National Defence Défense nationale

FALL 2004

Flight Comment

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Canada

FLIGHT COMMENT — FALL 2004

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Photo: Master Corporal Andrew Eaton, Canadian Forces Northern Area, Yellowknife, 2004.

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THE CANADIAN FORCES FLIGHT SAFETY MAGAZINE

Flight Comment is produced four times a year by the Directorate of Flight Safety. The contents do not necessarily reflect official policy and unless otherwise stated should not be construed as regulations, orders or directives. Contributions, comments and criticism are welcome; the promotion of flight safety is best served by disseminating ideas and on–the–job experience.

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Subscription orders should be directed to: Publishing and Depository Services, PWGSC, Ottawa, ON K1A 0S5
Telephone: 1-800-635-7943

Annual subscription rates: for Canada, $19.95, single issue, $5.50; for other countries, $19.95 US, single issue, $5.50 US. Prices do not include GST. Payment should be made to Receiver General for Canada.

To contact DFS personnel on an **URGENT** Flight Safety issue, please call an investigator who is available 24 hours a day at 1-888-WARN-DFS (927-6337). The DFS web page at *www.airforce.forces.gc.ca/dfs* offers other points of contact in the DFS organization or write to dfs.dsv@forces.gc.ca.

ISSN 0015–3702
A–JS–000–006/JP–000
Art Direction: ADM (PA) DMCS
CS04-0183-A

From the **Flight Surgeon**

SIMULATORS

Simulators are an everyday fact of life for many Canadian Forces (CF) aircrew. Thanks to increased technology and many other advantages, aircraft simulators have gained widespread acceptance as training devices. Simulators have the following advantages:

- safe training involving potentially hazardous scenarios
- increased availability
- lower operational costs

Flight simulators can be operated at costs that are far lower than the operating cost of the aircraft they simulate. Generally, aircrew trained in simulators can acquire the necessary skills with fewer flight hours than those pilots who are not trained in them. Unfortunately, simulator sickness is one side effect of using this technology.

Over recent years there has been an increasing interest in some of the side effects of using aircraft simulators. The CF has been installing new high-fidelity simulators in various locations. These next generation simulators have vastly improved visual and motion systems that more closely imitate the real aircraft, although some lag and artificiality still exists. However, as these newer simulators enter service, some side effects of their use have been coming to light, crewmembers reporting sickness and disorientation, both during and after simulator sessions. Reported levels of fatigue have also been an area for concern with the use of the new devices. Sometimes these effects have been reported as lasting well into the next day. As a result of the reports, there has been a growing concern for the safety of aircrew — one of the CF's most valuable assets.

Simulator Sickness

Simulator sickness is similar to motion sickness but occurs without any actual motion of the subject. Early cases of simulator sickness were documented in 1957 in a helicopter trainer. There are many symptoms of simulator sickness but the following are the most common:

- fatigue
- drowsiness
- headache
- eye strain
- nausea
- dizziness
- confusion

There are several theories about the cause of simulator sickness, but the most widely accepted one is the 'cue conflict theory' (also known as neural mismatch). This theory is based on the inconsistent information about body orientation and motion that is received by the different senses. The two primary conflicts thought to be at the root of simulator sickness occur between the visual and vestibular (i.e. balance system) senses. The factors causing this mismatch fall into three broad categories:

- simulator related
- task related
- individual related

Using the criterion of a pilot experiencing at least one symptom, US research has found that the average incidence of symptoms ranges from a low of less than 20% in the 'best' simulator to more than 60% in the 'worst'. That research noted that as much as 10% of all pilots experience the effects for several hours. One important point is that individuals not in their usual state of fitness (e.g. suffering from a cold, flu, hangover, etc.) tend to be at a higher risk of simulator sickness.

If we accept that simulator sickness exists, then we must consider what consequences there might be. The consequences can be grouped into three main problem areas:

- safety and health
- training
- readiness.

Safety and health hazards include visual effects and ataxia (see below). An increased occurrence of simulator sickness may threaten the long-term utility of simulators as integral components of flight training. Simulators that are particularly troublesome may generate distrust and apprehension by the users. In turn this may limit the training effectiveness of the devices. If a pilot is suffering from simulator sickness, he/she may adopt strategies to avoid the sickness. This may result in poor, even negative transfer of training from the simulator to the aircraft. If a pilot gets sick, then his/her performance may be affected in activities that they carry out following the session. In some cases, restriction of post-simulator activities may be necessary for aircrew members who experience sufficiently strong symptoms of sickness and disorientation. This sickness results in diminishing their operational readiness, which in turn, may limit their overall operational effectiveness.

Ground safety, in terms of exiting the simulator or driving away from the site, may be jeopardized by symptoms such as ataxia and flashbacks. As the CF wishes to maximise the usability and effectiveness of its simulators, anything that can be done to reduce the incidence of simulator sickness needs to be investigated, as the highlighted consequences are contrary to the goals of the CF.

Ataxia

Ataxia, also known as postural disequilibrium, is a major side-effect of high rates of simulator exposure. It has been suggested that ataxia is due to a disruption in balance and coordination (similar to the effects of copious alcohol consumption). The disruption may result from adapting to the conflicting information experienced in the simulator. In a study of US Air Force pilots, it was found that 60.4% reported ataxia shortly after simulator exposure. For about 15% of the pilots, it persisted as long as 0.5 to 10 hours. Additionally, it was observed that the intensity and duration of ataxia increases with increased simulator exposure

Photo: Master Corporal Bill Parrott, 404 Sqn, 14 Wing Greenwood, 2003


Photo: Master Corporal Bill Parrott, 404 Sqn, 14 Wing Greenwood, 2003.

and longer sessions. Very long simulator sessions, such as those experienced in mission rehearsal systems, may be particularly vulnerable to these effects. It might also be that some simulators are more conducive to causing ataxia than others.

As a result of the US research some recommendations relating to safety have been developed:

- individuals with measurable unsteadiness following simulator exposures should remain in the simulator building until the symptoms subside
- simulators and flight exercises which produce the highest ataxia scores should be identified and, following exposure to the high risk situations, appropriate and formal restrictions should be applied to subsequent activities (e.g. flying, driving).

Fatigue

As a result of the fatigue levels being reported by some aircrew in simulators, a need for continued research related to crew rest guidelines between simulators and actual flight has been identified. The crew rest considerations come as a result of the fatigue and the CFs' desire to manage the fatigue levels of its employees.

Fatigue is both physiological and psychological in nature, and is a result of extended duration of work, or high intensity of work, or a combination of the two. The aim is to find a balance between the fatiguing effects of simulator sessions and achieving the aims of the training exercise. This also needs to be considered in conjunction with the probability of an individual suffering from ataxia and/or simulator sickness. Both of these conditions may add to the fatiguing effects of the simulator session.

CF Sim Sickness

At this point in time it is unclear if simulator sickness is a significant issue within the CF. In order to determine the prevalence of this condition, 1 Canadian Air Division, Division of Flight Safety (DFS) is presently finalizing a formal "CF Simulator Sickness" survey which will appear at all CF simulator sites this fall. Keep your eye out for this survey and please provide your input as the results from this survey will be invaluable in determining follow-on CF studies and CF regulations relating to flying after being exposed to the simulator. ◆

* This article is loosely based on the article by Mark Corbett, Human Factors Specialist, ADF Institute of Aviation Medicine, RAAF Base Edinburgh, Australia in issue 0103 of *Aviation Safety Spotlight*.

TIME PRESSURE

During a recent exercise at the NATO Base in Geilenkirchen, Germany, I was flying as the E-3A Airborne Warning and Control System (AWACS) instructor pilot for an alert launch. I have almost 2000 hours on this type and was the most experienced on my flight crew of 4 (pilot, co-pilot, navigator, flight engineer). We also have approximately 14 mission crewmembers in the back of the plane who are responsible for operating our radar system.

The pressure from above to do well during the exercise (in preparation for the upcoming wing inspection) was being felt by all of the crews. You did not want to be the crew to screw up.

We were supposed to be in the air one hour after notification to launch. A few crewmembers were a little late showing up to the pre-brief and getting the weather report turned out to be more difficult than normal. We were supposed to have a contingency (planning) cell prepare a complete flying package for us to include — all the weather, the notice to airmen (NOTAMs), flight plan and take-off data. This should have been handed to us as soon as were told to launch, therefore allowing us to make the one hour launch requirement. We did not get any of it and my flight deck was over tasked to get it all done in time.

The jet was also supposed to be loaded with a fuel load that was appropriate for the mission that we were assigned to fly. The planning cell should have done this as well, but they had not. We had to call the trucks to add more fuel to accommodate the mission.

With all the extra work and stress, along with it being a scheduled midnight take-off, my crew was already starting to get fatigued and we had not even made it out to the jet. When we finally did make it out to the jet the fuel trucks were still there and all the plugs and covers were still on the jet. We waited until the trucks pulled away and the maintenance personnel motioned that we could now enter the jet. They removed the chain guarding the airstairs, told us that we could go up, and started removing the plugs and covers. When the flight engineer (FE) and I got to the cockpit there was a maintenance technician inside reading through his checklist. I was a little shocked because

my understanding was that nobody should be doing any maintenance work on the jet without us there because the jet had been "cocked" (meaning all checklists and preflight checks were done by a different crew hours before in order to have the jet ready for us to take-off at a moments notice). We asked the guy if there was anything wrong with the plane. He just looked at us. I figured he just didn't understand us, so I asked again. He then stormed out of the cockpit and down the airstairs throwing his checklist down in front of him (nearly hitting one of my mission crewmembers in the face). It caused quite a little scene between my mission crew and the maintenance personnel.

We had little time to worry about why the guy was upset. (Although I found out later that he was still performing his ground refueling checklist and that we shouldn't have been allowed on board until he was finished). I needed to get the jet in the air fast. My flight engineer and I both looked around the cockpit and noticed several circuit breakers pulled out. We knew that they should have been in if the jet had been properly preflighted by the other flight crew. Now we were worried about if the plane had been correctly checked out for us at all. We decided to do a shortened version of a preflight, just to be on the safe side and double check that everything was ready to go. Although, technically we should not have had to.

Now we were late. We all knew it and were moving fast to try and get airborne as soon as possible.

My FE was a brand new guy right out of the training squadron. The squadron's experienced FEs had discussed with him the day prior the procedures for going to a "cocked" jet. It was something different, something we didn't do very often-especially for a brand new guy. The experienced FEs really harped on him to make sure that he went around and verified that the gear pins had been removed. This is NOT required for him to do when we come to a cocked jet. We should all go straight to the cockpit and maintenance should pull the pins and confirm it with us right before engine start. But a few months before we had a different FE show up to a cocked jet for an exercise and he didn't verify that all the pins were removed. The aircraft took-off and could not raise their nose gear. Our squadron FEs wanted to make sure that the new guy didn't make that same mistake for this exercise.

