Unwilling to be defeated, I practiced this again and again until I found a technique that allowed me to beat the

simulator at least some of the time. This turned out to be extremely valuable as, with seconds to go, the memory of that technique vividly popped back into my head.

Having examined the data recorder, it almost certainly saved our lives; had I flown the technique as taught, we would almost certainly have rolled at high speed on touchdown and distributed ourselves liberally across the desert.

The recovery

As we rolled to a stop upright in the desert, my immediate response of 'holy **** Charlie, we're still alive' says a lot.

However, we had just abruptly transitioned from aircraft emergency to escape and evasion. I had realised early on in the tour that Combat Search and Rescue (CSAR) wasn't getting the attention it deserved. In eight years in Afghanistan there had been very few occasions for anyone to be on the ground and this had affected how seriously crews treated briefing their immediate reactions. I insisted that, instead of just reading through the CSAR information, we would spend a couple of minutes on every brief mentally rehearsing different scenarios until we all knew instinctively what each person in the formation would do. This proved to be absolutely the right thing to do. Our experience of local insurgent reactions meant that we were only likely to have a few minutes before we would have extremely unfriendly company.

As soon as we hit the ground, both Charlie and I went straight into our short-term actions. Running on adrenaline, I grabbed my go bag, unclipped my carbine and jumped out. After making both weapons ready I made my colour sergeant from Sandhurst proud and looked for cover and a fire position only to discover we had landed in possibly the flattest bit of Helmand ever. Not even a ripple anywhere nearby. Looking around the other side of the aircraft revealed that we were on the edge of the habitation with nothing but desert behind us. It could have been far worse.

For the first few minutes, Charlie and I quickly ran through our drill of preparing the aircraft for abandonment, removing the crypto and sensitive equipment. As I got out my 112 radio, I discovered



"As we rolled to a stop upright in the desert, my immediate response of 'holy ** Charlie, we're still alive' says a lot."**

a helpful safety equipment fitter had disconnected and tie-wrapped my pre-prepared ear-piece when servicing my vest. After cursing a bit while putting it back together, I quickly established comms with my wingman who was orbiting directly overhead anticipating providing suppressive fires or immediate extraction. He then gave me his second game-changing piece of information of the morning – there was no movement converging on us within 500 m. That instantly shifted me down into a more deliberate consideration of what would happen next.

Interestingly Charlie didn't pick up on that useful information and for a while he couldn't work out why I was so calm

and I couldn't work out why he was so stressed. Looking back on it, Charlie was unsurprisingly expecting to be mobbed at any time and was expecting to have to fight for his life.

As we had a little time on our hands and weren't going to be running anywhere imminently, I took the opportunity to take some photos of the site and as many relevant bits of the aircraft that I could. Knowing that destroying the aircraft was always going to be an option, I wanted to make sure that I could give any inquiry the best chance possible to find out what went wrong. After about 25 minutes on the ground, the CH53 flight that had responded to our earlier mayday picked us up and gave us a lift back to Bastion.



“In our case, had we responded as conditioned, we would almost certainly have been killed or seriously injured in the resulting crash. So how and why did we deviate from the response that had been repeatedly drilled into us? Despite reflecting on this for some time, I’m afraid I don’t have a clear answer and it was probably a combination of lots of factors.”

They didn’t really know where to drop us so helpfully took us to the ATC tower where we were able to thumb a lift with SATCO back the rotary flight line.

Having checked in briefly with the ops room, which was now sharply focused on securing and recovering the aircraft, we retreated to the familiarity of the Apache High Readiness tent. As I crossed over to my flight line to check in with my Downed Aircraft Recovery Team (DART), I was struck by the precise focused activity that was going on. Equipment was lined up ready to go, weapons and dismounted close combat kit was laid out while still supporting the airborne aircraft. One of my lasting memories of that day will be how the Squadron reacted to the incident – each part knew exactly what to do and meshed perfectly with the others without any overall command present.

The initial assessment team were flown out and on the ground within two hours of the site being secured. They rapidly assessed the aircraft and informed the recovery options being worked up by the Joint Aviation Group and Regional Command (South West). As the Taliban was showing no interest (or were grossly overmatched by the USMC), the decision was made to recover the aircraft by road at first light.

The DART deployed to the aircraft the following morning meeting a combat logistics patrol that had departed by road at first light. In less than 90 minutes and wearing full combat kit, the team removed the remaining ammunition and fuel and stripped the aircraft for a road move. The aircraft was then lifted onto a trailer using a recovery vehicle and secured for the trip back to Bastion.

The recovery operation was completed and the team extracted less than three hours after arriving. This was a slick and professional operation they had never had the chance to practice in training. Just over 24 hours after the tail rotor failed, I had the aircraft back in the hanger at Bastion.

Food for thought

Looking back at the incident with the benefit of hindsight, I offer my thoughts as both an aviator and as an operational squadron commander. From an aircrew perspective, one of the most interesting

observations is a question of psychology. We devote a considerable amount of time and money into conditioning behaviour to certain responses: immediate actions are a clear example.

In our case, had we responded as conditioned, we would almost certainly have been killed or seriously injured in the resulting crash. So how and why did we deviate from the response that had been repeatedly drilled into us? Despite reflecting on this for some time, I’m afraid I don’t have a clear answer and it was probably a combination of lots of factors. Experience probably helped but Charlie and I appear to reach the same judgement but with significantly different experience levels.

In terms of emergency training, the situation was novel and to a large extent didn’t reflect the simulator modelling although refusal to accept that I couldn’t land the sim turned out to be a life saver. From a psychological perspective, a skilled response can be improved by exposure to multiple variations of the same event. This helps build a bank of possible solutions that the non-conscious mind can process rapidly. It turns out that visualisation and reflection is a powerful tool to compliment simulation; we had mentally rehearsed the evasion drill so many times that it was entirely natural to us.

I suspect that having flown the best part of 150 hours over the previous eight weeks together significantly supported our performance as a crew. Over my flying career I have always trained and deployed as a formed crew and flight (pair of aircraft). The significant increase in combat performance has always been worth the loss of flexibility. Stress was also probably an important factor. For the majority of the time that we were still flying, it felt like the induced stress improved our performance, combining with drills to give us the freedom to adapt. It is entirely possible our final departure from controlled flight was a result of stress-induced control inputs although it doesn’t seem to have interfered with flying the engine off.

The squadron’s reaction to the incident was also extremely interesting. While I had rehearsed in my mind what I would do as the squadron commander

if we lost a crew, I hadn’t considered the possibility that it might be me. One of the most telling comments was from my second in command who was in the ops room at the point the mayday came in. He rather candidly told me afterwards that one of his first panicked thoughts was, “s***, the boss is dead – that means I am in charge”. Testing the squadron’s response to loss of its commander is something that all Army officers would recognise from armoured warfare training but is not something we routinely do in aviation.

The tactical success of the recovery operation was largely due to the extremely focused way the squadron responded to the incident. Each of the individual teams responded to both the incident and routine operations in a mutually supporting way and without any central direction. They all knew what my intent was, they trusted each other and the teams acted accordingly. The technicians and ground crew were pumped at the prospect of going onto the ground and getting the aircraft back as fast as possible; they were completely aware of the risks but not phased at all.

Their response was probably due to several factors. I would highlight service culture, training expectation and strong team ethos. When training for operations, we knew that a DART was a realistic prospect or potentially austere operations. The training standard I set for the deployable teams was that they must present no more burden to force protection than any other deployed combat support arm. Being soldiers, they took to this with gusto and this undoubtedly set a high level of expectation of how they would go about the task. The speed that the aircraft was stripped in full combat gear shows just how focused they were. “Train as you fight” was my mantra through our mission specific training and I feel contributed to our robust response.

We tried wherever possible to create common procedures that would stand up both in the UK and in an operational theatre. This is often not the easiest way of doing things in the UK but is essential if you

are going to create the standards, expectations and trust that allow you to perform adaptively on operations. Uncomfortably for commanders, this may mean taking increased risk in training. While we talk about as low as reasonably practicable (ALARP)*, we regularly feel under pressure to make it as low as possible. How often do we fly in full combat body armour with weapons in the cockpit? How often do we maintain aircraft and refuel in full PPE? Normalising these tactical frictions and still achieving maximum performance is the purpose of operational training; a commander’s skill in risk management is doing it realistically but safely.

Our dominant culture has become one of identifying things that are perceived to have gone wrong and then ‘fix’ them; we seem to find it extremely difficult to apply the same rigour to learn from things that go right. Two particularly powerful cognitive biases reinforce this culture: hindsight bias and outcome bias. In the case of hindsight bias, we tend to overweight the significance of factors that affected the outcome but we couldn’t have known at the time. Outcome bias is more troublesome in the world of aviation leading us to pay far more attention to failure than success.

We must strive whenever possible to overcome both of these and identify and reinforce those factors that helped us succeed with the same vigour that we try and eliminate errors. We will know that we have matured into a successful learning organisation when we can do both.

Lots of things went right that day and turned an otherwise tragic event into one that most people will never have heard of. Rather than exclusively attempt to avoid errors, we must ruthlessly track down the causes of success and reinforce them. They are often hidden and difficult to find but taking them for granted risks failure later if those successes become eroded. By reinforcing the many things that we do right, we can genuinely build the high performance organisations we need to take risk in combat and win.



Notes:

Lieutenant Colonel Nick English commanded 654 Squadron Army Air Corps from 2012 to 2014 including a tour of Op HERRICK from September 2013 to February 2014. He has 10 years’ experience of Apache operations including four tours of Afghanistan and over 1400 hours on type. He is studying for a PhD in Cognitive and Behavioural Psychology specialising in military decision-making.

Captain Charlie Russell completed Apache conversion to role in October 2013 and was on his first operational tour with just over 500 hours on type.

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* The term so far as is reasonably practicable (SFARP) is used in the RAAF.

LIGHTNING, FUMES AND CRM

My introduction to captaincy

By FLTLT Russell Adams

I was captaining my sixth flight as an AP-3C non-maritime captain (NMC) on 18 August 2013. This qualification allows you to transit the aircraft from A to B without being tasked for any missions that a maritime captain would fly.

We had been deployed as a crew to RMAF Butterworth for OP Gateway for two weeks, and were all ready to get home. As the crew's co-pilot with an NMC qualification, I was given the task to captain the transit home. The aircraft had been sporadically serviceable over the two weeks, and was signed up as serviceable for the 10-hour transit from Butterworth to Edinburgh.

When signing for the aircraft, an avionics cooling fan in the flight station had been CFU'd for the flight, and although I had not seen this done before, I consulted with my flight engineers who advised it would not be a significant issue. We also had only one of the two VHF radios available for use as the other had been signed up as intermittent; however, we were keen to get home and I trusted the professional ground crew's assessment of technical airworthiness.

We departed normally, and about 90 minutes into the flight we visually identified some dark, towering cumulonimbus clouds that appeared to be along our track. We asked the radar operator to scan the weather and assess how significant it appeared to be, which would influence our decision to fly through it or not.

In the flight station we were not aware that the radar operator had briefly vacated their seat for a bathroom break. Another operator leaned over, looked at the screen and advised that the weather was 'nil sig'.

What the temporary radar operator was not aware of was that

the aircraft was shortly about to make a 45 degree left turn, and instead of looking along track had only scanned directly ahead of the aircraft for 40 to 60 nm.

We continued along the planned flight route, and as we approached the cloud immediately doubted the veracity of the radar operator's assessment of nil sig. We attempted to contact Lumpur Control on VHF to organise a diversion; however, could not contact them. Over a period of five minutes we were unable to contact ATC, and as such entered the weather.

If we had had two serviceable VHF radios we would have tried VHF2 to contact ATC; however, with the radio unserviceable we had no way to directly contact Lumpur, and indeed it may have been electrical interference from the weather reducing radio range in a notoriously poor communications region.

As captain I advised the crew to secure loose belongings and strap in to their seats, but not enough warning was given. We entered the weather and encountered light turbulence before suddenly being subject to a downdraft resulting in a -0.4G descent, then coming through the other side and bottoming out with a 2.0G updraft. The TACCO who had been ensuring all the crew were strapped in had hit the roof of the aircraft in the galley.

After a minute or so we encountered significant icing, but with the P3 being designed for arctic operations to chase Soviet submarines, I was not too concerned and the flight engineer automatically activated most of anti- and de-icing systems available on the aircraft. However, the spare flight engineer who was located at an aft observer station reported that we had been struck by lightning on the wingtips

“Later on that evening, after the adrenaline had worn off, we took stock of our actions and I realised that there were many things I would have done differently if presented with the same situation.”



at least twice. At this stage I decided to divert off the air route and we eventually broke clear of the weather about three minutes after entering it.