My FE went out for a quick walkaround to verify that the gear pins were removed. Once he was back in the cockpit we started engines normally. Then we received a taxi report from the crew chief via a communications cord that is plugged into the nose of the jet. He verified that all plugs and covers had been removed, all hatches were closed and that we were in taxi configuration. All the normal things we expect to hear.

Take-off was normal except for the fact that we were more than 45 minutes past our one hour goal for take-off. We climbed up to flight level (FL) 290 on our way to our orbit area of the coast of Great Britain. My FE let me know that we had something strange going on with our aft forced air-cooling system. This system provides cooling power for the electronics that power our radar. Without it, we cannot fly our mission. He told me that the temperature was at 100 degrees Fahrenheit and climbing slowly. Normal temperature at this point would have been 30 degrees or less. Something was wrong.

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Photo: Corporal David Cribb, 8 AMS Imaging, 8 Wing Trenton, 2004.

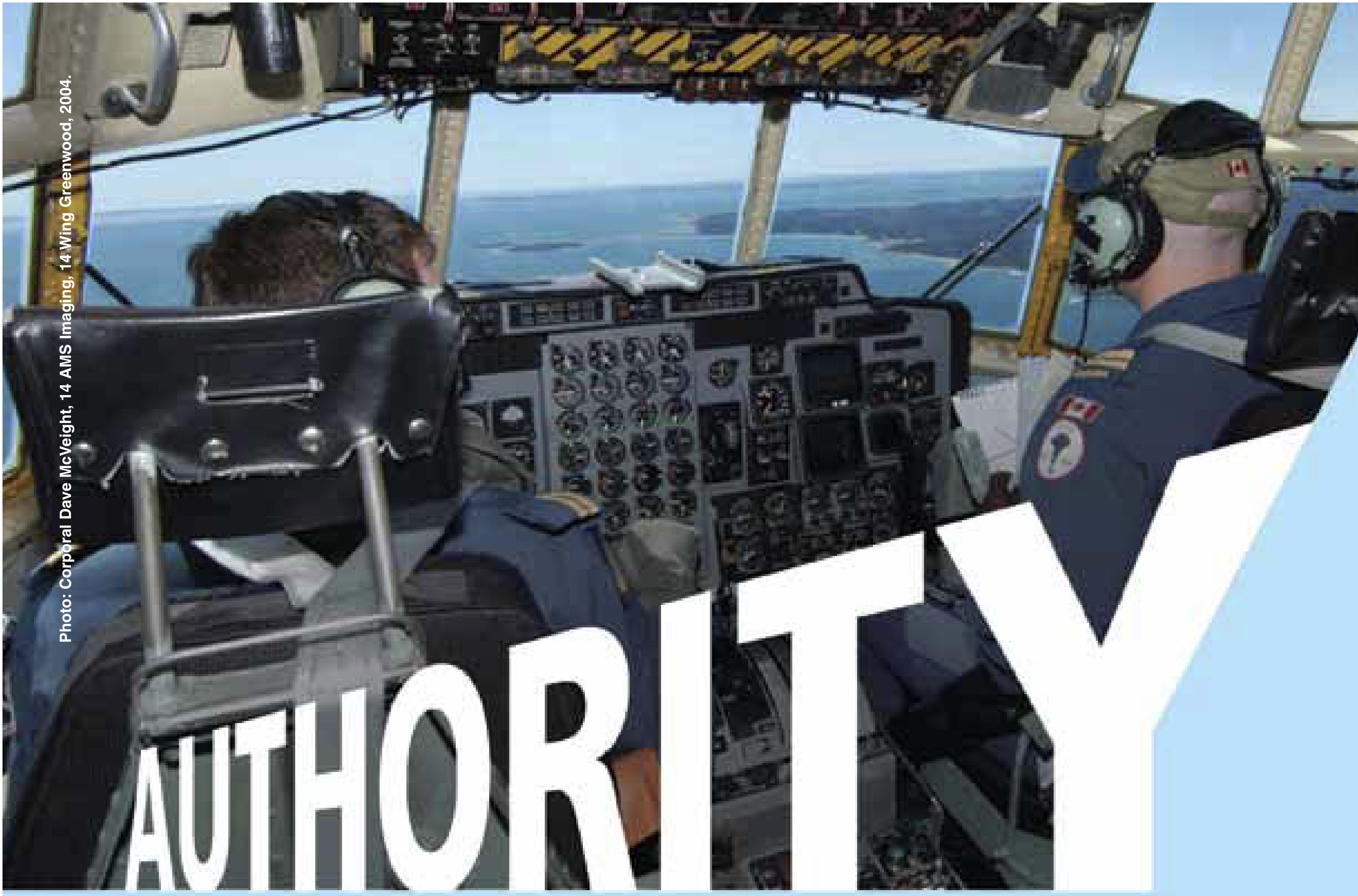

Photo: Corporal Dave McVeight, 14 AMS Imaging, 14 Wing Greenwood, 2004.

AUTHORITY GRADIENT

Have you ever given thought to authority gradient? Authority gradient can be found in situations where a junior individual defers responsibility to a senior individual in the belief that the senior person "knows best."

As a new CC-130 Herc driver, I was on a crew tasked to ferry an aircraft to a third line depot maintenance facility. The aircraft captain for the trip was a senior multi-engine pilot with over 30 years flying experience. Our navigator too was well seasoned with over 20 years in the multi-engine community. Coming from two previous tours on helos, my expertise lay in low-level visual flight rules (VFR) flying.

Prior to descent into one of our enroute stops, I studied the approach plate and descent transition and came up with a plan. During the approach check, I briefed this plan. The air traffic controller (ATC) gave us a clearance to the airfield VOR via the profile descent. As there was no other traffic, I interpreted this to mean we were cleared for the approach and could proceed with our own vertical navigation. I started the descent to the next published altitude. Immediately, the senior pilot queried what I was doing. He stated what he heard was that we were cleared to the VOR and not the VOR approach itself. To clarify any confusion, the senior pilot "requested lower," a term used within ATC-pilot parlance to indicate the pilot wanted to descend. The controller replied we were cleared for the VOR approach. The senior pilot then directed me to fly to the intermediate fix altitude, which we were 10 miles away from, and 3 500 feet lower than I had expected.

The abruptness of the senior pilot's tone had startled me. In the heat of the moment, I deferred to his experience and believed that what he was instructing me to do was correct. However, in the back of my mind, my spidey-senses told me something was wrong. I had planned the approach to follow the published transition using a pre-calculated rate of descent. The senior pilot had directed me to descend to a much lower altitude than I was anticipating (2 500 feet versus 6 000 feet). After continuing at our increased descent rate, the navigator spoke up and stated we had descended (almost 500 feet) below the minimum altitude for the transition leg we were on. The senior pilot debated this information. Since we were punching through a layer at the time, we could not see the surrounding terrain. In addition, our ground proximity warning system (GPWS) on the Herc fleet had been disconnected for technical reasons.

The navigator repeated we should climb back to the minimum altitude, to which the senior pilot agreed. Only after the published profile descent was resumed did the senior pilot recognize the error.

I learned some invaluable lessons that day which I will never forget. Never assume experience level is a substitute for knowledge level, *regardless of how senior that person is*. We could fill a book of pilots with 10 000 + hrs who have made critical errors. Lapses in judgment can occur outside of the sterile classroom environment. Too often we defer to seniority in the belief that experience knows best. DON'T! Aircraft designers put two seats up front for safety. *Think independently*. ◆

Captain Steve Yon serves with 436 Transport Squadron, at 8 Wing Trenton.

TIME PRESSURE

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We continued flying out to the orbit area and I relied heavily on my "new" FE to figure out the problem. Truthfully I didn't know as much about the system as I should have as an instructor pilot. I wasn't able to give him any ideas on what we could do to fix the problem. Nobody in the cockpit had any ideas. It wasn't something we practice in the simulator. The temperature continued to climb slowly and after 30 minutes had reached 122 degrees. At this point the inertial navigation systems (INS) onboard are supposed to automatically shutoff to prevent burning up do to the lack of cooling air. Losing my navigation systems didn't sound like a lot of fun tonight considering the weather all over Europe was horrible. I decided that was it, we were going home.

With all the extra gas on board we were too heavy to land, so I put the gear down and the speed brakes out in order to burn down to landing weight. We flew home and had to hold for 30 minutes before we were light enough to land. I could have opted to dump fuel over the ocean on the way home, but I would have had to declare an emergency to do that. I didn't feel that declaring an emergency was necessary at this point. The temperature had stabilized at 129 degrees and the INS systems were still working fine, but I really wanted to land as soon as I could.

Finally we landed without further event and I was exhausted. I had just sat down with the other crewmembers on the bus to take us back to the squadron when the FE came on board and asked me to come out and look at something. He walked me to the left aft fuselage and pointed to a plug sitting in the aft forced air-cooling inlet. I couldn't believe it.

The system was overheating because the protective plug was still in the inlet. All the plugs around the jet are normally pulled by the time we arrive at the jet. But because this had been a cocked jet it was different. And with the last minute fuel loading, the maintenance personnel forgot to pull it. On a "normal" walkaround the FE would have checked for this. But he wasn't required to do that for this flight, he just went out to check the gear pins...not the plugs.

The lesson here has nothing to do with finding out who is to blame. The real lesson is the importance of good communication — not just within a flight crew, but good communication with maintenance and other support units. We are all in this together and rely on each other to get the mission done. Good communication and coordination could end up being that one thing that "breaks the chain" in the events leading up to an accident. ◆

Captain Darren Ellisor is a USAF E-3A Instructor Pilot serving in Geilenkirchen, Germany.

MAKING A DECISION

Photo: Corporal Michel Levesque, DFS 3-3-2, 2002.

In order for Air Cadet Gliding Centres to successfully conduct their operations, support is required from various military units. To show appreciation for these efforts, our gliding centre organized a public relations day during the week to fly members of the supporting units. As the gliding centres normally operate on weekends, our staff was complemented with pilots from headquarters.

The weather was ideal for the familiarization flight operation. Leading up to a particular glider launch, I strapped into the back seat of a glider and a novice passenger was strapped into the front. As is normal practice, a hot tow pilot change was conducted in the Scout tow plane. It is worth noting that the tow pilot was not a regular member of our staff and I did not have a lot of experience flying with him.

The initial portions of the launch proceeded normally. I soon became aware that the tow plane had not left the ground in the normal distance. In addition to being a glider instructor at the site, I am also a staff tow pilot and familiar with the idiosyncrasies of the airfield. I initially attributed the minor increase in distance to a slightly different take-off technique and the usual slight downwash from the hangars on the east side of the take-off path.

The tow plane left the ground but it soon became evident that my initial analysis of the irregularity was incorrect and that I should abort the glider launch — the tow plane was not building sufficient power! Unfortunately, at this point releasing the glider from the tow plane left no options: a straight ahead landing or turn to the right would result in a collision with a forest, a turn to the left would lead to a collision with the hangars, and there was insufficient altitude to conduct a 180 degree turn. I decided the safest action was to continue with the launch and hope we cleared the trees in front. I also planned to abort the launch if required beyond the forest where there was a more hospitable landing site in the tank range beyond. The passenger was thoroughly enjoying the experience and having never before flown in a small aircraft was oblivious to the threat. I elected to not inform the passenger until we were committed to an action so as to not complicate the situation with an unknown reaction.