We regained communications with ATC and advised them of the diversion from track, and received the appropriate clearance to operate as we needed.

A systems check was done and the flight engineers examined the aircraft to the best of their ability. We determined no serious damage or overstress had occurred. While we were deciding how best to proceed, I noticed a faint hot smell in the flight station. I was not sure of myself, as the P3 tends to produce a lot of different smells and sounds at times, and did not say anything. About one minute later I smelt it again, stronger this time, and asked other flight station members if they noticed anything unusual. The co-pilot said that they too noticed a sharp, metallic hot smell.

We initiated the Fumes of Unknown Origin Checklist, and donned the oxygen masks.

Our nearest divert at the time was Paya Lebur airfield in Singapore; however, being a military field it was closed on Sundays, so the next best was Changi International. I declared an emergency and requested radar vectors for Changi, which was approximately 80 nm away. I was fully aware that this is

one of the world's busiest airports, and a stricken P3 could affect their usually slick flow of RPT airliners.

At the start of the descent the flight engineer moved the power levers back to idle, and he noticed the shaft horsepower gauge on number 2 engine had not moved from about 3500 hp, when it should be indicating close to zero with the power lever at idle. I did not notice any asymmetric thrust indications through the flight controls, so we believed that the gauge had failed.

Approaching Changi we were above our maximum landing weight, so we requested an area to hold to dump fuel. At this stage in the Fumes of Unknown Origin Checklist we had secured power to Main AC Electrical Bus A, which supplied power to a range of mission essential and duplicate flight systems, though nothing that is essential for normal flight and landing.

Part of the fuel-dump checklist calls for most of the RF transmitting equipment on the aircraft to be powered down to minimise the risk of electrical interference causing an ignition source while thousands of pounds of vapourised fuel are being dumped from the aircraft. As such, we advised ATC that we would be turning off our transponder and unable to respond to ATC radio calls unless in an

emergency for approximately five to 10 minutes, calculated from the nominal 1000 lb/minute dump rate the flight manual specified and the 6000 lbs of fuel we had to dump.

About three to four minutes into the fuel dump, we assessed that we were only meeting a dump rate of 300 lbs a minute, less than one third what would be expected. We realised that in securing Main AC Bus A, we had removed electrical power to two of the three pumps that the system used to dump fuel. Based on the perceived time-critical nature of getting the aircraft back on the ground, we decided to pull the circuit breakers to all the non-essential equipment on Bus A except for the fuel-dump pumps, and then reenergise the electrical bus, thus allowing us to increase our rate of fuel dump and minimise the time until we could land.

After this decision had been communicated to the spare flight engineer, we suddenly lost a variety of attitude sources, and saw a lot of red indications on the Electronic Flight Information System. I broadcast over the PA to the engineer to 'undo whatever you just did'. In the heat of the moment they had accidentally pulled power to one of the Essential AC Bus CBs that powered a majority of the avionics for the flight station.

By the time we had resolved the situation we assessed that whatever dump rate we were getting would have to do, and that to land over the maximum recommended landing weight was not as big an issue as accidentally getting ourselves in trouble pulling circuit breakers, of which the Orion has many hundreds.

About 15 minutes after we had started the fuel dump we were finished, and contacted ATC requesting radar vectors for the ILS to the active runway. They acknowledged our request, and gave us a vector which we followed. They passed us a second adjustment heading, which we read back then turned on to. They repeated the vector, to which we repeated the readback. We then were given a vector, to intercept the localiser, after which we heard that we were "Observed following radar vectors; however, no readback is being heard. If you acknowledge, please squawk ident (on the transponder)." They advised that they saw our transponder ident flash up on their ATC screen, so they knew we could hear them, but they could not hear us. We continued on the approach, squawking ident in response to any ATC instruction.

When we were transferred to tower frequency they cleared us to land, and we read back the clearance, not expecting them to hear it. They advised that they had heard the readback,

indicating that the single radio we had had somehow, again, returned to serviceability. We landed the aircraft approximately 200 lb below the maximum landing weight, taxied to the nearest available gate away from the terminal where we were met by emergency services.

After shutting down we paused and took stock of the situation. Luckily nobody on board the aircraft was injured from the turbulence; however, two of the crew were diagnosed with having carbon monoxide exposure symptoms and were treated by the professional medical team at Changi Airport.

The number 2 engine horsepower gauge had failed, and the serviceable VHF radio appeared to be intermittently working. There were several small holes in the wingtip where the lightning has struck, and a few static discharge wicks had been blown from the wings. Apart from that, everyone was safe and the aircraft was mostly fine.

We later determined that the inoperative avionics cooling fan had allowed the horsepower gauge to overheat, which was the probable cause of the fumes in the flight station.

Later on that evening, after the adrenaline had worn off, we took stock of our actions and I realised there were many things I would have done differently if presented with the same situation.

Firstly, the decision to accept the aircraft without the avionics cooling fan and only one serviceable VHF radio for a 10-hour international transit came back to bite us in this instance. Though with an ageing aircraft it was increasingly common to accept minor unserviceabilities in order to get the mission done. Knowing the difficulties it caused us on that day, I would seriously reconsider this acceptance if tasked with the same transit.

Secondly, the decision to enter cloud that visually looked dangerous because we were unable to arrange a diversion from ATC. If given the chance again, I would have diverted off track without clearance and transmit our intentions on the area frequency, using the radar operator to scan for any potentially conflicting traffic. Putting the aircraft into a dangerous environmental situation based on not being able to get

ATC approval to divert is a case of not avoiding the most immediate threat while focussing on an overall less important perceived restriction.

Thirdly, the eventual source of the fumes was an overall innocuous gauge failure, unrelated to the lightning strike. In isolation this could have been resolved more efficiently, and indeed the aircraft is more than capable of continuing all day with three of the four (SHP, Turbine Inlet Temp, RPM and fuel flow) engine instruments functioning normally. However, based on the previous environmental conditions and lightning strike I preconceived that the situation was worse than it probably was, and didn't quite acknowledge that the SHP gauge was the source of the fumes. I understand that I was operating close to my maximum capacity managing multiple checklists an incredibly busy ATC environment while wearing a restrictive oxygen mask. Had I taken 30 seconds to take stock of the situation, I may have realised that the situation was not nearly as time critical as I thought.

Finally, the decision to dump fuel delaying the landing in what I thought was close to a land as soon as possible scenario. The Orion has a maximum landing weight of 114,000 lbs, and a maximum recommended landing weight of 104,000 lbs. However, if you feel the aircraft needs to land NOW, these weights are irrelevant as an engineering inspection can inspect any damage as a result of an overweight landing. Better to slightly overstress the landing gear than stay airborne with the crew and aircraft in danger during a dynamic and unknown situation.

These were the four big lessons I took from the flight personally. I discussed the miscommunications with the radar operator's assessment of weather, or the flight engineers identification of the wrong circuit breaker; however, these were minor human errors that had minimal impact on the overall outcome. As captain the responsibility remains yours to ensure that your intentions have been properly communicated to your crew and that they fully understand exactly what they are doing, and why they are doing it.

Note: This article was submitted through DDAAFS Aviation Safety Officer (ASO) training and published with permission.



AIRBORNE

Author's name supplied

Those of us directly involved in aviation on some level can understand the potential hazards surrounding flight-control restrictions and regardless of whether the controls are only partially restricted, or completely unresponsive, the thought is equally as terrifying.

This is a personal story of luck, where the possible ramifications didn't completely sink in until a few days after the event. At the time I was an Air Mobility Group pilot with just shy of five years' experience, and several years of private flying prior to joining the ADF.

The final leg of a long trip, both the co-pilot and myself were eager to get home and see our better halves. I gave the leg to the co-pilot, meaning he was directly in control of the aircraft. If something went wrong it would have taken longer for me to gain control of the aircraft.

Throughout the flight there was nothing to alert us there was a potential we may not walk through our respective front doors that afternoon.

Nothing was abnormal, I remember it being quite a nice day; I don't distinctly remember the landing which probably meant the co-pilot had a good one. After we parked and shutdown, the co-pilot left the aircraft first and I followed him after a few minutes. As I stepped onto the aircraft's door I stopped.

To this day I cannot find an explanation for what I did next – I had never done an inspection of the aircraft's tail from the door before. What I found still sends chills down my spine today.

Hanging from the front of the horizontal stabiliser was the finger-thick high frequency (HF) radio antenna cable. Normally the cable is attached in three places to the airframe. One halfway down the roof just above the door, another on the roof at the base of the tail and the other is on the front of the vertical fin just below the horizontal stabiliser. The front fuselage mount had disconnected at some point during the four-hour flight, resulting in a four-

and UNAWARE

meter-long segment of wire being able to freely move within a few inches of the rudder, elevator and elevator trim tab.

At the time I thought, 'that's interesting' and even called the technicians over to have a look; one smiled and the other looked shocked. I took some photos, finished the paperwork and walked away like I had at the end of every other trip.

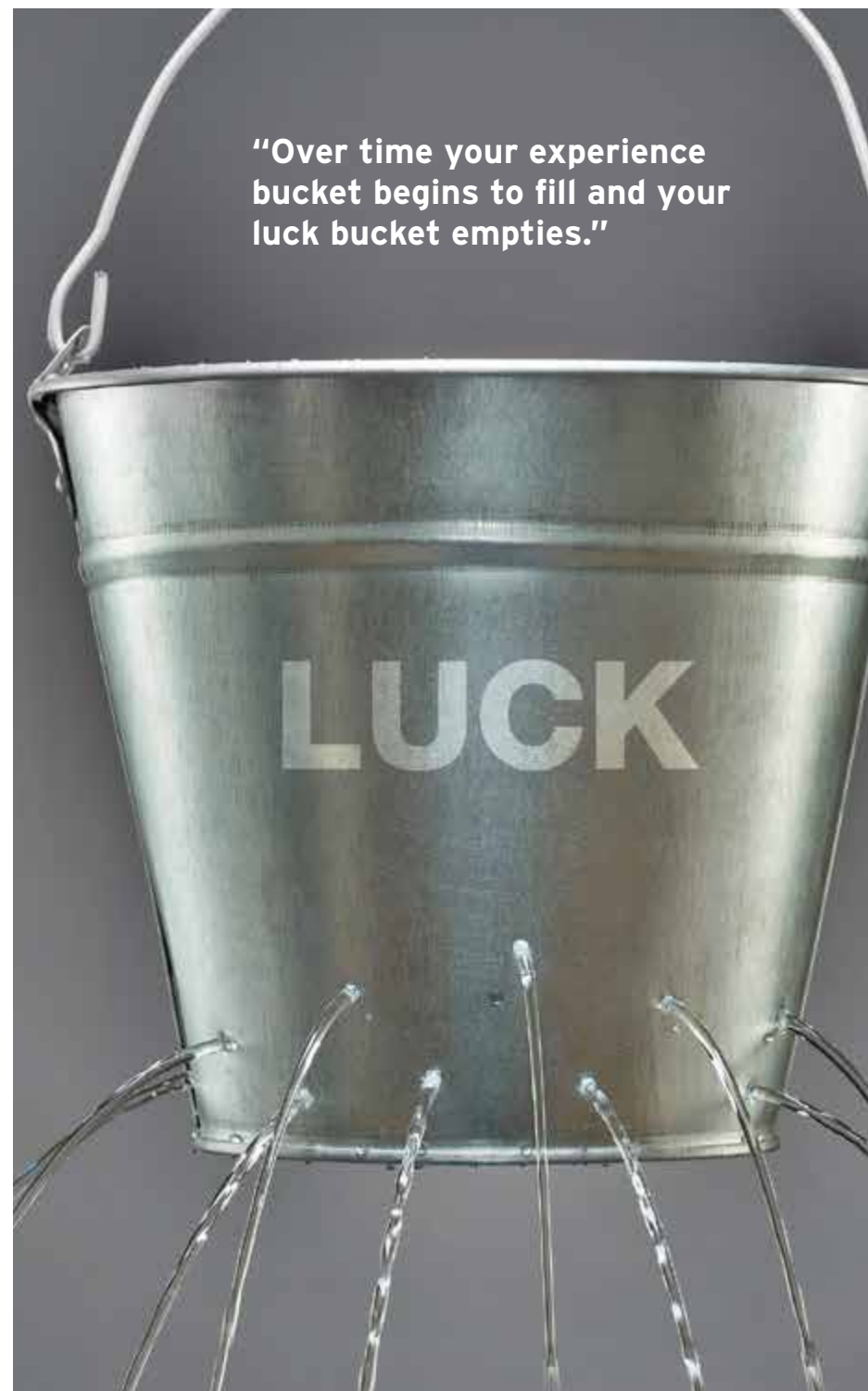
The next day in the office I showed the photos to a very senior pilot at the unit. His reactions still resonates with me and I still remember his words like they were spoken yesterday. "Mate, at lunch go and buy yourself a lotto ticket. Do you realise how lucky you are?"