Fortunately both the tow plane and glider cleared the forest by making slight deviations in the take-off path and avoiding high spots in the forest. We successfully made it to the tank range where a shallow turn back towards the field was initiated while slowly gaining altitude with the plan of putting both aircraft within gliding position of the airfield. The tow pilot conducted a causal check to find the source of the power loss. The check revealed that the carburetor heat was full hot and once returned to the cold position, full power to the tow plane was restored and the launch was continued up to release altitude without incident.

After the flying day was done, I drove a staff vehicle down the take-off path to re-examine my decision-making process and concluded that from the glider perspective, the only "out" was when I first noticed the slightly abnormal tow plane take-off distance. Regardless of the initial cause of the launch incident, it is up to all crew to complete the mission to safe conclusion — this means you need to ensure you always make the best decisions possible under the circumstances and always have an out. ◆

Captain Peter Anderson serves as the Deputy Commander of the Central Ontario Gliding Centre.

Simple Telephony

Communicating is easy! It must be because no one ever says that we need refresher training yearly, or that we are not proficient communicators if we don't get it. Oh yes, our supervisor carries on about proper phraseology, otherwise known as radiotelephony (RT); but, isn't aviation communication merely adapting to specific task skills that we all learned as children? Learn a bit of proper RT, a little bit about radio theory, and then move on.

Pilots and controllers rarely think about slip-ups in communication; we assume that errors are often minor and human nature convinces us it won't happen again. We tend to think that once we correct an error, we don't need to worry about it any further. Transferring uncomplicated and objective information to another person is an easy matter for most. We know instinctively what needs to be done, yet, within a possible flight safety situation, it could be considered valuable to repeat instructions that are already known. A review of safety-related incidents shows that most incident reports include a problem with the transfer of information between humans. It follows that the ability to communicate effectively is clearly as important to safety as the proper application of operating procedures. What causes such errors in the free flow of information?

Poor radio discipline expands the problem of inadequate or shortened responses. It could be an attitude problem that says, "only rookies worry about saying it right every time." Yet, improper RT and poor microphone techniques have been around since aviation communication began. Aviation radio procedures were developed and improved on during most operating procedures. Proper usage of these procedures can minimize the opportunity for communication errors.

Deliberately abbreviating call signs and acknowledging responses with "that's right" or "right on" are unprofessional and, yet, some people seem to feel that being so unprofessional *is* professional. The purpose of procedures is to limit and, thus, control the opportunity for error. Instead of answering with a "that's right," let the other person know that you have received the message with a "roger." Thereby, such incidents as busted altitudes, traffic conflicts, or switching to wrong frequencies may be behind us. During bad weather, saturated frequencies, or mechanical failures, communication will receive a smaller segment of our time than during periods of lighter traffic. Here is where time management is important. Resources must be allocated effectively and communication must be handled carefully and properly.

Communication is and will continue to be one of the most difficult tasks facing air operations. Given the hundreds of possible communications

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A Flight Philosophy RELEARNED on the GROUND

How many of those annual flight safety briefings have I attended? Typically, I noted the line-up of causal factors — some active, some latent — that led up to some disastrous crash and then, with the thankfulness that comes from not having been that poor guy, I filed it. Did it invigorate my flight safety consciousness the next time I threw on the flight-suit and stepped into the aircraft for my next mission? Certainly, but it lacked the passion that only a personal close call can invoke. Approximately ten years ago, I had the opportunity to learn that philosophy of awareness from an event that was far removed from the flying environment.

It was a mundane day of post-exercise report writing at the Wing Operations Centre (WOC) in Greenwood the day that I had my brush with death. With a mere half-second warning from the alarm, two bottles containing fifteen tons of Halon were explosively discharged into a sealed, oversized vault by the fire-fighting system. About a second later, while racing towards the emergency exit, my world went black — pitch black. Hitting the panic bar that opens the emergency exit, I ran into the steel weather door and struggled in vain to turn the knob handle. It simply would not budge. It was locked and I was trapped!! Cold and light-headed, I pounded on the door alongside a workmate as we struggled to escape. We knew full well that our lungs were taking in virtually nothing but Halon. We bent the top corner of the door out enough so that a sliver of light shone through. I felt my shoulder sliding down the wall as I began to lose consciousness.

Some moments later that weather door miraculously blew open and I was seemingly flung from my knees onto the lawn — ravenously sucking in air until my head cleared. Some half hour or so later I, and the dozen or so other guys who spilled out on to the lawn behind me, wandered back inside to secure classified materials. What a disaster! Walls had shifted and there was a sea of flung paper. Four-foot square fluorescent fixtures hung by their power cords at head level. Thankfully though, the floor was not covered with the bodies of suffocated men.

So...what does this have to do with flight safety? A lot — at least to me. As I reflected upon the causes of that incident, I became aware of how many lessons it held for me in relation to flying. Knowing your emergency procedures? We should have had thirty seconds of alarm to vacate the WOC before the first of the bottles blew but, in reality, we only had enough time to do what was absolutely essential. Remembering those emergency lights that didn't work, I now look much closer at things like our Aviation Life Support Equipment (ALSE) kit. Had we adhered to servicing specifications, those hallway fluorescent lights would have been hard-wired to the ceiling, not resting on the ceiling tile framework, waiting to fall to head height and knock somebody out who was sprinting by in the dark. An evident hazard was a panic bar on the first steel door but not on the second, where the tremendously increased internal pressure jammed the doorknob bolt. I shamefacedly admit to having noted and questioned that oddity, but never pressed for change — for, after all, the system was state-of-the-art and perpetually checked by techs and firemen. Foolproof, right?? Flight following...no!! Nobody had a list of who was in there and nobody came to check on us at the rear of the building for ages, well after we would have suffocated.

Did life seem sweeter after that brush with death? Certainly, a bit — but far more clearly I realized how latent hazards could line up to put your life at risk. I also appreciate how essential it is in the flying environment to be watchful for them and to ensure they are rectified if found. As importantly, I learned to question and to know the procedures. I think the reflective person can draw these lessons from many sources and, for myself, I am thankful that this epiphany came from a bailout on to a lawn, and not into the air or frothing sea. ◆

Captain Adam Chalmers serves with the Software Engineering Squadron at 14 Wing Greenwood.

Simple Telephony

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breakdowns that could occur, and the possible potential for accidents, it behooves us all to work hard at using proper communication procedures. Standard RT procedures will convey the most information possible in the shortest possible time. When your habit is to use good communication procedures, your tendency will be to do it right in all situations. When things are busy or tense, it is not the time for anyone to have to guess what the other person really means. Remember KISSS — keep it short, simple, and standard!

Major Paul Adams is the Wing Flight Safety Officer at 15 Wing Moose Jaw.

DFS Responds

Thank you Major Adams for this insightful reminder that flight discipline includes the way we use words and it includes people who aren't flying (and it applies in maintenance and other support activities as well as Air Traffic Control). Any time we deviate from the proven, accepted, standard, and regulated ways of doing things, we are tempting fate, and most of us operate in an environment where fate is easily tempted. Procedures have been developed by people who have done what we're doing before and know where the pitfalls are. Violating them is not "cool," it is unprofessional and dangerous. ◆

Colonel Al Hunter

Director Flight Safety

MAINTAINER'S CORNER

THE TIME IT TAKES

A poster called "The Time it Takes" has been hanging on a wall in my cubicle for years. Anyone who has worked with explosives will probably know this poster; it is a powerful reminder that it doesn't take much to destroy a lifetime of good practices. I believe the principles outlined in the poster apply to any safety program and can easily be adapted to the Flight Safety Program.

The time it takes:

to become a safe technician	ONE lifetime
to receive a Flight Safety award	ONE year
to implement a Unit Flight Safety Program	ONE month
to carry out a formal Flight Safety survey	ONE week
to conduct Flight Safety training	ONE day
to hold a Flight Safety briefing	ONE hour
to read a Flight Safety poster	ONE minute
to destroy all of the above through a Flight Safety accident	ONE second

Do you think ***it takes A LIFETIME to become a safe technician?*** If you answered "yes", I think you have the right attitude towards Flight Safety and safety in general. I believe we cannot possibly become a safe technician through a course or briefing. However, these tools give us the basic building blocks we need to start our safety education. And, throughout our career, working on the line, in shops and on different types of aircraft, we acquire additional safety blocks that add to our knowledge. Furthermore, this cumulative process never ends, and we continually gather safety components from several sources, including our work, home and social environments. Over time, all these safety building blocks come together to form a safe technician.

It takes A YEAR to receive a Flight Safety award. Technicians who have averted or reduced the severity of an aircraft accident or serious incident can, and should, be nominated for an award (see A-GA-135-001/AA-001 for more details on the different awards). Once the nomination is in, it takes a little while for the paperwork to be processed through the Unit, Wing, 1 Canadian Air Division (Cdn Air Div) and Directorate of Flight Safety (DFS). Once approved, the Director of Flight Safety often presents the award to the recipient during his annual briefing to the Wing. He particularly enjoys these presentations, which recognizes individuals who have made a significant contribution to Flight Safety.

Although it takes ONE MONTH to implement a Unit Flight Safety Program, it has to be adapted and refined to reflect the unit's evolution throughout the years. It could be a change in the type of aircraft the unit is flying (e.g., replacing the CH-113 *Labrador* with the CH-149 *Cormorant* or the CF-104 *Starfighter* with the CF-18 *Hornet*), in the way maintenance is carried out (e.g., civilian personnel maintaining the CT-155 *Hawk*) or in the internal organization of the unit (e.g., deletion of positions). The Program has to be dynamic to remain relevant and this can only be achieved by adapting to the changes happening in the unit. Of course, this concept not only applies to units; it also applies to Wings, 1 Cdn Air Div and even DFS.

It takes ONE WEEK to carry out a formal Flight Safety Survey at most Wings. Spearheaded by 1 Cdn Air Div, the survey is a tool used by both DFS and 1 Cdn Air Div to measure the effectiveness of a Wing's or Unit's Flight Safety Program and provide Commanders with an external view of their organization on matters related to Flight Safety. Because people external to the Wing carry out the survey, it is also a great opportunity for personnel to voice their Flight Safety concerns to people outside their chain of command. However, don't forget that concerns can also be brought up the chain of command through a Flight Safety Hazard Report (see A-GA-135-001/AA-001 for more information on how to submit hazard reports).

It takes ONE DAY to conduct Flight Safety training. As stated earlier, training is only one of the many components making up a safe technician. Formal Flight Safety training is often administered only to people who will be in Flight Safety positions, such as the Wing Flight Safety Officer Assistant or the Unit Flight Safety NCM, and most technicians will not get the benefit of that type of training. It could be advantageous for units to create their own Flight Safety training day in order to provide newcomers with an overview of the unit's Flight Safety Program, as well as to introduce them to the members of the unit's Flight Safety team.