At the time the answer was no. It took some time and my involvement in another incident involving a fuel leak that my mindset changed. How many times had I walked away when others may not have? How many of my close friends who had been killed in aviation accidents just ran out of luck? When looking at accident causation models such as the Reason Model, where does luck come into it? To this day I am convinced it was nothing but luck that kept the HF cable from wedging itself in the flight controls.

There is a saying most old pilots know – some of you may have heard it – in your aviation career you have two buckets, one is for luck and the other is for experience. When you start your career your bucket of luck is full, your experience bucket is empty. Over time your experience bucket begins to fill and your luck bucket empties. Since I began my flying career my experience bucket has been filling; however, how much of my luck bucket have I emptied?

It has been several years since this incident, and I am now part of the ADF's pilot training system. On a daily basis I see fresh-faced candidates doing their best to learn the art of flying, some doing better than others. After the experiences I have had – the good and the bad – I see it as a necessity to pass on as much as I can to the new generation of pilots so they can avoid using the contents from their bucket of luck.

Note: This article was submitted through DDAAFS Aviation Safety Officer (ASO) training and published with permission.



"Over time your experience bucket begins to fill and your luck bucket empties."

EXPERIENCE

Only one aircraft required for an aviation tragedy

By WGCDR Michael Duyvene de Wit

Operating in a resource-constrained environment sees many military aviation support services faced with the reality of needing to do more with less. This has resulted in organisations utilising the rate of effort, specifically the number of aircraft or aircraft moves operating in a particular piece of airspace or at an aerodrome, as the metric for managing their resources.

It seems a common practice nowadays that capability managers will look to predicted lulls in flying to take essential equipment offline for servicing or to run lean rosters without supervisors in order to accommodate breaks and secondary duties. However, it only takes one aircraft to be involved in a serious incident and that rate of effort when viewed in isolation, can often be misleading in terms of the resultant consequences.

Throughout history there have been many occurrences where the consequences were vastly disproportional to the perceived rate of effort. One such example was the Überlingen mid-air collision. In July 2002, a Tupolev Tu-154 passenger jet with 69 people on board collided with a Boeing 757 cargo jet with a crew of two,

over Überlingen in southern Germany, killing all personnel on board both aircraft. This included 45 Russian school children.

One key point from this scenario was that these two call signs were pretty much the only two aircraft in the airspace at the time. This anticipated rate of effort was a contributing factor in that only one controller was on console, performing multiple roles in a combined configuration and that several important warning systems were offline for maintenance. This included the main radar image processor and communications lines with other control organisations who at the time, were aware of the pending collision but were unable to raise the alarm with the duty controller.

A second point is that this methodology of using rate of effort as a sole metric for planning is a common practice within our own organisation.

There is a real concern that the scenario that played out in Germany could be easily replicated in Australian airspace as the pressures of working with finite resources often ask for control and maintenance managers to push the boundaries of acceptable risk in order to meet tactical obligations.

There needs to be a full appreciation of the consequences at all levels of command and good fortune, as opposed

to good management, should not be used as a precedent when evaluating risk. In other words, just because we got away with something in the past, does not deem it acceptable practice for future operations.

For Defence risk management, the shift in mindset from as low as reasonably practicable, to so far as is reasonably practicable supports this concept.

We need to look beyond just the rate of effort and develop a thorough understanding of the nature of operations through a holistic approach to mission evaluation, so as to achieve the best resource to task allocation.

So where only one aircraft may prompt a reduction in services, a skeleton crew operating limited systems with nil redundancy is a recipe for disaster. Only one aircraft is required for an aviation tragedy to occur.

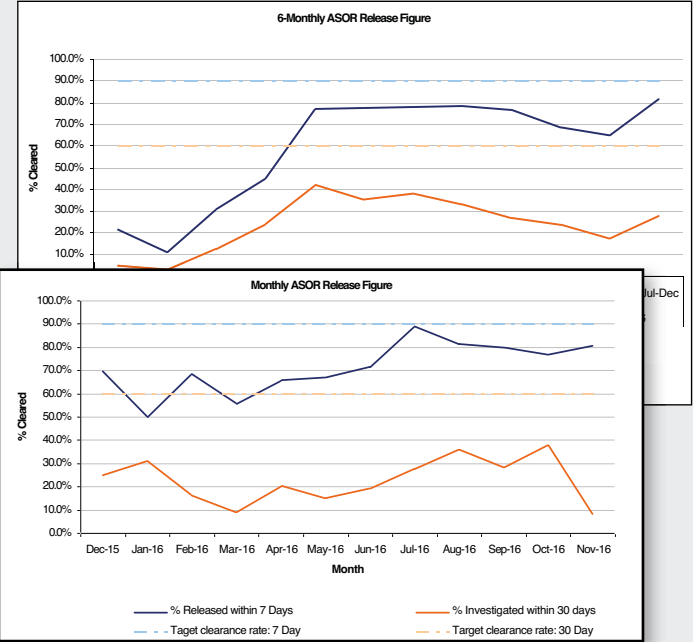
Note: This article was submitted through DDAAFS Aviation Safety Officer (ASO) training and published with permission.



ASOR Release Figures 7 & 30 Day Release Figures

The DDAAFS Safety Data Analysis and Exchange team has created a new spreadsheet to assist in the monitoring of seven- and 30-day ASOR release figures. The spreadsheet is accessible via the DDAAFS homepage by selecting the 'ASOR Release Figures' button on the right-hand side.

The spreadsheet itself does not contain any data. But by running the 'Released via DISCON' report through DAHRTS, you can input your data into the spreadsheet and simply refresh to display release figures by month or six monthly blocks. The spreadsheet also has some interactive capability, whereby you can change your release figure 'target' and filter by unit (if you wish to compare multiple units in your Wing/FEG).



Wildlife hazard management for a moving airfield

By WO2 David Ferguson
(HMAS Canberra)



In November 2016, I was invited to present at the Australian Aviation Wildlife Hazard Group (AAWHG) annual forum about Wildlife Hazard Management for a Moving Airfield. This is regarded as the first of its kind in Australia and relates to managing wildlife risk for air operations on the RAN's new Landing Helicopter Docks (LHDs).

The AAWHG is an Australian-based group of aviation industry leaders who work together to reduce the risk of

wildlife strikes to aircraft. The forum brings together representatives from Civil Aviation Safety Authority (CASA), Australian Transport Safety Bureau (ATSB), biologists, ornithologists as well as airports, airlines, Defence and industry specialists in risk mitigation. The key note speaker was Richard A Dolbeer, who was the principal wildlife consultant for the National Transport Safety Bureau (NTSB) in its investigation into the *Miracle on the Hudson* now the subject of the motion picture *Sully*.

So how did I come to be presenting at this forum? How did an Army aircraft

technician find himself writing a wildlife hazard management plan (WHMP) for an LHD. In order to answer that question it is probably best to start at the beginning.

About five years ago I met my partner, an inspirational and talented woman who is a renowned expert in the field of aviation wildlife hazard management. Her enthusiasm and passion was somewhat infectious and over time my passing interest started to develop from a hobby for want of a better word, into a personal mission.

Early on, it became apparent that

in Defence aviation there is little or no real understanding and appreciation of wildlife hazard management at the lower rank level. The groundcrew, the maintainers and to some extent even the aircrew. There is virtually no awareness and no training on the subject. I felt that something should be done. It was time to spread the gospel of wildlife hazard management to my peers.

In November 2012 I accompanied my partner to the AAWHG forum being held at the Australian Museum in Sydney. The Commanding Officer,

1st Aviation Regiment authorised the unit to fund my registration costs for the forum. In return I was to report back and provide a presentation to the regiment as a first step to raising awareness of the risk of bird strikes to our aircraft. This investment in me and the positive feedback on my presentation encouraged me to continue further with my new mission.

The next opportunity to attend the forum came in 2015 and the Air Division Commander, HMAS Canberra ensured the unit funded the registration cost and in return delivered a presentation

to the ship's air department to raise awareness. However, during the forum as I listened to numerous speakers talking about their WHMP for their aerodrome I had a lightbulb moment.

HMAS Canberra is essentially an aerodrome, so why don't we have a WHMP? Defence Aviation Safety Regulations (DASRs) state that all Defence airfields are to have a WHMP in place. I put this question to my commander on my return and he agreed, that we needed one too, especially as we had already experienced some issues. There were two ways to proceed; engage an industry specialist or I try to write one myself using the WHMP template on the AAWHG website. We went with second option and it became my side project for the next 12 months, while I continued to exercise my primary role as quality manager on HMAS Canberra.

If I am honest, I suddenly had this overwhelming feeling I was biting off more than I can chew. If WHMPs at airports are developed and managed by experts, who was I to write one on an airfield, let alone the fact that this airfield moves. Some of the challenges I had to consider included, support from command, and will this WHMP continue to be used after I depart and I only have five weeks left on the ship. Will the flight deck team who are relatively new to aviation take on board the requirements of the plan and ensure it is implemented correctly. Would I get same level of enthusiasm from our sister ship, noting this WHMP was developed for both ship's.

We currently operate a moveable 10-hour flying window in a given 24-hour period. We operate different aircraft doing different roles conducting operations such as vertical replenishment (VERTREP), casualty and civilian evacuation, troop carrying and anti-submarine warfare (ASW). As you can appreciate we plan flying as much as possible but of course as is the nature of our business, there are

“Aviation is not the only type of operation the ship conducts that has to contend with wildlife hazards. The well dock has ongoing issues with sea snakes and jelly fish and we have even had a turtle.”

also unplanned flying ops, when we are reacting to a threat, conducting boarding parties, or emergency evacuation to or from the ship.

So how do you write a plan for an airfield that is located in Bass Strait one day and four days later is loading troops and equipment in Townsville for departure to Fiji to provide humanitarian assistance. Having said all that there are a couple of advantages. Noting the attraction to the ship is the ship itself, as somewhere to perch in the open sea, there is nothing then we can do change that. Unlike conventional aerodromes, we don't have to worry about grass height, fruit trees, fencing or other ground wildlife. We only deal with birds.

Our principle area of responsibility is Australian Eastern Seaboard and the wider Asia Pacific Region. When considering the development of the WHMP, it was necessary to consider our area of operations but in particular with a view to maintaining simplicity I identified four principle areas of operations; Garden Island Sydney, Jervis Bay, Townsville and in the near future Shoalwater Bay. However, in reality we can be called upon to operate anywhere in the world.

We have already deployed to Fiji and this year took part in the Rim of the Pacific Exercise (RIMPAC) in Hawaii, the largest ever seaborne exercise. I also had to factor in our operating environments as different species of birds operate in different marine environments, including alongside, in a sheltered bay or harbour area, and on the open ocean.

To write a plan that was then broken down into every place we operate was unrealistic and too difficult to manage, so I employed the age old military philosophy of keep it simple stupid (KISS). Having looked at various sources of information it became apparent that a high percentage of Australian sea/coastal birds live all the way up and down the coast, with a couple of exceptions. Therefore in general terms the risk remained the same for the same species irrespective of whether we were in Jervis Bay or Townsville.

At anchor in a bay close to shore, the ship doesn't provide as much of an

attraction, more something that just happens to be in its way; and over the past 12 months in a variety of locations, little activity has been observed. At sea, however, activity is more common and more concerning. There seems to be two common types of behaviour; perching for a breather or just curiosity and soaring on the updraft of the bow of the ship. The theory I am working on, which was supported by ornithologists at the forum, is the ship's movement through the water is sending any fish in its path scattering out of their way. This sudden movement in the water is easier for birds to visually pick up on.