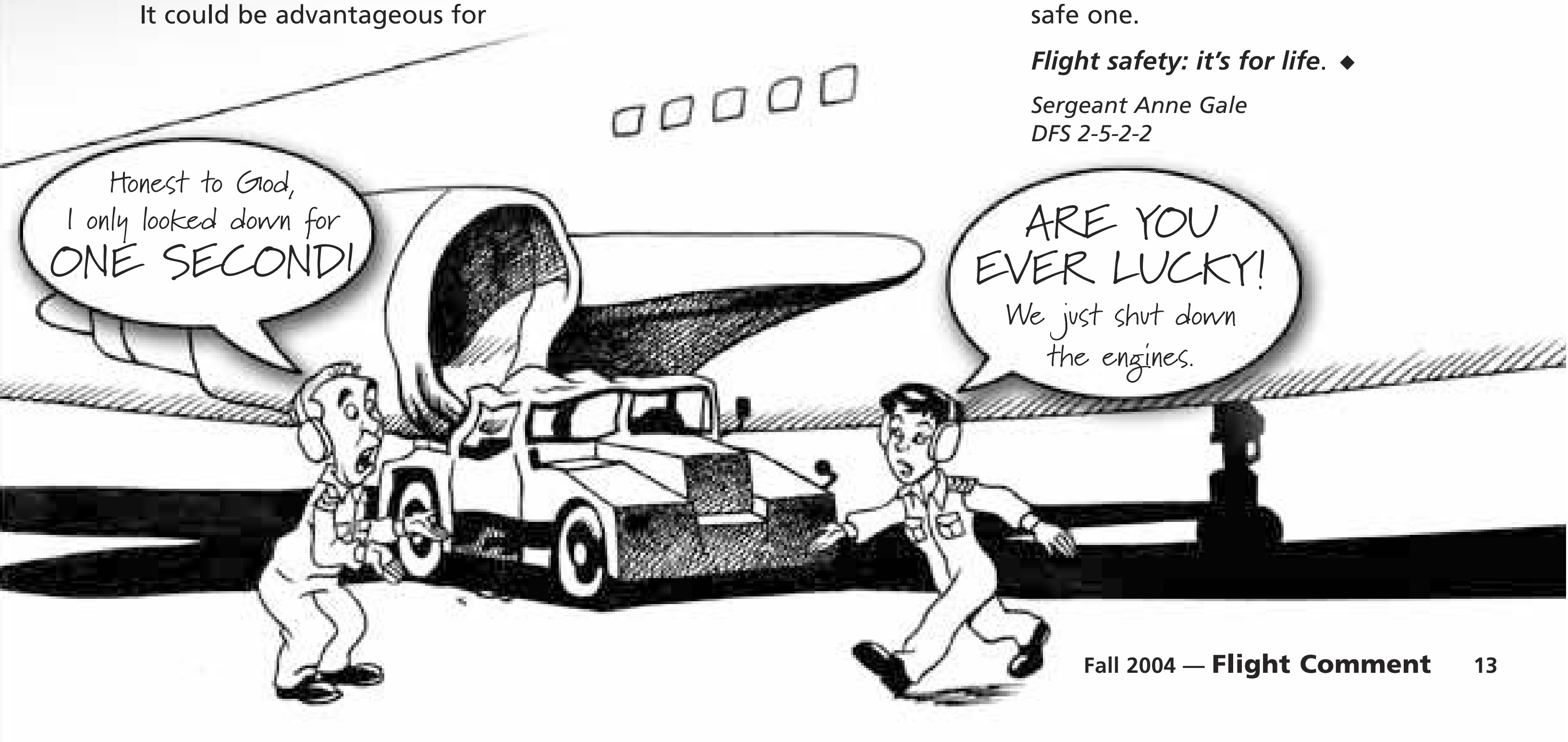
It takes ONE HOUR to hold a Flight Safety briefing. Unfortunately, these briefings are often reactive rather than proactive. Aircrews usually have a regular, scheduled Flight Safety briefing as part of their morning briefing. However, most briefings to technicians occur as a result of a recent incident. I know in some units it may be extremely difficult to find an hour to conduct a Flight Safety briefing, but I believe the same effect can be achieved by having regular (once a week) five-minute safety talks. These could be easily carried out at the beginning of the shift, each crew chief passing on Flight Safety information to his or her crewmembers. Subjects could include, for example, cold or hot weather safety precautions, aircraft danger areas, tool control, etc.... The point is not to explain in detail the chosen subject or the Flight Safety Program, but rather to offer a reminder of the dangers associated with aircraft and airfield operations.

For most of us, it takes ONE MINUTE to read a Flight Safety poster (if the poster is interesting, that is!) Unfortunately, we often don't even look at these posters although they are a great source of Flight Safety information. If the posters on your Flight Safety board or around the canteen are old and outdated, let your Flight Safety NCM or Officer know that it is probably time to put up new ones. Furthermore, DFS is always extremely happy to get poster ideas from the field.

Unfortunately, ***it takes only ONE SECOND to destroy all of the above through a Flight Safety accident.*** One moment of inattention, and a lifetime of safe practices are destroyed. If we're lucky, we'll just get a close call and a good scare, and, undoubtedly, this will renew our interest in Flight Safety. If we're not so lucky, however, we won't have to worry about Flight Safety because the Program is aimed at the living; although, it could be said that the dead helped write it. So, to honour those who have perished in aviation accidents, embrace the Flight Safety Program and encourage new technicians arriving in the unit to do the same. We only have one life to live, so lets make it a long and safe one.

Flight safety: it's for life. ◆

Sergeant Anne Gale
DFS 2-5-2-2



SERA

SYSTEMATIC ERROR AND RISK ASSESSMENT

A TOOL FOR UNDERSTANDING HUMAN FACTORS ISSUES IN ACCIDENT INVESTIGATIONS

Keith Hendy,
Human Factors Research and Engineering Section
Defence Research and Development Canada (DRDC) Toronto

BACKGROUND

Something has gone wrong in your operation. There has been an accident or incident and you need to get to the bottom of it. Human operators are involved and you need to find the answer to the question "...why did they do that?"

You already believe human factors issues are important in accident investigation, and you know the Air Force has a classification scheme for capturing human factors causes once you identify them...known as the **Human Factors Accident Classification System** or HFACS. Now comes the big question: how do you make sense out of the complexity of human behaviour so you can correctly assign human factors causes and populate the HFACS database with useful and reliable information? The **Systematic Error and Risk Assessment** (**SERA**) tool was designed to help you through that process, to try to make sense out of chaos and lead you though the critical steps in identifying what human factors issues contributed to the unsafe acts or conditions you are investigating (Hendy, 2002).

THE BASIS FOR SERA

SERA is based on collaborative research conducted by the author and others at DRDC Toronto over a number of years (Hendy, 1995; Hendy, 1997; Hendy, East, and Farrell, 2001; Hendy and Farrell, 1997; Hendy, Liao, and Milgram, 1997). DRDC is an agency of the Department of National Defence responding to the scientific and technological needs of the Canadian Forces. The agency is made up of six research centres located across Canada, with a corporate office in Ottawa. The author leads the Human Factors Research and Engineering Section at DRDC Toronto. For further information on DRDC Toronto, see *www.toronto.drdc-rddc.gc.ca.*

The aim of this research was to understand what factors lead to perceptions of operator workload and the eventual breakdown of human information processing. This work resulted in two models that provide considerable insight into the limitations of the human information processing mechanism.

Information Processing Model

The first model is called the Information Processing (IP) model and it claims that mental workload depends on the perceived time pressure as defined by:

$$\text{Time pressure} = \frac{\text{Time to make a decision}}{\text{Time available}}$$

It can be shown that if humans process information at a constant rate, this is the same as (k is a scaling factor related to the rate at which processing proceeds):

$$\text{Time pressure} = K \frac{\text{Amount of information to be processed}}{\text{Time available}}$$

Hence, the IP model reduces all factors that contribute to operator workload to their effect on the **amount of information** to be processed or to the **amount of time you believe you have** to make the decision. These equations are acted out in the head of the operator...not in the outside world. The amount of information to be processed for any decision depends on what an individual knows about the world and their strategies for dealing with the situation at the time the decision must be made. The perceived time available will also depend on a variety of individual differences, including the operator's tolerance for risk and uncertainty.

The IP Model is about **time** and the **information (knowledge) to be processed**. The IP model applies everywhere in the human cognitive system where information is being processed.

Perceptual Control Theory Model

The second model, shown in Figure 1, is an adaptation of William T. Powers' Perceptual Control Theory (PCT) model (Powers, 1973). PCT claims that humans behave as multi-layered closed-loop control systems. The "set points" — just like the temperature you set on a room thermostat — for these control loops are our perceptual goals (or how we want to **see, hear, feel, taste,** or **smell** the state of the world). According to PCT, we sense the world state, forming a perception of that state which we then compare with our goals or desired states. This is shown by the $\sum$ sign in Figure 1, which represents the mathematical summing operation. If there is a difference between our perceived and desired states, we formulate an action. This action is implemented in order to operate on the world so as to drive the perceived state of the variables of interest towards the goal. The perceptual processes and the decisional processes draw on knowledge that is stored in our memory to transform **sensation** to **perception**, and **difference** to **action**. Our attentional mechanism shifts our focus from loop to loop to loop. The PCT model is therefore about **goals, attention, knowledge** and **feedback**.

The bottom line

The principal points of the IP and PCT models can be summarised in the following six general rules:

1. **Time pressure**

   Error production, level of **performance** and perceptions of **workload** all depend on the perceived time pressure.

2. **Speed and accuracy trade off**

   In human information processing — what might be colloquially called decision-making — speed and accuracy trade off. If one increases the other decreases.

3. **Reducing time pressure**

   There are two — and only two — fundamental time management strategies for reducing the perceived time pressure. These are:

   - Make the decision simpler, resulting in less information to process (use rules of thumb or heuristics, prioritise, delegate, postpone, schedule, pre-plan, etc.).
   - Extend the time before you have to respond.

4. **Error management**

   A feedback system is error correcting; all error correcting systems use feedback. Error correcting systems manage to drive the system towards the goal even if external events are conspiring to defeat you, just as an air conditioning system stablises the room temperature even if people are opening doors as they come and go.

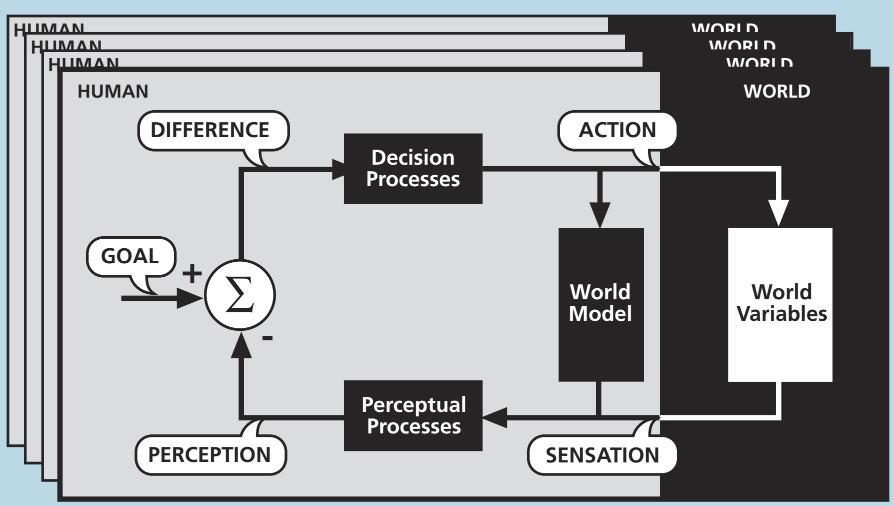


Figure 1. The multi-layered Perceptual Control loop for a human operator interacting with the world.

5. **Resource management**

   The decisions you make draw on what you know of the world (the content of all your internal knowledge structures — you may not be consciously aware of all items in your knowledge structures). To **know** you must **attend** (or control), to **attend** you must have **time**. This is particularly relevant in talking about the transient or situationally specific knowledge called Situation Awareness or SA (e.g., Endsley, 1993).

6. **Ignorance is NOT bliss**

   What you don't know **can** hurt you (see rule 5 above).

You will find these rules reflected in the "decision ladders" SERA uses to trace how the human information processing broke down.

HOW DOES SERA WORK?

Let me count the ways

From PCT it is predicted that the answer to the question "...why did they do that?" is generally resolvable once you know (see Figure 2):

- what a person's goal was;
- how they perceived the world; and
- how they were trying to achieve the goal (their actions).

If the action was not what was expected then the problem must lie with: the **perception**; the **goal** setting or intent; or the **action** selection and execution. SERA, the tool developed to help you find out why the unexpected happened, sets out to understand how these processes may have broken down. A SERA analysis starts with a statement of the unsafe act or incident and then traces the information processing breakdown through a series of decision ladders based on the theoretical concepts embedded in both the IP and PCT models.

But what can I do about it?

The SERA decision ladders are shown in Figure 3. These ladders lead to eleven points of active failure (counting the **sensory** and **response** categories as two different points of failure). Exercising these decision ladders identifies the immediate or active failures that we believe led to the unsafe act or incident...but the job is not finished there. It is the underlying conditions of the task, the personnel, the environment, the command and control or supervisory situation and the condition of the organisation that create the opportunity for the active failures. These are known as the "pre-conditions." They exist prior to and leading up to the unsafe act or condition.

It is the states of the pre-conditions (the "whys") that you must change to prevent a similar occurrence from happening in the future, because there is little, if anything, you can do about the active failures (the "whats") themselves. They represent fundamental human capabilities and limitations.

SERA acknowledges the existence of three layers of pre-conditions, as shown in Figure 4. They start with those most immediate to the operators and conclude with those contributed by the organisation and its supervisory and control structure. The result was strongly influenced by the work of James Reason (Reason, 1990) and others who have significantly demystified our understanding of 'human error' and its root causes. To help the investigator in the diagnosis of accidents and incidents, all active failures have been mapped into those pre-conditions that are most likely to be associated with each active failure as shown in Table 1. While other linkages are possible, Table 1 is a good starting place for making connections. Finally, to be consistent with the Directorate of Flight Safety's use of a version of HFACS, SERA's active failures have been mapped to their closest equivalencies in the HFACS scheme.

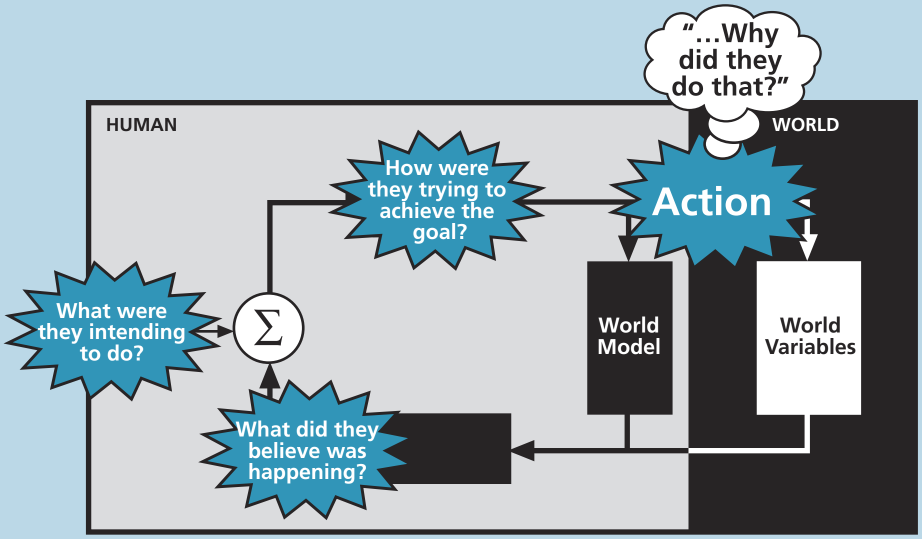


Figure 2. Three questions to ask.

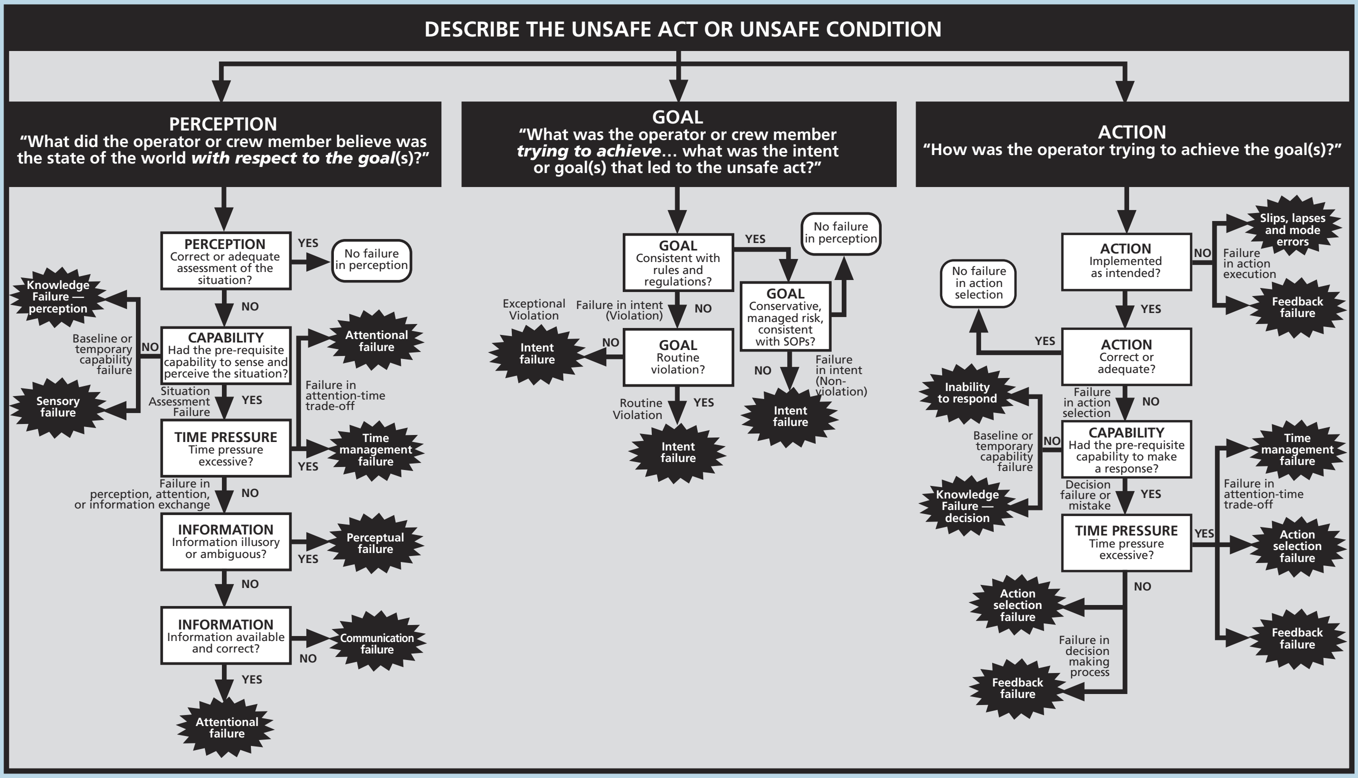


Figure 3. SERA decision ladders.