Having established which birds were active in our area of operations, the next step was to compile a risk ranking using the Paton risk-analysis method. This tool accounts for bird behaviour and size with a point score annotated against each component. The higher the point score, the higher the risk. At the high risk end of the spectrum were pelicans, boobies and albatross – larger birds who tend to glide and soar with slower and more predictable flight characteristics. At the other end of the spectrum were the smaller birds such as gulls and terns, who are a lot lighter in weight but more agile and dynamic in flight.

In my forum presentation I highlighted a couple of issues we were already mindful of and where the WHMP would come into its own. The first is a significant issue we have alongside in Sydney with Sulphur Crested Cockatoos. They actually pose minimal risk to aircraft because we generally do not conduct flying operations alongside. Our issue is their taste for the sensors and antenna situated on the superstructure. Most notably they like chewing on the anemometers made of a hardened plastic. The anemometers provide wind-speed data direct to flight control room (FLYCO) and the bridge. This data is crucial in monitoring ships helicopter operating limits (SHOLs).

One challenge that this particular WHMP is difficult to capture is managing the risk when the ship operates outside its normal area of operations. This became apparent on our return from Hawaii this year. After a stopover in Fiji, for about five days while we transited back to Townsville, we had a particular

species of bird operating around the ship. I headed to the bridge and began filming with my smart phone but despite video footage and photos, I was struggling to identify the species and the numbers were increasing. Outside help was sought and they were confirmed as Masked Boobies, quite common in the area. They were flying to the forward port side of the ship and cutting across the front of the flight deck and repeating their behaviour on the starboard side before cutting back across and this went on for hours.

Due to technical issues with the aircraft we weren't flying, so we couldn't test our new procedures. Worryingly there was still a lot of activity occurring on the flight deck with vehicles being cleaned, as well as weapons training and PT lessons being conducted and they seemed not to be phased by it.

So now we have identified the risk how do we manage it? Counts will be conducted before flying operations. Yes it is restrictive; however, our 10-hour flying window can move every day to a different start time, we only have enough manpower to man one shift and our fatigue-management policy means we are not in a position to work anyone past 14 hours in one day at sea. Surveillance for other bird activity in particular roosting, is conducted during preps for flying as part of a FOD walk where every upper deck is checked for FOD.

When it comes to dealing with birds during flying operations, a number of techniques are available to flight deck personnel including:

- arm waving and shouting,
- tow motor horn and lights,
- aircraft director whistle blast
- ship's whistle,
- FOD walks,
- pre-launch clearance checks, and
- water hose – 38 mm.

We do also have 100 rounds of BirdFrite Mk 2 in one of our magazines but there is no evidence of any procedure or properly trained aviation personnel. At this stage I am not expecting the ship to pursue this as an active management response.

Noting the plan is brand new and currently going through the approval process the next step will be implementing it. In particular there will be an initial

training requirement and ongoing rigid training plan. The training will cover the conduct of counts, what to look for, bird identification, biohazards and the reporting process. Aviation safety officers on board will take ownership of the plan and will become responsible for its management and periodic review.

Aviation is not the only type of operation the ship conducts that has to contend with wildlife hazards. The well dock has ongoing issues with sea snakes and jelly fish and we have even had a turtle. So the well-dock operators have already expressed an interest in my plan with a view to perhaps creating their own, or incorporating the well dock into this one.

The response I received from other participants at the forum following my presentation was extremely encouraging and greatly appreciated. The support I received from my partner and my command team from two different units on my mission was invaluable and where I have a great sense of pride and achievement in developing the only WHMP in Australia for a ship, my hope now is this important flight safety issue is provided greater attention in Defence aviation at all rank levels. Let us bear in mind, our aircraft numbers and operations are increasing, and so are bird populations.





The importance of workplace inductions

By FSGT Russ Saint

An important safety lesson can be learnt by reflecting on an incident that happened in the mid 1990s. At the time safety was undergoing a transformation in Air Force, following several aviation accidents. People were becoming more safety aware but the safety culture still had a long way to go. The incident provides a good example of why training and education, communication, culture and risk management are important elements of aviation safety – and workplace induction is key in getting the safety message across to visitors and new employees.

Oxygen-toolkit cleaning

Periodically, 492SQN flight-line personnel would walk oxygen toolkits over to the avionics workshop for cleaning in the ultrasonic cleaner. They would often inform the oxy workshop personnel when they arrived and then let themselves into the back room where the ultrasonic was located. “No worries just help yourself mate” would usually be the response.

This incident occurred when the workshops was comprised of uniformed maintainers, who were often known to each other. Oxy-toolkit cleaning was typically assigned to the junior troops, many of whom had workshop experience before being posted to the flight line.

On this occasion, two leading aircraftsmen were tasked with cleaning the oxy toolkit. The oxy workshop personnel were not

around at the time so they let themselves into the back room and removed the tools from the toolkit. Having seen the task performed once before, they knew the ultrasonic cleaner had a wire basket – just like a fish-and-chip fryer, the tools were placed in the basket before being lowered into the Freon (Trichlorotrifluoroethane solvent*). Unfortunately, they could not locate the cleaning basket, so just dropped the tools into the Freon bath, replaced the lid and turned on the ultrasonic. After a period of time, the ultrasonic was turned off and the lid opened.

The incident

The two leading aircraftsmen now faced the problem of recovering the tools from the Freon bath without the basket. The ultrasonic cleaner was around waist height and the tools were under about 300 mm of Freon solvent. Some personal protective equipment (PPE) was located nearby, so being safety conscious, one of the troops donned some long gloves, a face shield and respirator. He then proceeded to hang headfirst over the side into the ultrasonic to recover the tools.

After 30 seconds or so headfirst in the ultrasonic, most of the tools had been fished out. At that point, to the surprise of his mate, the technician who had his head in the ultrasonic passed out on the floor. His offsider immediately went for help. When a few of us from the oxygen workshop arrived on the scene, the leading aircraftsman had regained consciousness, but was still groggy and confused. We sent him to medical for observation, where he was released without any ill effects a short time later.

What went wrong?

Workplace induction. The first issue was that flight line personnel were not given a proper workshop induction. There was often an assumption that people knew what they were doing as they may have worked somewhere in the building before. As is the case today under contract maintenance, the toolkit should have been placed unserviceable and then cleaned by technicians trained in the use of the ultrasonic. People should not be able to just wander in and help themselves without escort, safety induction and training on the equipment they are using.

PPE. Although it was encouraging that the visiting troops attempted to use the available PPE they had found, it was in fact inappropriate for the task. Freon is a toxic ozone-depleting substance, especially once vaporised and in a confined area like inside the ultrasonic. Freon essentially removes the oxygen from the air. The respirator was ineffective because there was insufficient oxygen in the air to breath when dangling over the side of the ultrasonic.

TRICHLOROTRIFLUOROETHANE MIL-C-81302

* Trichlorotrifluoroethane solvent (also known as Freon – discontinued in the ADF) is an ozone-depleting substance that will displace oxygen in enclosed quarters. Positive pressure respirators must be used in situations where air may be replaced by vapours. Overexposure to high vapour levels may result in central nervous system depression with breathing difficulties, cardiac arrhythmias and unconsciousness.

Sources:

ChemAlert – <http://dsmachem.defence.gov.au/chemalert/>

Mach-Dynamics technical data sheet –
http://www.mach-dynamics.com.au/Technical_Data_Sheets/Coatings/tds_MIL-C-81302.pdf

Other contributing factors. Aside from the lack of workplace induction, inappropriate PPE and the incorrect use of the ultrasonic cleaner, several other contributing factors were present. There may have been perceived pressure on the troops to do the job. Their ‘can-do’ attitude may have influenced the decision to push on without asking for help. The technician who passed out due to lack of oxygen was lucky not to be by himself. The consequence may have been fatal if he had passed out head first in the ultrasonic alone. This hazard had not been previously identified; therefore, could not be assessed and managed. It is unlikely that an OHS/WHIS incident report or ASOR was raised at the time.

Evolution of safety culture

Reflection on this incident has provided an opportunity to appreciate how far the safety culture in Air Force aviation has evolved since the 1990s. Although incidents still occur, our people have a much better understanding of the need to control hazards and brief people new to the workplace.

Whatever the safety management system, the aim is always to prevent harm and maintain capability. For visitors this starts with a workplace induction. Procedures must be followed and where PPE is prescribed, it must be appropriate to the task. As identified, a respirator used in a low-oxygen environment without an external air supply is clearly not effective. Never underestimate the importance of training and education, communication, culture and risk management in aviation safety.

Note: This article was submitted through DDAAFS Aviation Safety Officer (ASO) training and published with permission.

FOD control starts with you

Who is responsible for foreign object control in your unit? The answer to that question is easy... the unit foreign object awareness representative. Right?

By CPOATV Geoff Goodwin

When I first arrived at 805 Squadron I noticed the warrant officer (WO) standing in the middle of the hangar, quietly watching the maintainers walking back and forth going about their business. The look of disappointment on his face was obvious as he moved to pick up the piece of lockwire that had been seen and ignored by at least a half dozen people.

The now quite irate warrant officer then “briefed” the transgressors on their responsibilities and walked away shaking his head. At the time I remember wondering why it was such a big deal. It is just a simple piece of lockwire. But if you consider the potential problems that that this little blighter can cause, the warrant officer had every right to be disappointed. Foreign objects, aka FOD, come in many shapes and sizes. They include such varied objects as:

- loose bits of lockwire, rags, nuts, bolts and washers;
- plastic bags, packing foam and boxes;
- loose documentation;

- uncontrolled tools and consumables;
- rocks, insect carcasses and vegetable matter; et cetera.

Foreign objects are defined as “any item, material, substance or other object that is left, or gains access to, either deliberately or inadvertently, any part of an aircraft, aeronautical product, or ground-based technical equipment, which could cause damage to, or present a potential hazard to serviceability and safety”.

FOD control is one drummed into all of us from the first day we began training in the aviation environment. Whether you are aircrew or maintenance, it is an important facet of the safe operation of aircraft.

There are many documented reports detailing aircraft incidents and accidents caused by FOD. One of the more infamous incidents was that of Concorde F-BTSC, operated by Air France, which in January 2000 ran over a strip of metal on the runway just before rotation, shredding the LH main landing gear tyre, which in turn penetrated and ruptured the main fuel tank resulting in a major fire and caused the aircraft to crash resulting in the loss of 104 lives.

When I first wrote about the issue of FOD, in 2007, the previous 12 months had seen 20 ASORs involving FOD-related incidents in the Fleet Air Arm alone. And FOD issues continue to be a problem today.

Since 2010 there have been 226 Navy FOD-related ASORs raised in DAHRTS. The average is between 20 and 30 each year, with highs of 40 in both 2010 and 2012. One serious incident occurred in 2012 that saw a tail drive shaft protective cover sucked into the environmental cooling system during the after-start checks. (See page 33.)

But FOD isn't an issue at your unit is it? You all do a FOD walk on the flight line every Monday and display the bag of goodies you find in a prominent location. Everyone who passes admires their unit's FOD-control abilities and feels confident that they are relatively FOD free.

When was the last time you did a FOD walk inside the hangar, or around the hangar environs and workshops?

You may or may not have seen the front cover of the Royal Navy flight safety magazine (*Cockpit* issue No. 191 Winter 2007/08) where a group of personnel independent of a RN squadron conducted a FOD walk immediately after the squadron had conducted their FOD walk.

The amount of foreign objects that were found was staggering to say the least, with the front cover of the magazine adorned with the photo layout of what had been found. Recently the FAEU (now AMS) inspectors visited all our squadrons and conducted walkthroughs with a similar agenda to our RN counterparts with the results shown in the pictures on the right.

Would you consider this amount of FOD to be acceptable at your unit? Given that two of the squadrons had just completed cleaning stations and all four were previously informed of FAEU's actions, these pictures seem to indicate that our FOD control isn't really up to scratch.

While it would be virtually impossible to eliminate FOD entirely, a marked reduction of FOD in the workplace can be achieved by taking simple measures such as, but not limited to:

- cleaning your immediate work area on completion of the task,
- not using the tow motor glove box as a bin,
- using a “FOD tin” and emptying it when you are finished the job,
- not carrying loose objects in your pockets,
- using correct tool control procedures,
- disposing of rubbish in the appropriate bin and keeping lids on those bins, and
- checking your boots for trapped FOD on entry to the maintenance areas.

Now that we are further enlightened, I repeat the original question.

Who is responsible for foreign object control in your unit? I think YOU know the answer.

Note: This article was submitted through DDAAFS Aviation Safety Officer (ASO) training and published with permission. A version was previously published in *Touchdown* Magazine.

Squadron A



Squadron B

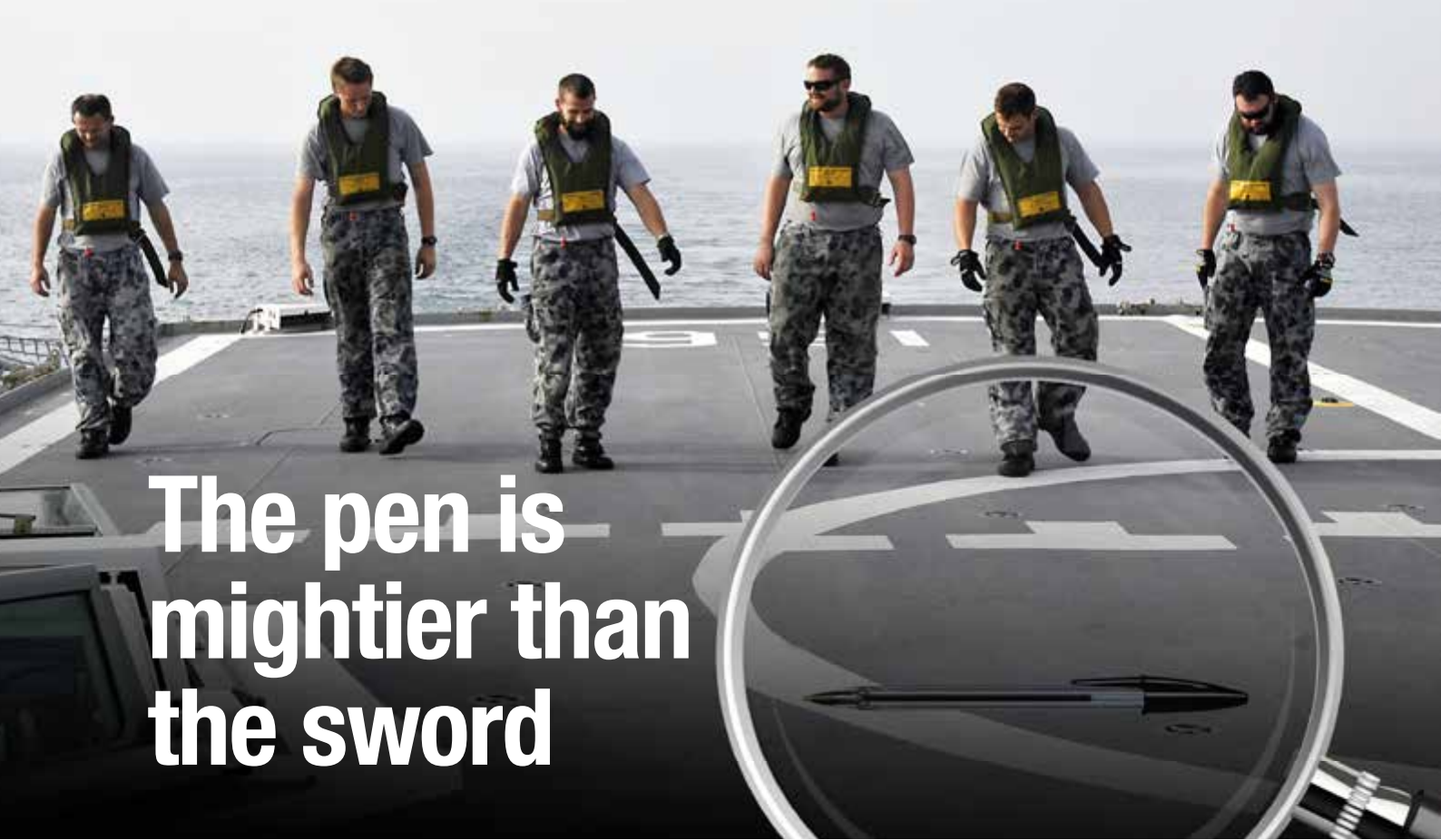


Squadron C



Squadron D





The pen is mightier than the sword

By LCDR Nathan Reid

‘The pen is mightier than the sword’ was a phrase coined by Edward Bulwer-Lytton in his 1839 play *Richelieu; Or the Conspiracy*. Little did he suspect that in the 21st century a literal pen could potentially take down a weapon of war.

The issue at hand is foreign object control (FOC) of items that could potentially become foreign object debris/damage (FOD) in military aircraft. Three ASORs relating to pens as FOD in four months at 816 SQN prompted a look at these very useful and seemingly innocuous devices.

Firstly, some definitions are required:

A **critical area** in an aircraft or engine is an area where a foreign object could migrate to and cause damage, malfunction or deterioration of the system.

Potential foreign objects can be substances or items that are not part of the system design that have potential to invade the system but have not, as yet, caused damage. Such items could include buttons, coins, jewellery, lost or unaccounted tools, packaging material, hardware, or pens.

Foreign object damage is any damage attributed to a foreign object (that is, any object that is not part of the vehicle) that can be expressed in physical or economic terms and may or may not

degrade the product’s required safety or performance characteristics. FOD is an abbreviation often used in aviation to describe both the damage done to aircraft by foreign objects, and the foreign objects themselves.¹

Awareness of the causes of FOD and FOD checks greatly reduce the risk of damage and/or injury to personnel and materiel by removing the FOD from the aircraft before it flies. To reduce FOD there must be a preventative system, known as foreign object control, in place and all personnel must be aware of the FOC system.

Pens are very useful devices, great for taking notes when conducting maintenance, awesome for pointing to that hard-to-reach spot when inspecting the aircraft, even good for scratching your head when thinking about an issue. They are ubiquitous, with almost every maintainer and aviator having one or more on their person at any time. Our DPNU jackets even have four external pen pockets. Flying overalls also have space for four pens. They are an everyday item. Are we becoming complacent about them around the aircraft?

A search through DAHRTS revealed that 816 SQN has had five recorded pen related FOD instances in four years, three occurring in four months.

ASOR 816SQN-060-2008 – Pen found in cabin during preflight.

Summary – During a pre-flight inspection a piece of plastic was found in the cockpit. Further inspection by the pilot revealed a pen near the collective.

Unit actions – Supervisors to ensure that a FOD check is carried out on completion of maintenance. A brief was given to personnel covering the responsibilities of both aircrew and maintenance personnel with regard to the security of pens (and other personal items) when personnel are moving around, conducting maintenance on, or flying, aircraft.

ASOR 816SQN-048-2010 – FOD found in aircraft transition section.

Summary – A blue ball point pen was found on the ledge forward of the transition access hatch during an after-flight inspection (AFI). It was considered likely that the pen was dropped sometime between the previous AFI and the AFI during which the pen was discovered.

Unit actions – Modification of FOD check to include the lip on the transition section access door. 816 SQN QO conducted a targeted check of compliance with *NASM/ 9-05 Foreign Object Control (FOC)* during daily walkarounds over a one-week period after this incident. A brief was also given at the next squadron maintenance training day.

ASOR 816SQN-076-2011 – Pen clip found adjacent to intermediate gearbox.

Summary – Upon removal of the fairing cover to the intermediate gear box (IGB) the pocket clip to a ball point pen was found resting adjacent to the aft mounting feet. The investigation determined that the squadron issued pens had flimsy pen clips and when the pen was put in the pocket, or knocked, the pen clip could come adrift.

Unit actions – The pens of this type were removed from service and taken off the approved purchase list. Future pen

issues to maintenance personnel will be of a pen type with a stronger pen clip.

ASOR 816SQN-086-2011 - Pen found under pilot collective stick.

Summary – During an area 1 and 2 (cockpit and cabin) before-flight inspection, a black pen was discovered on the cockpit floor below the pilot’s collective. Through a lack of objective evidence this incident was not attributed to contractor or squadron maintenance personnel.

Unit Actions – Commended the vigilance of the maintenance personnel in discovering the pen before the aircraft went flying. Increased FOC awareness as directed by the squadron safety goals through a ‘back-In-the saddle’ briefing.

ASOR 816SQN-008-2012 - Pen found in No. 2 engine bay during aircrew preflight.

Summary – Aircraft captain found a pen in the no. 2 engine bay during the pre-flight inspection. The tradesperson conducting the before-flight inspection normally carries a small note pad secured with two rubber bands to hold a pen and keep the note pad closed. The tradesperson did not check for his pen on completion of the inspection.

Unit actions – Personnel briefed on personal FOD control when they leave the hanger to go onto the flight line or flight deck of a ship. Individuals are to remove all loose articles (ID tags, pens, hats, et cetera) and secure them only in pockets that can be zipped or velcroed closed. Personal FOD control should also apply while completing aircraft maintenance.

Across the Fleet Air Arm there have been a number of other incidents where pens have been the source of FOD. Follow up actions included the following:

- Aircrew reminded of the requirement to remain vigilant during pre-flight inspections, especially at night;
- Security of personal items during flight operations and the inherent dangers of FOD constantly reinforced through the squadron safety plan and work practices;
- A brief by the supervisor on the requirement for increased vigilance with respect to FOD during flight operations;
- Introduction of a significant flight FOD campaign; and

ASOR April 2012

NAVY: Serious incident Maintenance FOD

A tail rotor drive shaft protective cover (TRDS) not removed during before-flight checks was sucked into the environmental cooling system (ECS) and spat out again during the after-start checks causing damage under the aft cowl.

This serious incident was caused by a series of latent and active failures from the organisation and individuals involved, according to the DDAAFS Accident Investigation Team (AAIT). The DAHRTS Aviation ASOR notes that the inherent design of the TRDS cover made it impossible to detect its presence when the engine cowl is closed. The lack of a visual marker resulted in the installation of the TRDS cover being missed by late watch, early watch and aircrew.

“There was a lack of procedural knowledge of the senior sailors with respect to the requirement for an A/F and what was expected post the non-engaged ground run to secure the aircraft,” the ASOR reads.

Significant work has been carried out to reduce the chances of this incident being repeated. This includes the review and revision of procedures and documentation and the design of the TRDS cover being modified to ensure visibility if the engine cowl is closed. Proactive hazard identification has been incorporated in the squadron’s safety goals and personnel were briefed on the findings and contributing factors during a maintenance training day.

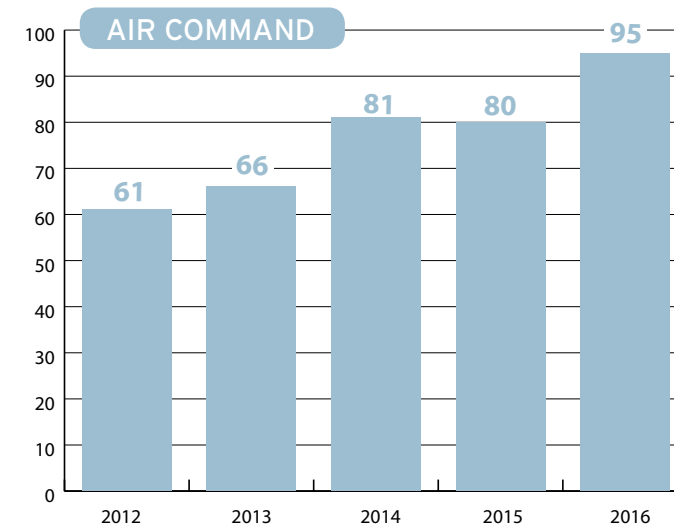
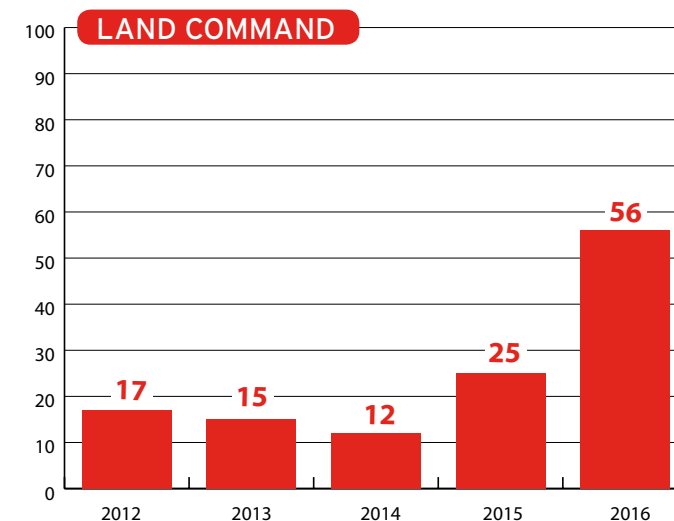
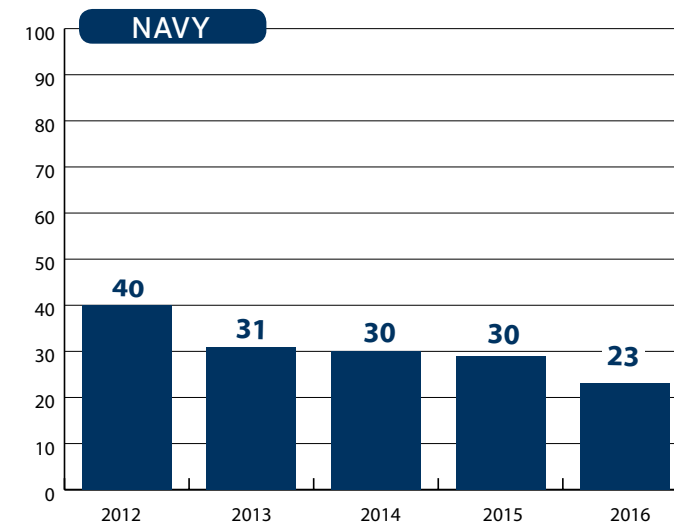
- Aircrew and maintenance personnel reminded to ensure that what they bring to the aircraft leaves the aircraft.