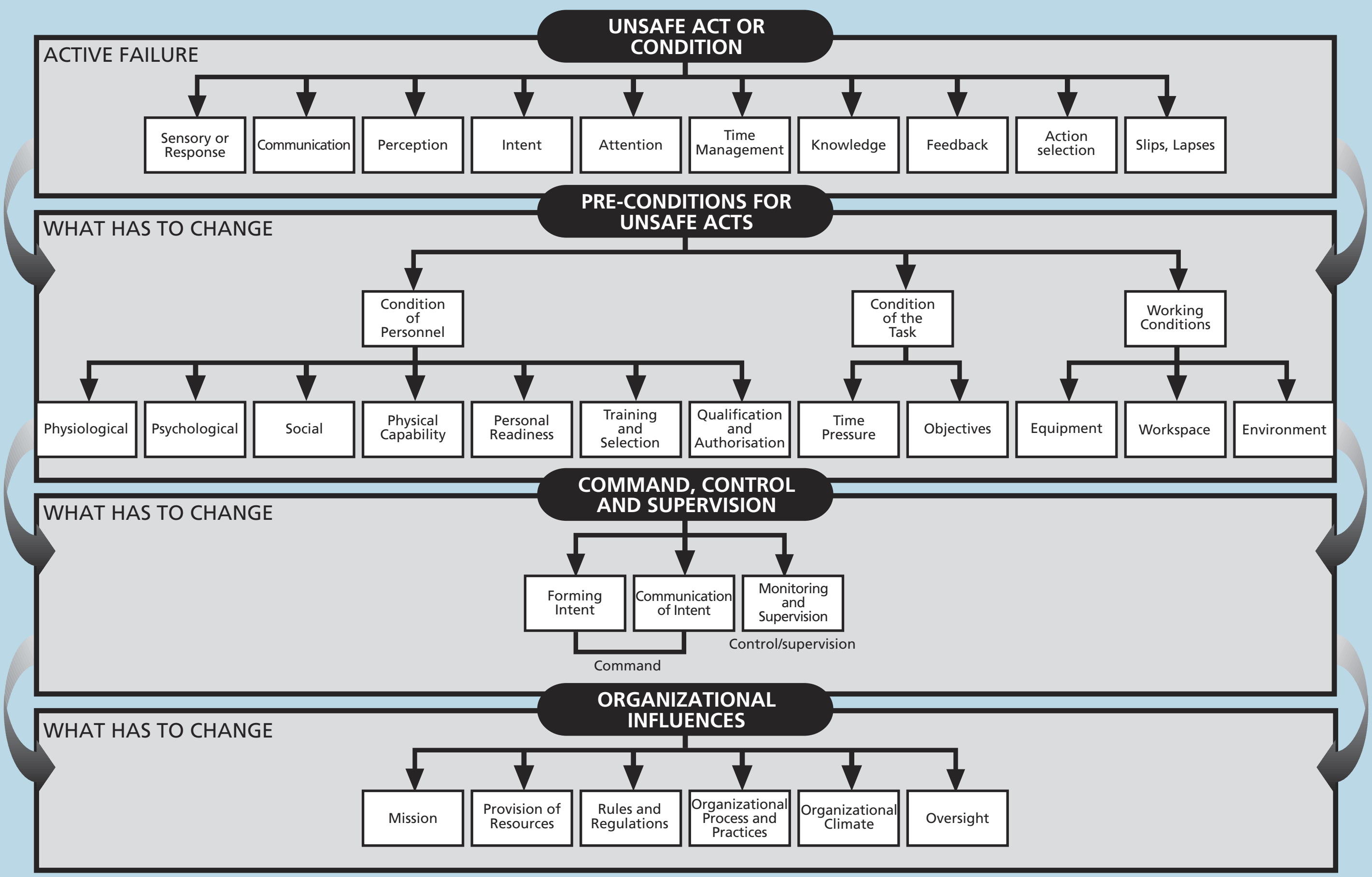


Figure 4. Active failures and three layers of pre-conditions.

	PERSONNEL							TASK		WORKING CONDITIONS			C2 AND SUPERVISION			ORGANIZATION					
FAILURES	Physiological	Psychological	Social	Physical Capability	Personal Readiness	Training and Selection	Qualification and Authorization	Time Pressure	Objectives	Equipment	Workspace	Environment	Forming Intent	Communicating Intent	Monitoring and Supervision	Mission	Provision of Resources	Rules and Regulations	Organizational Process and Practices	Organizational Climate	Oversight
Sensory	✓			✓	✓	✓			✓	✓		✓			✓				✓		✓
Knowledge — Perception						✓	✓		✓				✓		✓	✓	✓		✓		✓
Perception	✓	✓				✓				✓		✓			✓				✓	✓	✓
Attention	✓	✓	✓		✓	✓		✓		✓		✓			✓	✓	✓		✓	✓	✓
Communication		✓	✓							✓		✓			✓				✓	✓	✓
Time Management						✓		✓							✓	✓	✓				✓
Intent — Violation		✓	✓			✓	✓	✓	✓				✓	✓	✓			✓		✓	✓
Intent — Non-violation		✓				✓	✓		✓				✓	✓	✓	✓		✓	✓	✓	✓
Knowledge — Decision						✓	✓								✓	✓			✓		✓
Response	✓			✓	✓	✓	✓		✓	✓	✓	✓			✓		✓		✓		✓
Action Selection		✓						✓							✓	✓	✓				✓
Feedback	✓	✓	✓					✓		✓		✓			✓	✓	✓				✓
Slips, Lapses						✓				✓								✓	✓		✓

Table 1. Linking active failures with pre-conditions.

NOW WHAT?

At this point you might just see SERA as an interesting idea and can't imagine how one would go about conducting an analysis using these concepts. To overcome some of the barriers to adopting a new approach to investigation, and to make the SERA concepts more accessible, DRDC Toronto has had a software tool created using the JAVA® programming language. It potentially runs on any platform that supports this environment. Currently SERA has been ported to computers running the following operating systems: Windows®, Macintosh®, and Personal Digital Assistants (PDAs) using Windows® CE. A rather novel feature of SERA is that it produces a first cut at the accident report by assembling all the decision ladder selections and supporting text that is entered into a text file that can be read by common word processing programs. Recently we have also added some basic direct voice input capability to make note taking in the field easier, particularly when using a PDA for data gathering.

As DRDC Toronto produces human factors analyses for most aviation related accidents in the Canadian Forces, as a supplement to the investigations carried out by DFS, SERA has the potential to make life easier for our investigators. For over 12 months now DRDC Toronto has been using SERA to structure our investigative work and organise our reports. Over a dozen accidents have been subjected to SERA analyses. So far the results have been encouraging and appear to lead to more detailed and logical conclusions.

Continued on page 21

How could this have happened?

It was time for the last helicopter to be put in its nest, and the crew would soon be headed home for the night. The crew was a lively bunch that evening and had put in a lot of good work. Over the public address came an announcement: "Crew Chief, report to the servicing desk immediately." I broke off my discussion with a technician and walked across the hangar floor. The servicing desk said "there has been an accident and one of the tow crew members has been run over. Ops had been notified and an ambulance was on its way." *How could this have happened?*

I ran to the flight line and saw the tow crewmembers administering first aid to the injured member as they prepared to move him. His spirits were high and he was embarrassed to have been injured. He was transported to the safety of the hangar canteen where the ambulance attendant could easily enter and he could rest. We soon learned that he tripped and the ground-handling wheel ran over his leg before anyone could act.

The ambulance arrived and he was quickly transported to a local hospital. We made telephone calls to senior staff and had a conference with the Commanding Officer about what to do next. *How could this have happened?* How could I have failed this man? The end of the shift did not come as quickly as I had anticipated.

We assembled in the crew room and went over the events of the evening. Many questions were asked: "What position was each member fulfilling? Who was in charge?..." One member stated that he *guessed* that he was i/c. (assume? leadership?)

Everyone was accounted for. The injured member was on the right hand side near the skid tube. Why? During the move he tripped and was caught by the ground-handling wheel before he could pull his leg away, or even shout for the tow driver to stop. Where were the local towing procedures? They were not complete and that led to more confusion. What about general safety rules? Review of the qualifications of the tow crewmembers identified confusion in standardization, depth of tasks, and recording procedures. Some things were not signed off/authorized. More gaps! *How could this have happened?*

The helicopter wheels were not being installed correctly, resulting in excessive weight problems for the tailskid member. Large changes in crew organization and supervision in the last six months. *How many other causes were there? How could this have happened? What were the root causes?*

For every accident or incident there are cause factors that identify the problem or problems, which lead to preventive measures. ◆

Anonymous

MINIMUM MANNING

As the Air Traffic Control (ATC) Unit Flight Safety Officer (UFSO), I have had the opportunity to investigate and learn some important lessons. One of the most valuable lessons I have learned is that the cause of a flight safety (FS) incident may not always be as obvious and immediately apparent as it seems.

One such case occurred in the form of a runway incursion. An armament vehicle traveling from one ramp to another, along a taxiway, proceeded onto the runway as a CF-18 was on short final to land. Fortunately, the CF-18 pilot noticed the vehicle, overshot the runway, and went around to land without further incident. The question remained — how did it happen that the vehicle was on the runway?

At first, the investigation revealed that the ground controller had not issued a “hold short” restriction to the vehicle. Had the investigation stopped there however, one would be led to believe that this was the sole cause factor leading to the FS incident. But this was definitely not the case. When looking deeper into the situation it became apparent that the ground controller had been performing two jobs at the same time — covering both the ground control and the air traffic control assistant position. Although it is not uncommon for this to occur, certain rules govern the traffic levels during which one person should be able to perform both tasks.

Photo: Warrant Officer Pat Meuse, Air Traffic Control Standards and Training, 15 Wing Moose Jaw, 2004.

At the time of the incident, there were ten aircraft airborne and about four to six more flight-planned for departure. As a general "unwritten" rule, the shift supervisor calls "minimum manning" only at such time when there are four or less aircraft airborne or flight-planned. This, being an unwritten rule, has left much room for interpretation and judgment. Most shift supervisors have pushed the envelope more and more over the years, and called minimum manning with more and more aircraft airborne. It seems to have become a "routine violation," not only acceptable, but almost expected. The truth is however, it was an accident or incident waiting to happen. It was only a matter of time before something happened ...and it did!

As a shift supervisor in a control tower, we must be aware that every day we are faced with this judgment call of when to declare minimum manning. By pushing the envelope, we may overtask the ground controller and force him or her to work beyond a level that is deemed reasonable.

What we must realize is, although it may seem that we are doing the ground controllers a "favour" by letting one person go home early, we may be putting the whole operation in jeopardy. We would not wittingly put this person nor, for that matter, the whole operation at risk of incurring a flight safety occurrence. Fortunately, we were all given the wake-up call and now perhaps will think more carefully when deciding on the appropriate time to declare minimum manning. ◆

Anonymous

SERA

SYSTEMATIC ERROR AND RISK ASSESSMENT

Continued from page 18

What is missing is a formal test of the reliability of the SERA process. To do this we will need to get numerous investigators to analyse the same set of accidents using SERA. Some attempts have been made to get this done, using National Transportation Safety Board (NTSB) data and involving DFS and the international scientific community...so far without a successful conclusion. However, if this phase can be completed then we can compile the root causes that come from the all the analyses and check them for consistency. Not only can we look for internal consistency in the results, we could also compare the causal factors from the SERA analyses with the conclusion of the NTSB investigator. Only then might we claim that SERA is indeed the better mousetrap we think it is! ◆

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TEST THAT FUEL

Often when we examine the prevention of flight safety occurrences, or attempt to assign cause factors to those that take place, we focus on weakness in procedures, organizational culture and our local flight safety education program. While doing so allows us to develop and refine out systems, we often overlook the importance of the many support programs that support flight safety until they become cause factors themselves. Explosives safety and air weapons safety come quickly to mind as examples of contributing programs but equally important is maintaining the quality of your fuel supply.

The greatest hazard when dealing with aviation fuels is the accumulation of water in aircraft and bulk storage tanks. At low temperatures, the presence of water can lead to the formation of ice in fuel lines and filters. The presence of ice can lead to compressor stalls and, potentially, engine failure. If these conditions develop in flight, the consequences can be fatal.

As lodger units on land forces bases, tactical helicopter units rely on the host base for the majority of their fuelling needs. At times, this separation between user and supplier makes it difficult to ensure fuel quality as land forces personnel frequently do not have experience dealing with aviation fuels. This makes good communications between the two groups essential.

This was highlighted recently by a situation that developed for 403 Squadron at CFB Gagetown. Daily testing on bulk storage tanks did not indicate the presence of water at the fuel farm, even though the accumulation of water is a normal occurrence and can be remedied with relative ease. This continued until one day, periodic testing resulted in a sample contaminated by a thick, dark substance.

Additional testing by the Quality Engineering Test Establishment (QETE) showed this fluid to be a significant quantity of water with microbiological growth (MBG).

For the MBG to form, the water in the tanks would have had to have gone undetected for an extended period of time, which ran counter to the results of regular daily testing. When these results were reported to 403 Squadron, the entire bulk fuel facility had to be quarantined until the problem was resolved.

By working together, personnel from both units were able to determine that the wrong detection chemical had been used and as a result, the presence of water would never be detected. A suitable alternative was located and approved, the contamination was cleaned out and fuelling operations eventually returned to normal but the condition had apparently existed for a considerable length of time. This means that flying operations may have been conducted using fuel with high water content, increasing the risk of experiencing a flight safety occurrence.

Although effective communications were able to bring a quick resolution to the problem once it had been identified, had that same effort been applied at an earlier stage, the risk might have never developed. Although the flight safety program often overlooks fuel quality until the investigation of occurrences, careful management can prevent them from happening. ◆

Lieutenant Jose Castillo serves at 403 Squadron as the Deputy Squadron Aircraft Maintenance Engineering Officer at CFB Gagetown.

EPILOGUE

TYPE: **Sea King CH12401**

LOCATION: **540 NM ESE of Halifax, Nova Scotia**

DATE: **27 February 2003**

During the launch sequence from HMCS IROQUOIS, the aircraft lost lift while in the hover over the flight deck. Numerous personnel, both within the helicopter and on and around the flight deck, reported hearing a loud popping noise. After falling heavily onto the flight deck, the helicopter's sponson detached and the helicopter rolled over, suffering "A" category damage. All four crewmembers egressed the helicopter under their own power with only one minor injury.

Just prior to the helicopter's launch, IROQUOIS was conducting a Replenishment-at-Sea (RAS) with HMCS PRESERVER. During the RAS it was noted that two waves broke over the helicopter's fuselage. IROQUOIS' flight deck video system did not record the accident. Additionally, had Cockpit Voice Recorder/Flight Data Recorder (CVR/FDR) equipment been fitted to the CH-124 fleet, the data would have enabled a more expeditious and definitive conclusion to the Flight Safety Investigation (FSI).

Pilot technique, weather, and environmental conditions were eliminated as factors in the uncommanded loss of lift, thus focussing the investigation on technical cause factors. Analysis of the main rotor gearbox determined that it was fully serviceable and did not experience the known phenomenon of freewheel unit spit-out. The T58-GE-100 engines exhibited no indication of compressor salt encrustation and engine icing was also eliminated. Analysis did, however, indicate that the number one engine's inlet guide vanes and variable stator vanes were adjusted open towards the decelerative stall boundary, beyond Canadian Forces Technical Orders (CFTO) limits. It could not be determined when the engine was mis-rigged, yet it was likely post-installation while at 12 Wing Shearwater.

During the latter stages of the FSI, several unexplained losses of torque occurred within the Sea King fleet. The ensuing technical investigation, the largest in the history of the CH-124, identified the phenomenon of Sudden Uncommanded Transient Loss of Torque (SUTLOT) to be the result of anomalies within the Sea King's torque system. Based on the information provided to the FSI by the SUTLOT Technical Investigation, the cumulative analysis of the components of SUTLOT within CH12401 was consistent with the conclusion that CH12401 likely did not experience a SUTLOT occurrence at the time of the accident.

After carefully examining all the available data, it was concluded that the number one engine likely experienced a compressor stall that limited the total power available to CH12401 during a critical phase of flight over the flight deck.

Numerous safety measures were taken post-accident, most importantly improvements to ships' flight deck fire fighting systems were made, a review of engine tuning procedures was initiated, and the development of effective single engine training (which was expedited by the SUTLOT phenomenon) was initiated.

It was further recommended that a crashworthy CH-124 CVR/FDR capability be acquired, improvements to ships' flight deck video systems be made, a CH-124 single engine training needs analysis be completed and fire retardant seals be procured for the constant wear immersion suit.

Peripheral issues addressed by the FSI included discrepancies with the current engine tuning procedure, a lack of adequate single engine training, a poor correlation between flight safety and maintenance data, and operational problems with the firefighting equipment aboard HMCS IROQUOIS. ◆

EPILOGUE

TYPE:	**Cessna 172, C-GTHL**
LOCATION:	**Fredericton, New Brunswick**
DATE:	**14 August 2003**

The solo student-pilot was participating in the Air Cadet Atlantic Region Powered Flying Scholarship program through Moncton Flying College (MFC). She had just completed the first leg of a Visual Flight Rule (VFR) cross-country flight when, while on short final to Fredericton Airport, she changed from a normal approach and landing configuration to a short-field approach and landing configuration in order to hold short of a runway intersection. This change was done at the request of the Fredricton Flight Service Station (FSS) specialist to accommodate other traffic. The accident aircraft landed hard, bounced several times, and finally came to rest on the runway past the intended hold-short intersection. The cadet received minor injuries while the aircraft received "C" category damage.

The investigation determined that the aircraft was serviceable prior to the accident. Also, the FSS specialist was unaware of the pilot's student status.

By accepting the 'hold-short' request, the solo pilot placed herself in a position in which a stabilized approach was never achieved. Following the unstable approach, the student attempted to complete a full-flap, short-field landing at a higher than prescribed airspeed, which resulted in the accident. The option of conducting an overshoot was available at various points during this sequence of events.

This accident highlights the requirement to include Human Performance in Military Aviation (HPMA) training in the Air Cadet Powered Flying Scholarship Program. HPMA includes topics on time-management, and decision-making. As well, students should be reminded during the training program that they have limited experience and should not attempt to perform complex manoeuvres under pressure without supervision.

There is also a requirement that Air Traffic Control (ATC) be advised of a pilot's student status on the flight plan. This will remind them of the pilot's limited experience, and assist ATC in their management of traffic flow.

The final report is available on the DFS website. ◆

EPILOGUE

TYPE: **Katana DA-20 C1 C-GEQF**
LOCATION: **St-Lambert de Lévis, Quebec**
DATE: **25 June 2002**

The Katana aircraft and crew were conducting the second flight of the private pilot course in the Air Cadet Flying Scholarship program. The student and Instructor Pilot (IP) were practicing circuit procedures in the local training area when, during a simulated final approach at approximately 400 feet above ground level (AGL), the IP took control of the aircraft and executed a missed approach. The IP felt a restriction to the flight controls and subsequently noticed that the student's hands remained on the control column. The IP repeatedly ordered the student to release his grip, however, the student did not respond. The aircraft contacted the ground, right wing first, and came to rest in a newly seeded cornfield. The student and IP exited the aircraft unassisted and uninjured. The aircraft suffered "A" category damage.

The Flight Safety Investigation (FSI) determined that meteorological conditions and aircraft serviceability were not factors in this accident.

The FSI concluded that it was most probable that the student unknowingly gripped the control column and interfered with the IP's control inputs during a critical phase of flight. Contributing to this was most likely the student's elevated stress level which caused him to tense-up and pull back on the control column against the IP's inputs. Additionally, the IP was surprised by his inability to control the aircraft and, in the ensuing high stress situation, he did not consider physically removing the student's hands from the control column.

The student's ability to resume training was assessed by a Canadian Forces Flight Surgeon; he subsequently resumed training, successfully completing the course. It was recommended that this accident be used during IP training within the Air Cadet Gliding and Flying programs to illustrate the rare situation when a student freezes on the controls and impedes the IP's ability to control the aircraft, thus requiring an IP to use more than verbal means to regain aircraft control. ◆

EPILOGUE

TYPE: **SZ2-33 Glider**
LOCATION: **Alexandria, Ontario**
DATE: **20 September 2003**

During the final flight of the day, the Air Cadet glider, piloted by a Cadet Instructor Cadre (CIC) pilot, crashed while manoeuvring to land at the Alexandria Gliding Site. The passenger, also a CIC pilot, suffered minor injuries to his lower back. The glider suffered "A" category damage.

The pilot took off from Runway 25 and, after some work at altitude, flew a standard circuit profile to runway 25 until he was established on final at about 450' above ground level (AGL). At this point, the pilot fully opened the spoilers and lowered the nose to begin a rapid descent. The aircraft was then levelled at approximately 50' AGL and 85 MPH before the pilot executed a 30° angle of climb pull-up, reaching approximately 100' AGL and 50 MPH. A 45°–60° angle of bank left turn was then initiated to line up on the auxiliary field, situated 90° to runway 25 and adjacent the glider overnight parking area. The spoilers remained open throughout this manoeuvre. It was during this low level turn that the left wing first contacted the ground, sending the glider cartwheeling.

The investigation revealed numerous issues of concern. Although he departed from, and completed the initial part of the approach to runway 25, the pilot chose to land on the auxiliary field in order to avoid the extra time it would take to push the glider from the end of runway 25 to the overnight parking area. To set himself up for landing, the pilot conducted the "very rapid pull-up," an aerobatic manoeuvre; aerobatic manoeuvres are prohibited within the Air Cadet Gliding Program. This manoeuvre was initiated from a height of 50' AGL and resulted in a turn to final at about 100' AGL, both well below the 300' minimum altitude for being established on final approach in accordance with safe operating practices (and as specified in the Air Cadet Gliding Program Manual). While within wind limits on runway 25 (260 11G18), the decision to land 90° from the take-off runway on the auxiliary field exceeded the crosswind limits by 3-10 knots. Finally, an underlying culture of non-compliance was present among the staff of the Quinte Gliding Centre. This led to instructors carrying out prohibited manoeuvres, specifically the very rapid pull-up, while receiving accolades from their peers for their perceived flying ability.

Recommended safety actions included the establishment of an effective Standards Evaluation Team and the implementation of supervisory training for gliding site supervisors.

DFS Comments

For the past few years, the flight safety organization has emphasized the requirement for a strong safety culture. It is my firm belief that encompassing a just culture, a reporting culture, a flexible culture and a learning culture is a fundamental requirement for an effective safety program. Accordingly, the safety culture concept has been taught on our Basic and Advanced Flight Safety Courses and has been highlighted in a variety of our flight safety promotion mechanisms.

In reviewing this report, it is clear that the safety culture at the Alexandria Gliding Site was very poor. In particular, evidence of a just culture was lacking. The pilots at this site apparently understood the difference between what constituted acceptable behaviour and unacceptable behaviour in that they knew the rules and regulations as well as the aircraft operating limitations. However, by routinely allowing some personnel to operate outside of the acceptable limits, supervisors and CIC glider pilots effectively undermined the safety culture of this site. In addition, a number of impressionable young Air Cadets observed this behaviour. The conclusions that this latter group drew can only be postulated, but I suspect that they do not bode well for a strong safety culture.