FOD is not just a Naval aviation problem, but is a global aircraft issue. Gary Chaplin, Founder and of The FOD. Control Corporation considers that, “Promoting a FOD program is essentially a public relations campaign. Even if other elements of effective FOD prevention are not in place, a good promotion and awareness program can significantly help reduce FOD by engaging a workforce with information, feedback and involvement.”²

ICAO recognises that FOD is a difficult issue for the international aviation community, “The absence of

Changes to Bureau aviation weather products forecast

FOD OCCURRENCES 2012 TO 2016 (5 YEARS)



*This data was extracted from DAHRTS in March 2017.

a globally accepted FOD definition and taxonomy, with its adverse consequences for FOD's consistent recording, analysis and costing, is the first obstacle to the development of a proper understanding and mitigation of FOD's safety and other impacts."³

To provide a consistent taxonomy and to comply with Technical Airworthiness Regulations, the ADF has a FOC policy defined in AAP 7001.059(AM1) Section 3 Chapter 8 - Foreign Object Control which is further distilled for the Fleet Air Arm through NASMI 9-05 - Foreign Object Control.

A reduction in FOD-related incidents was an 816 SQN safety goal for 2012 and was advertised frequently during monthly training days, safety forums and on safety posters displayed throughout the 816 SQN maintenance facility.

There is always the likelihood of individuals introducing sources of potential FOD if they are not careful to individually account for uncontrolled items such as pens, notebooks, rags and similar items.

As part of its commitment to safety, and safety management, 816 SQN presents Squadron Safety Goals annually as part of the Back-in-the-Saddle training. FOC continues to be an important safety goal for 816 SQN as articulated in the statement below:

Goal: Improvement in foreign object awareness with an emphasis on the management of uncontrolled items.

Indicator: Less safety occurrences attributable to FOD.

There is a hierarchy of control measures at 816 SQN including the command commitment to safety, the senior maintenance manager's FOC program managed by the assistant AEO, awareness training conducted by the squadron ASO, and maintenance ASO, and personal vigilance by squadron personnel.

Aspects of personal vigilance include ensuring the pocket flaps on flying clothing are not twisted and are properly secured. Maintenance personnel checking pockets, and moving potential FOD to zipped pockets. Treating everyday items, such as pens, as a tool when around an aircraft and accounting for it when leaving the vicinity.

The pen seems to be innocuous but is potentially lethal if left in a critical area of the aircraft. It is through awareness of issues surrounding FOD that we can promote vigilance. So whether visiting an aircraft, conducting maintenance, performing an inspection, or flying, ensure you secure your pen.

1. <http://www.nafpi.com/>
2. <http://www.fodcontrol.com/>
3. ICAO White Paper, Foreign Object Debris, A37-WP/191, TE/106, 13/09/1

Note: This article was originally published in *Touchdown Magazine*.

The Bureau of Meteorology provides a wide range of weather-related products and services to the Australian aviation and Defence industries. On 10 November 2016, the bureau introduced changes to some aviation products to better comply, where practical, with the standards set out by the International Civil Aviation Organization (ICAO). This includes low-level area forecasts (ARFORs); SIGMETs; and AIRMETs.

ARFOR

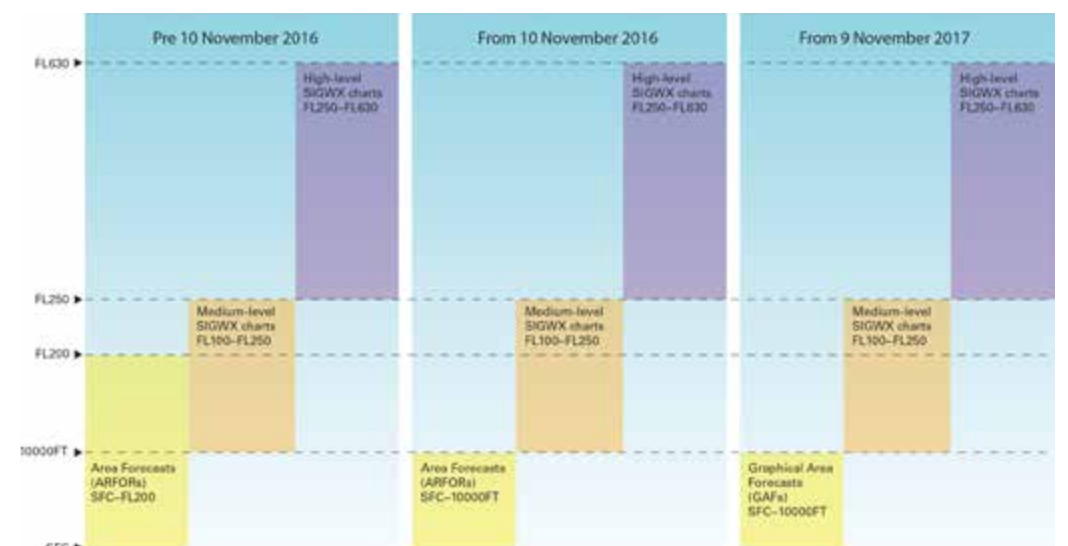
Changes to Vertical Extent of an Area forecast (ARFOR).

Area forecasts now only cover the airspace between the surface and 10,000 feet AMSL compared to previous area forecast, which covered the airspace from the surface to 20,000 feet AMSL.

Forecasts for airspace above 10,000 feet AMSL can be obtained from medium- and high-level Significant Weather (SIGWX) charts, Grid Point Wind and Temperature (GPWT) charts and the NAIPS Wind/Temperature Profile.

Further changes will be made to ARFORs over the course of 2017, including changes to AREA boundaries and the introduction of a graphical component to the ARFORs. More information is available at: <http://www.bom.gov.au/aviation/data/education/graphical-arfor.pdf>

It is important to note that the vertical extent of military ARFORs will



not change, as these are specific to military requirements in each area.

SIGMET

Changes to Australian SIGMET sequence numbers and the remarks line (RMK). Australian SIGMET sequence numbers no longer reset at 0001UTC, and instead the sequence numbering continues until the SIGMET for the event is cancelled. Should more than 99 SIGMETs be issued for a particular event, the number portion of the sequence number will go from 99 to 02. Sequence number 01 will be reserved for new SIGMETs.

The status information (NEW, EXT, CNL) will be removed from the remark line of Australian SIGMETs as this information can be determined from other sections as follows:

NEW - any SIGMET with a sequence number of one, such as X01, will always be a new SIGMET;

EXT - any SIGMET with a sequence

number greater than one, such as X02, will be an extension or a cancellation of a current SIGMET; and

CNL - cancel information is contained in the body of the SIGMET.

AIRMET

The format of AIRMETs has changed mostly to align with ICAO Annex 3 specifications. The new AIRMET follow a very similar format to the previous SIGMET format. For more information refer to <http://www.bom.gov.au/aviation/data/education/proposed-airmet.pdf>

Note: For more information on all of these changes visit the Bureau's aviation Knowledge Centre at <http://www.bom.gov.au/aviation/knowledge-centre/> or contact webav@bom.gov.au with any questions.

Jet blast dangers

Compiled by Paul Cross

In 2016 a jet-blast incident was reported at Richmond when a C-17 was taxiing to a parking position after a day's flying. To get to the parking bay the pilot needed to execute a very tight turn, with very limited wingtip space. An increase in power to no. 4 engine – the closest to the building – put the building, vehicles and personnel inside the jet blast area.

Jet blast (or jet efflux hazard) is defined as hazards associated with the blast force generated behind a jet engine. The hazard exists whenever a jet engine is running but is increased and extends over a greater area and at greater distance behind the engine, at high engine power settings when taxiing, before and during take-off, and during engine maintenance activity.

Operationally, Jet blast can be hazardous in three ways:

- In the ramp environment, where it can damage other aircraft, blow over ground equipment (aircraft steps,

vehicles, et cetera), cause structural damage to buildings, or injure or kill passengers, crew and ground personnel who may be in the vicinity.

- On taxiways, where other aircraft (and especially jet engines) may be damaged by foreign object debris (FOD) and smaller or light aircraft blown over or subjected to loss of directional control.
- On surface manoeuvring areas that are not designed to withstand the efflux from engines running at high power and are easily damaged.

While these risks are ever-present and generally recognised within the ramp environment, when there is a specific hazard then signage and, or NOTAMs are usually provided. Flight crews should check these and always use the minimum breakaway thrust to commence moving.

What is not generally recognised are the hazards that may be created when away from the ramp environment. Two specific hazards to aircraft safety are particularly important:

- The blast from one aircraft on the ground can affect another (usually smaller) aircraft and there is often no appreciation by the flight crew of large aircraft of the potential hazard to smaller aircraft that is created by the application of breakaway thrust to commence moving. This is particularly hazardous when the smaller aircraft is moving behind the larger aircraft. The most dangerous case is when the smaller aircraft is on the take-off or landing roll and passes at speed behind a larger aircraft, which has stopped just clear of the active runway after crossing or vacating it and

which is applying breakaway thrust to re-commence taxiing. In the worst case, a loss of directional control and runway excursion could result. As well as light aircraft, smaller regional and business jets operating at busy airports with frequent wide-body aircraft movements are at particular risk. The only defence for a smaller aircraft is a high degree of proactive situational awareness on the part of all flight crews.

- The second major hazard is where the jet efflux dislodges sections of taxiway or stopway paving, or other debris, deflecting it rearwards and upwards causing it to hit and damage the stabiliser and/or elevators. This could lead to impaired control authority resulting in loss of control during rotation and initial climb. Manoeuvring surface cleanliness is the responsibility of the airport authority but its major impact is on aircraft safety. Other than during scheduled airfield/ATC inspections, contamination may only be apparent to operating flight crew.

Operational mitigations

The exhaust of a running jet engine always creates an efflux/blast. In being aware of this risk, flight crews should always consider:

- Aircraft creating jet efflux/blast.
- Taking special care in narrow cul de sacs.
- Do not apply more than the flight manual-specified break away thrust (if known).
- If break away thrust is not sufficient, advise ATC of needing to apply more thrust before simply applying it; they may be able to hold or divert traffic passing behind.
- High-thrust operations; for example, a cross-bleed engine start, must only be carried out in specified locations and require specific approval from ATC before increasing thrust.

Aircraft at risk from jet blast

- Be aware of the potential danger area behind large jet aircraft (large aircraft with two jet engines generally have greater installed thrust, and potentially longer hazard areas, than the four-engine wide bodies).

- Be aware of the increased risk potential when a large aircraft is moving off.
- Consider remaining clear of the rear of any aircraft that you suspect may be using, or about to use, high power settings.

All aircraft

- Be attentive to taxiway and runway conditions.
- Report all loose surface material
- Avoid high thrust as much as possible and especially if avoidance of loose surface material is impossible

Other instances

On 14 October 2011 at 9.50 am, a Boeing 747-400 aircraft taxied for departure from Brisbane Airport on a scheduled passenger flight to Sydney. The flight was originally scheduled for departure at 6.30 am, but had been delayed.

It had been instructed by Brisbane Ground Air Traffic Control to hold at taxiway Charlie 9 (C9) short of taxiway Bravo, which was directly in line with parking bay 76B on the international apron. A Boeing 737-800 was parked at gate 76B at the time.

The flight crew of the parked aircraft was preparing the aircraft for a flight to Denpasar. The first officer, who was tasked with calculating the fuel required for the flight, went to communicate this figure to the aircraft refueller on the apron.

He exited via the rear left door and stepped onto the push stairs. At the same time the 747 was cleared by Brisbane Ground to turn left into taxiway Bravo. The pilot applied power to initiate the aircraft forward movement, producing a jet blast. The push stairs at the rear of 737 were blown over by that jet blast and the first officer standing on the stairs fell to the tarmac, sustaining serious injuries.

Also at Brisbane

On 23 October 2011 at 7.20 am an Airbus A320 on a scheduled passenger flight to Perth had pushed back from Bay 38 at Brisbane Airport to the bay disconnect point.

At the same time, another A320 parked at Bay 31 was disembarking passengers from the front and rear push

stairs. It was reported that on taxi, as the first A320 turned to face the taxiway, breakaway thrust was maintained, exposing the disembarking passengers at Bay 31 to moderate jet blast.

Ground staff in the vicinity described the jet blast velocity as "more than normal" and estimated the strength as about 20 kts (37 km/h). Closed circuit television (CCTV) footage of the incident was obtained by the ATSB and examined.

On review there was no clear evidence that passengers, crew or ground handling staff were being adversely affected by the blast. The *CASA Manual of Standards, Part 139 - Aerodromes, at 6.6.2 Jet blast and Propeller Wash Hazards*, recommended that the maximum jet engine exhaust velocity should not exceed 32 kts (60 km/h) where passengers are expected to walk or people are expected to congregate. Where personnel are working on an aircraft the recommended maximum exhaust velocity is 43 kts (80 km/h).

ATSB safety message

Ramp safety is one of the understated risks for passengers, cabin crew and ground personnel, especially with the increase in the number of parking bays located remote from aerobridges.

Every airport is unique and cabin crew and ground personnel need to maintain their vigilance. Situational awareness is the best defence against accidents on the ramp. Ground personnel and cabin crews need to develop an awareness of other aircraft activity in their vicinity and direct passengers accordingly.

This accident also serves as a reminder to pilots of the real danger posed by jet blast. The level of thrust utilised during ground operation requires sound judgment and technique. Even at relatively low power settings, the blast effect from large modern high bypass turbine engines can be destructive and may cause injury to those nearby.

1. www.skybrary.aero/index.php/Jet_Efflux_Hazard Retrieved January 31, 2017.

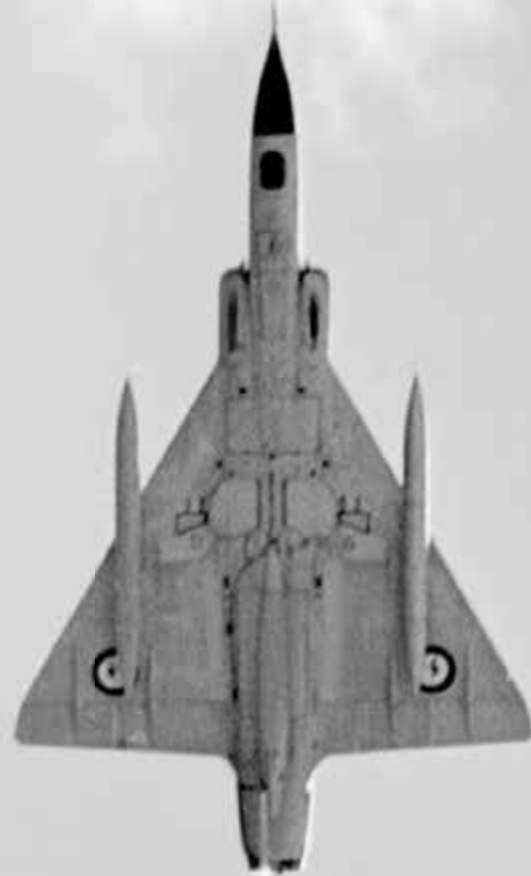
2. www.flightglobal.com/news/articles/jet-blast-incident-prompts-caution-on-single-engined-428890/ Retrieved 31 January 2017.

3. ATSB Investigation AO-2011-137 Jet Blast Occurrence Boeing involving 747-438 and Boeing 737-800 October 14, 2011

4. ASOR 36SQN – 095 – 2016

A lack of oxygen or something else?

The Vance Drummond Mirage accident – 17 May 1967



By AIRCDRE Mark Lax (Retd)

By 1967, he was well on track to become the Chief of the Air Staff (as the Chief of Air Force was titled back then). He was Wing Commander Vance Drummond AFC, DFC (US), fighter pilot, war hero, POW and a recently promoted wing commander at 39 years of age. Drummond was on the Mirage conversion course as he was already appointed the Commanding Officer of No. 3 (Fighter) Squadron when the accident happened.

On 17 May 1967, Drummond was strapped into Mirage A3-077, an Operational Conversion Unit aircraft at RAAF Williamtown. He was call sign *Hawkeye 3*, the number three of a four-ship training sortie, tasked to fly 2 v 2 air combat manoeuvres over the water, about 50 nautical miles north-east of the base. They were on the last wave of the day.

The flight took off at 1600 hours, climbed quickly to height in four-ship battle formation and headed out to the training area. Once over the sea and now at 35,000 feet, the two pairs separated and moved into position so the exercise could begin. At 1611, the students *Hawkeye 3* and *4* were ready, 2000 feet above and 4000 feet behind another student in *Hawkeye 1* and a student and instructor in *Hawkeye 2*. Drummond in *3* called “in position” and the mock attack commenced – “fight’s on”. Camera film of the Mirage gunsight picture would later be used to confirm if a kill was made.

Hawkeye 3 and *4* closed on *Hawkeye 1* who commenced a barrel roll to the right. Both *Hawkeye 3* and *4* followed but then for no apparent reason, *Hawkeye 3* stopped following *Hawkeye 1*, who was still in a turn, dropped his nose and entered a steep 60 degree dive. True to procedures, *Hawkeye 4*, Drummond’s wingman, broke off the attack and followed him down.

The pair continued to descend and passing 22,000 feet, they entered cloud at which time *Hawkeye 4* pulled up and recovered from the dive. *Hawkeye 3* made no emergency call – there was just silence. Shortly after, the instructor in *Hawkeye 2* took over and descended below the cloud base to investigate. He and his student located the crash site in the ocean below. There was no sign of life, there was no parachute and no body visible, just a small oil slick. This entire sequence of events took less than four minutes.

Very quickly two Mirages, two Sabres, a Canberra and an Iroquois were flying around the location. They were joined by a Neptune aircraft on SAR standby that had been called in from Richmond.

The Williamtown crash boat was immediately launched and a search of the area well into the evening could not locate the aircraft or the pilot. As last light approached, and with no further sightings, the search was called off. The search resumed at first light and continued for two days but as the NCO Marine Section later testified, nothing was found.

Drummond’s career

According to his entry in the *Australian Dictionary of Biography*, Vance Drummond was born on 22 February 1927 in Hamilton, New Zealand. In May 1944, he joined the RNZAF as a trainee navigator and was demobbed in October 1945 when the war ended. A few years later he reapplied to the RNZAF, was rejected, so moved to Australia and joined the RAAF.

He graduated as a sergeant pilot and top of his course in 1951 and was posted to No. 78 Wing to fly Meteors. Shortly afterward, he found he was on his way to Korea. He was commissioned on 30 November 1951, but the next day was shot down and captured by the North Koreans. Despite a valiant attempt to escape, he and four colleagues were soon recaptured, punished and held until the war ended.

After repatriation, and as the RAAF was acquiring the Sabre aircraft, Drummond was posted to the Sabre Trials Flight at Williamtown. It was the next logical step in his fighter pilot career and he never looked back. Next, when at No. 75 Squadron, he led the *Black Diamonds* aerobatic team where he was awarded the Air Force Cross for leadership. In 1965, he was promoted acting wing commander and posted to fly Forward Air Control aircraft with the Americans in Vietnam. He flew 381 combat sorties and his flying skills saw him awarded the US DFC and the Republic of Vietnam’s Cross of Gallantry with Silver Star. After he returned home, he was promoted wing commander and started Mirage conversion course as the incoming CO of No. 3 Squadron.

Such was Drummond’s reputation, when they later examined his log book, the court of inquiry members were not surprised to see that Drummond had continually been rated ‘well above average’ as a pilot and had an ‘exceptional leadership ability’ assessment by the Americans in Vietnam. At the time of the accident, he had amassed 2,952 hours, but only 18.5 were on the Mirage.

The Mirage IIIO

Drummond and his colleagues were flying the new Dassault Mirage IIIO, a French designed supersonic fighter built in Australia under licence. A total of 100 of the single-seat version were acquired together with another 16 of dual-seat version which was used for instruction and flying categorisation tests. Deliveries commenced in May 1965 and by the end of the year they were in squadron service.

The Mirage was a giant leap in performance over the Sabre which it replaced. The aircraft could climb to over 50,000 feet, was rated to Mach 2.2 at 36,000 feet and at sea level could manage a respectable Mach 1.2. On the downside, its short range and lack of air refuelling capability meant it was not the best for a continent the size of Australia. As such, the aircraft

configuration for training exercises was two supersonic drop tanks and a pair of AIM-9 sidewinder missiles which complemented the two 30 mm cannon flush mounted under the fuselage.

At the time of the accident, the three single-seat aircraft (Hawkeye 1, 3 and 4) were fitted with supersonic tanks and missile rails, but no missiles. All aircraft were deemed serviceable by the engineers and the senior NCO in charge of the flight line.

Previous mirage losses

The Mirage had entered service with the RAAF in January 1964 and up to the time of Drummond's accident, only three of the initial order of 110 aircraft had been lost. All three pilots had ejected safely and a full account was made of the reasons. The first on 7 December 1964 was the ARDU test aircraft A3-1, which, while undergoing flight performance testing, entered a stall, then spun out of control. The pilot, SQNLDR Tony Svensson, an RAF exchange test pilot, ejected at high speed. The second loss, in July 1966, was A3-28 which resulted from an engine failure when the drive shaft failed and the pilot, SQNLDR Doug Johnston subsequently ejected safely. The third, A3-46, which was the month prior to Drummond, was also due to engine drive shaft failure and again, the pilot, FLGOFF Jack Ellis, ejected safely. By the time the Mirage had gone out of service in 1988, 47 had been written off (CAT 5) or very seriously damaged (CAT 4) and 14 pilots had been killed.

The Court of Inquiry

As was normal RAAF procedure, a Court of Inquiry was convened the next day. President of the inquiry was WGCDR Les Reading, another very experienced fighter pilot and the immediate past CO of

No. 77 Squadron. He was posted to HQ Support Command at the time and was not familiar with the Mirage. He was assisted by FLTLT Jack Ellis, pilot of No. 76 Squadron (yes, the pilot and who had just ejected from A3-46) and FLTLT Alan Emmerson, an aero engineer from No. 481 (Maintenance) Squadron at Williamtown.

WGCDR Reading was given extensive terms of reference to guide his deliberations. There were 25 lines of inquiry, which were standard (as specified in Air Force Orders 12/N) and included among other things: determine the circumstances of the accident, consider the ability of the pilot, his authorisation and supervision, any causal factors such as weather or airworthiness, any carelessness and whether anyone else might be involved.

The Court convened on 22 May and called 24 sworn witnesses and examined all applicable documents such as authorisation sheets, maintenance releases and medical reports. The first witness was FLTLT C, an instructor at No. 2 OCU who was flying in the rear seat of the dual Mirage Hawkeye 2. In the front seat was witness five, PLTOFF S, a student. C stated that the exercise was briefed by FLTLT Bob Walsh, another student who was in Hawkeye 1 (and who was called as witness three). The brief was thorough and covered all aspects of the sortie, included emergency procedures and a 'knock-it-off' brief – the radio call to end a mock fight if something was amiss. C continued (edited for brevity):

Shortly after initiation of the hard turn No. 1 [Walsh] called 'We have two bogies in our 6 o'clock about 4000 feet and closing – defensive split go'... we then increased our bank, max afterburner and obtained lateral and vertical separation from 1... During this manoeuvre, I was talking to the student in the front cockpit drawing his attention to mach number and performance. No. 1 started a barrel roll to the right...

Over the top of the barrel we then started to turn towards them to effect a sandwich. The attacking aircraft appeared to go wide on the downward side of the barrel. [shortly afterwards] 3 and 4 were then nose down approximately 60 degrees and

"The evidence shows that, after breaking away from the attack, WGCDR Drummond made no radio transmissions, did not extend speed brakes, did not significantly reduce power, apparently did not have aerodynamic control of the aircraft, and took no other known action to remedy or notify an emergency."

appeared to have very little 'G' applied as all I could see was the plan form on two aircraft at 90 degrees angle off to me. We closed quite rapidly, which was unusual as our performance was low.

[My] student started to chase the pair and No. 3 and 4 were rapidly approaching cloud tops in this steep nose down attitude and I told the student "don't follow them, two in cloud is enough". The two aircraft disappeared over the ledge of cloud and I lost contact with them. A few seconds later a call was made which was "No. 4 bugging out" and shortly after that again "3 from 4 do you read?"

After 3 disappeared, 1 and 2 then began a search, found a long oil slick and initiated search and rescue action.

Walsh (witness three), FLGOFF R (witness four - Hawkeye 4), PLTOFF S (witness five) and the Air Traffic Controllers on radar control, all corroborate C's testimony. Witness four, Drummond's wingman was also asked if Drummond's canopy either broke up or came

off the aircraft and replied "I am certain that it neither disintegrated nor came off the aircraft".

Possible causes

After establishing the sequence of events, the court next turned to possible causes. They interviewed witnesses regarding the condition of the aircraft, the environment, and Drummond's physical and mental condition before flight.

First, the court turned to the aircraft. Engine drive shaft failure as had caused the previous two crashes was immediately discounted. They called the flight desk NCO. He testified that the accident aircraft had no outstanding unserviceabilities and none recorded in the EE500 maintenance release form. The Court then called an engineer, SQNLDR R (witness 13), to enquire about the accident aircraft oxygen system. He stated that the oxygen was regularly checked for contaminants and the oxygen used on Drummond's aircraft had been cleared. In addition, the oxygen replenishment system used on the accident aircraft had been used on all other OCU Mirages that day, so it too was discounted as a possible cause.

Weather was next to be considered but very soon discounted as a contributing factor.

Next, the court turned to Drummond's medical condition. The senior medical officer (Witness 16) reported that Drummond had never reported sick while at Williamtown and was "fit for full flying duties without any restrictions whatsoever". He had a full aircrew medical four months earlier. But when Mrs

Drummond (witness 20) gave evidence, she offered a slightly different story as to Drummond's health. She stated:

"About a month ago... my husband suffered a severe headache accompanied by cold sweats. He fell asleep and, when he woke up, stated that he felt better. He later said that he felt at the time that his head would burst. He normally suffered very occasional mild headaches.

"On a Friday evening about six weeks ago he experienced double vision while watching television and said that he felt very tired.

"She also recalled a number of attacks of heartburn associated with chest pains and difficulty in breathing. On each occasion he was at a party and consuming alcohol. These symptoms disappeared when he went to bed."

A corporal on the flight line who strapped in Drummond was next to offer his testimony. He stated he had known the wing commander for about eight years. On this occasion, during final start up, he stated that Drummond appeared quite normal in all respects; however, before he signed for the aircraft, he "looked tired and somewhat red-eyed as though he had been studying hard or *something like that*" (italics added).

Was Drummond hiding something from the RAAF doctors, perhaps to protect his medical category? The Court must have thought so too, as the SMO was recalled as witness 21. The doctor was asked specifically about the heartburn and the headaches in that order. He provided his opinion. Surprisingly, he did not mention the headaches or blurred vision. As to the heartburn, a peptic ulcer was possible, but any bleeding or discomfort airborne would not have caused incapacity to the extent that a radio call could not have been made. On the other hand, a heart attack in the air was a different story, as the doctor stated: "A mild ground attack could be a severe or fatal attack under air conditions... It is feasible therefore that an initial medical catastrophe occurred at the first point and any momentary recovery was insufficient to allow the speaking of a message or that there was no recovery at all".



The verdict

The Court retired to consider the witness statements and the pile of documents that had been tendered. The Court concluded that "the most likely immediate cause of the accident was that Mirage A3-077 dived at supersonic speed into the sea". This was obvious. The findings went on to record that:

The evidence shows that, after breaking away from the attack, WGCDR Drummond made no radio transmissions, did not extend speed brakes, did not significantly reduce power, apparently did not have aerodynamic control of the aircraft, and took no other known action to remedy or notify an emergency.

The Court had been thorough under the circumstances, looking specifically at cabin pressurisation failure, G-suit malfunction, oxygen deficiency or contamination, and illness. They concluded that a cardiovascular medical event was the most likely cause but they could not determine whether such an event was caused by the flight or equipment malfunction.

With that, the Court of Inquiry closed. Upon considering the report, the AOC Operational Command (now called Air Command) concluded that "it seems reasonable to assume that the cause lay in pilot incapacity".

What is your view?

So what do you think? There are quite a few possible causes of pilot incapacity in high-performance aircraft cockpits. Here are a few:

- oxygen contamination leading to blackout;

- oxygen disconnection causing hypoxia leading to blackout;
- pressurisation failure, explosive or slow leak leading to hypoxia;
- fatigue combined with g-loading causing blackout;
- loss of situational awareness due flight instrument failure;
- 'G'-suit pressurisation failure leading to either physical incapacity or 'g' induced loss of consciousness; and finally
- a significant undiagnosed medical condition such as heart attack or stroke.

Given the evidence presented in this case and the findings of a possible medical condition causing pilot incapacity, the probability of a heart attack or stroke occurring when the body is placed under stress would seem likely. While we will never know exactly what happened, one thing is for certain. Undiagnosed or unchecked medical conditions, even if they seem mild must be checked by the Air Force doctor. Better to be alive and treated than dead and gone.

Note:

I have deliberately removed names from this article as some of those involved are still alive. Those now deceased have been named as the Archive record is open to the public.

Sources:

NAA: A703; 400/67/450 Drummond Accident file, open to the public.

Wing Commander MR Susans, The RAAF Mirage Story, RAAF Museum, Point Cook, 1990.

ASMIS the aviation safety capability for the future

The future of Defence aviation safety is in good hands with the introduction of a contemporary aviation reporting, investigation and analysis capability that will enhance the tri-service community's ability to learn from aviation-related safety occurrences and take action to prevent recurrence.

The Aviation Safety Management Information System (ASMIS) Project was initiated by DDAAFS to replace the ageing and increasingly difficult to support Defence Aviation Hazard Reporting and Tracking System (DAHRTS), which has served Defence aviation well since 2004.

Defence aviation has an excellent safety record across a broad spectrum of training and operations, from counterinsurgency to humanitarian support.

In years to come, responding to global and regional events will pose new challenges with the proliferation of technology and transformational change within the Defence aviation environment.

Defence aviation has to evolve in order to harness the potential of emerging technologies in order to meet these new challenges.

The ability to pro-actively manage risk, learn from safety occurrence, and to achieve continuous improvement in the Aviation safety space will play a critical role in Defence aviation maintaining its track record and enhancing future capability.

With this clear focus, on 6 October 2016, DCAF, AVM Warren McDonald formally initiated development of the DAHRTS replacement system by signing the new ASMIS contract with Managing Director Risk Management Technologies (RMT) Dean Apostolou.

RMT will use the existing First Priority (Sentinel) platform to deliver a contemporary aviation safety reporting, investigation and analysis information management system that will develop Defence aviation's safety management capability well into the 21st century.

The replacement system will not only deliver a significant improvement over DAHRTS, it will also provide an integrated platform where incident precursors can be correlated with risk controls, thus providing

critical early warning of risk-control effectiveness.

An agile implementation methodology is being used for the design, build and test of the new system, which includes continual stakeholder engagement, essential to ensure the new system meets user requirements.

The ASMIS Project completed Project Mobilisation in November 2016 and is currently in Phase 2 – Build and Implement, which involves building the solution over seven sprints in an agile development. The project is currently in Sprint 4.

Stakeholders from Air Command, DASA, Fleet Aviation Safety, 44WG, HQ Forces Command, UAS and 5 Flight have been involved in the design and build of the ASMIS.

User acceptance testing is scheduled for September 2017, with gap training to begin in October 2017. The project is currently on track to achieve full system roll out of the new ASMIS in February 2018. Current DAHRTS will be supported until June 2018 to allow users to finalise existing safety events before the system's decommissioning.

A DASM update will be developed before implementation of ASMIS. Crucial areas to be updated are: keywords, training, contributing factors, factual information, reporting and analysis.

To support the new ASMIS, an analysis capability is being developed to support reporting and trending analysis for the future system. Users will be able to pull historical data from a data warehouse and COGNOS reporting tool.





Aviation Safety Training

2017 Courses

ASO (I)

Aviation Safety
Officer (Initial) Course

COURSE AIM:
To graduate Unit ASOs,
Maintenance ASOs
and Flight Senior
Maintenance Sailors.

PREREQUISITES:
Personnel who are
required to perform the
duties of an ASO.

COURSE DESCRIPTION:
The course provides theory and practical exercises in the broad topics of the Defence Aviation Safety Management System, an introduction to human factors and the organisational accident model, incident investigation and reporting.

ASO (A)

Aviation Safety
Officer (Advanced)
Course

COURSE AIM:
To graduate Base, Wing,
Regiment, Fleet, Group
and Command ASOs.

PREREQUISITES:
ASO (I) Practical and
applied experience as a
ASO (or equivalent)

COURSE DESCRIPTION:
The course provides theory and practical exercises in the broad topics of the Defence Aviation Safety Management System, advanced human factors and risk management, and base emergency response. Includes a practical CRASHEX component.

NTS

Aviation Non-
Technical Skills
Trainer

COURSE AIM:
To graduate students
with the knowledge and
skills to deliver non-
technical skills training.

PREREQUISITES:
A solid background
in Crew/Maintenance
Resource Management
and/or Human Factors.

COURSE DESCRIPTION:
The course provides the theoretical background of aviation non-technical skills and trains students in the skills and knowledge for delivering non-technical skills training. The course also introduces students to scenario-based training and assessment techniques.

AIIC

Aviation Incident
Investigator Course

COURSE AIM:
To develop members
with the skills to
conduct aviation
incident-level
investigations in
support of their ASOs.

PREREQUISITES:
Any personnel who are
involved with Defence
aviation. There is no
restriction on rank,
defence civilians and
contractor staff are also
welcome to attend.

COURSE DESCRIPTION:
This one-day course provides theory (taken from the ASO(I) course) on the topics of; the Defence Aviation Safety Management System; generative safety culture; error and violation; the organisational accident model; incident-level investigation and hazard reporting and tracking. Interested personnel should contact their ASO.

COURSE NAME /NUMBER	DATES	LOCATION	NOMINATIONS CLOSE
1/17 ASO Course (I)	27-31 Mar	Canberra	27 Feb
2/17 ASO Course (I)	8-12 May	Canberra	10 Apr
3/17 ASO Course (I)	19-23 Jun	Canberra	22 May
4/17 ASO Course (I)	TBA		
5/17 ASO Course (I)	TBA		
6/17 ASO Course (I)	TBA		
1/17 ASO Course (A)	TBA		
2/17 ASO Course (A)	TBA		
1/17 NTS Course	15-19 May	Canberra	17 Apr
2/17 NTS Course	31 Jul to 4 Aug	Canberra	3 Jul
3/17 NTS Course	20-24 Nov	Canberra	23 Oct

COURSE NAME /NUMBER	DATES	LOCATION
1/17 AIIC	4 Apr	Darwin
2/17 AIIC	6 Apr	Tindal
3/17 AIIC	17 May	Richmond
4/17 AIIC	5 Jul	Edinburgh
5/17 AIIC	2 Aug	Amberley
6/17 AIIC	16 Aug	Williamstown
AIIC	TBA	

All courses are generally oversubscribed, dates provided are for planning purposes and are subject to change due to operational requirements, nominations from individual units or candidates will not be excepted, nominations are to be forwarded with Commanding Officers endorsement to :

- **Air Force:** the relevant Wing Aviation Safety Officer, or for CSG, Staff Officer Safety HQCSG
- **Navy:** the Fleet Aviation Safety Officer and
- **Army:** HQ FORCOMD, Aviation Branch, Force Preservation Section.

For further details regarding the above courses visit the DDAAPS Aviation Safety Assurance and Training intranet site or email ddaafs.setcourses@defence.gov.au