So what can be learned from this accident? To me, this accident reinforces my belief that a good safety culture is critical to a safe flying operation. While a good safety culture will not prevent all accidents, it is highly likely that it would have prevented this one. Another point that needs to be emphasized is that a safety culture is not something that is practiced only by some members of the organization or only within sight of senior supervisors. By definition, a safety culture is a full time commitment by everyone. ◆

FROM THE INVESTIGATOR

TYPE: **Hornet CF188761**
LOCATION: **Yellowknife Airport, Northwest Territories**
DATE: **19 June 2004**

The aircraft had just transited to the Yellowknife Airport from 4 Wing, Cold Lake, Alberta as number two in a three plane formation. The landing runway, 33, was "bare and wet". During the after landing roll, aircraft directional control was lost with the aircraft turning through at least 300 degrees. The pilot ejected from the aircraft just prior to the aircraft leaving the runway/taxiway surface near the departure end of the runway. The pilot sustained a serious injury during the ejection sequence and was transported to the local hospital for treatment.

The aircraft remained upright but a missile was dislodged from its mounting during contact with the runway environment. The aircraft and loose missile skidded to a halt in the taxiway edge gravel area, about 90 degrees from runway heading. The aircraft suffered "D" category damage in the accident due to runway contact and the ejection sequence.

Several precautionary measures to assure public safety were taken by the Yellowknife Airport Authority until the aircraft weapons could be made safe, and the aircraft was towed to an isolated area.

The investigation is ongoing and will focus on issues such as ejection seat related injuries, routine calculation of after landing roll at non Main Operating Bases for deployed CF-188 operations, verification of the status of the aircraft anti-skid system and rectifying a training deficiency for the 6B Physician Assistant with respect to aviation medicine. ◆

FROM THE INVESTIGATOR

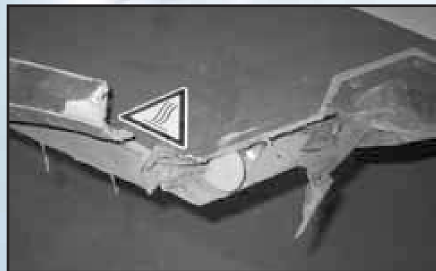
TYPE: **Sperwer, CU161004**
LOCATION: **Kabul, Afghanistan**
DATE: **30 June 2004**

The unmanned aerial vehicle (UAV) troop was tasked to carry out a routine mission in the Kabul area. The crew completed the pre-flight check without any problem. Take-off occurred at 2135 hrs local. Everything was normal and the crew proceeded to complete the mission.

At 2150 hrs local, transmissions were lost with the Sperwer approximately 20 km from the normal recovery zone. The crew carried out emergency procedures as per the checklist. At 2205 hrs local, transmissions were regained. The crew checked all the systems and everything appeared to be normal. The crew elected to continue mission with a target closer to the recovery zone.

At 2230 hrs local, transmissions were again lost with the vehicle approximately 15 km from the recovery zone. Every attempt was made to regain transmissions but to no avail. The Sperwer was recovered in emergency mode and landed in a residential area, lightly contacting a power line and coming to rest against the wall of a house. No obvious collateral damage and no injuries were experienced.

The vehicle suffered "C" Category damage to the right wing and nose areas. ◆



FROM THE INVESTIGATOR

TYPE: **Sperwer, CU161002**
LOCATION: **Kabul, Afghanistan**
DATE: **20 March 04**

The accident, a Sperwer unmanned aerial vehicle (UAV), was being launched on a operational mission. The launch sequence appeared normal until the air vehicle reached approximately 50 meters above ground level (AGL) when it started to level off.

At this point, the vertical speed indicator (VSI) began to fluctuate between plus 0.2 meters per second (m/s) and minus 1.1m/s and at an altitude of between 40-60 m AGL. The crew then took control of the vehicle to attempt to induce a climb.

This was unsuccessful and as the air vehicle approached a populated area the aerial vehicle commander (AVC) made the decision to initiate an emergency recovery. The vehicle's altitude was at 50 m AGL. The vehicle's parachute deployed but did not inflate. The vehicle subsequently impacted in an open area to the south of Kabul.

The Sperwer sustained "B" category damage.

The investigation is focusing on the carburetor settings and vehicle ability to operate at high density altitudes. ◆

For Professionalism

CORPORAL KIP CORMIER

While walking across the hangar, Corporal Cormier, a student on the basic Flight Engineer course noticed worn paint on a CH-146 main rotor blade, near the tip. Suspecting corrosion, Corporal Cormier investigated further, and discovered a void in the composite material at the joint with the main spar. Early detection of this fault, and subsequent repair averted a potential serious flight safety hazard. Corporal Cormier's high degree of professionalism and extra effort are exceptional for a student undergoing training.

Corporal Cormier exhibited professionalism and dedication to safe operations beyond his years. His immediate actions averted a serious Flight Safety incident. In recognition, he is awarded this Flight Safety *For Professionalism* award. ◆

Corporal Cormier now serves with 408 Tactical Helicopter Squadron, CFB Edmonton.

CAPTAIN HUGH KENNEDY & CAPTAIN KATHERINE ASHTON

In June of 2003, school standards pilot, Captain Hugh Kennedy, and instructor pilot, Captain Kathy Ashton, were conducting autorotation training in a CH-139 Jet Ranger helicopter at Grabber Green near Southport, Manitoba. Captain Ashton commenced a power-off 500-foot straight ahead autorotation, simulating a demonstration to a student. During the descent, Captain Ashton noticed that the controls were becoming stiff, but thought that the standards pilot (Captain Kennedy) was simulating a student that was holding the controls too tightly.

While in the flare, and just seconds before touchdown, Captain Ashton realized that there was a total loss of hydraulic pressure and called Captain Kennedy to assist with the landing. With no opportunity to overshoot, and with very little time for communication, they were committed to an autorotative landing. As the flight controls were now un-boosted, the helicopter required the combined efforts of both Captain Ashton and Captain Kennedy to pull in sufficient collective to cushion the landing. Together, the crewmembers landed the helicopter from the autorotation without hydraulic assist.

While it is not uncommon for instructors to simulate flight without hydraulic assistance under very controlled circumstances, crews have neither been trained to complete an autorotation with a hydraulic failure, nor have they attempted one. In this case, the crew was committed to completing the autorotation with a genuine failure of the hydraulic system and made a successful landing.

By utilizing a high level of crew co-ordination, in a situation where time was critical, both instructors prevented the loss of aircraft and personnel. ◆

Captain Kennedy and Captain Ashton are still serving with 3 Canadian Forces Flying Training School, 17 Wing Winnipeg.

For Professionalism

MR. LES STEELE

On 27 January 2004, while conducting a Daily Inspection on a CH-149 Cormorant, Mr. Steele detected a fuel smell. Suspecting that a fuel line may have backed off, Mr. Steele checked all fuel line fittings. While conducting the check, Mr. Steele noticed a small collection of fuel directly beneath the number two engine. Checking further, he discovered that fuel was leaking from the main fuel line for the number two engine.

As a result of this discovery, and the consequences that might have developed had this flaw gone unnoticed, the Technical Authority immediately issued a fleet wide restriction pending resolution of the problem. A Special Inspection was initiated, Maintenance Alert issued, and an interim fuel line modification was developed. Mr. Steele's actions not only identified a potentially hazardous maintenance condition, but also prevented what could have been an aircraft disaster. Demonstrating exceptional professionalism Mr. Steele took the additional time that was required to ensure the safety of both the aircrew and the aircraft. Mr. Steele is to be commended for his actions on this occasion and is awarded a flight safety *For Professionalism* award. ◆

Mr. Steele is a civilian contractor with 442 Squadron, 19 Wing Comox.

MASTER CORPORAL CRAIG BALLINGTON

Master Corporal Ballington is employed in quality management at 19 Air Maintenance Squadron. In July 2003, he volunteered to be a member of the servicing crew for the 19 Wing Air Show. On the day after the Air Show, Master Corporal Ballington was tasked to assist a visiting F-16 aircraft with refuelling and then assist as the ground man for start-up and departure. Being unfamiliar with this type of jet, he asked the pilot if there were any special start-up procedures. The pilot told Master Corporal Ballington that he would do his own walk around and explained to Master Corporal Ballington how to visually check the flight controls for him, once the aircraft was started.

Upon engine start, the pilot carried out all his pre-taxi checks and gave the thumbs up sign, indicating he was ready to taxi. Master Corporal Ballington marshalled the aircraft from its position and sent it on its way. As the jet taxied away, he noticed what appeared to be a "REMOVE BEFORE FLIGHT" tag, hanging from the underside of the aircraft. He immediately notified his crew chief of the situation who, in turn, contacted air traffic control and had the jet stopped for further inspection. The inspection revealed that the tail hook pin was still installed. The pin was removed and the aircraft departed without further incident.

As an aircraft structure technician, Master Corporal Ballington is not familiar with regular servicing requirements. None the less, his keen eye and professionalism prevented a potential accident. If, during the take-off roll, the aircraft needed to abort using its tail hook to engage the runway cable, or needed to use it on landing at home base, the end result could have been disastrous. Master Corporal Ballington is commended for his attention to detail and his quick action during this incident. ◆

Master Corporal Ballington still serves with 19 Air Maintenance Squadron, 19 Wing Comox.

CORPORAL CHARLENE MORGAN

On 19 August 2003 at approximately 1830hrs, a civilian fixed wing aircraft entered the Petawawa Mandatory Frequency Airspace without first establishing communications with Petawawa advisory. Corporal Morgan was the sole Air Traffic Control operator in the tower during this time. She attempted to make radio contact with the intruder aircraft but to no avail.

As the civilian aircraft continued its westerly transit through the airspace, it became apparent that the pilot might overfly the live range areas west of the Trans Canada Highway. Still unable to establish radio contact, Corporal Morgan telephoned Range Control and advised them of the situation and that they must check fire. In the meantime, a Squadron Griffon helicopter was nearby, and Corporal Morgan requested assistance from the crew, that they might identify the civilian aircraft.

Range control called the tower and informed Corporal Morgan that there was a scheduled para-drop at around that time, although they had contact with neither the drop zone controller nor the pilot. Soon after, the Griffon crew successfully made radio contact with the civilian pilot and instructed him to contact Petawawa advisory. The pilot then proceeded with para-activity with the permission of Range Control through Corporal Morgan.

The Flight Safety investigation revealed that the civilian aircraft and pilot had been hired by Land Forces Central Area to conduct para-drops into drop zone Anzio in Petawawa in support of a militia exercise. The pilot was unfamiliar with the procedures for operating in the Petawawa airspace and within the confines of the drop zone.

Corporal Morgan's knowledge of flight advisory and air traffic control procedures led to their resolving a potentially serious incident. She responded quickly and showed sound judgement in her actions. Corporal Morgan's resourcefulness and initiative surrounding this event is just one example of what makes her an asset to her unit. ◆

Corporal Morgan is still serving with 427 Tactical Helicopter Squadron, 1 Wing Petawawa.

PRIVATE MARTIN DELISLE

Newly posted to the squadron, Private Delisle was assigned to start aircraft 188745, under supervision, to achieve his knowledge on CF-188 park/start qualification. On the last chance check, he saw that the left horizontal stabilator was incorrectly positioned two inches above the 12 degrees nose up position index mark. He immediately informed the pilot who subsequently shutdown both engines. Summary investigation revealed that the actuator ram was almost completely detached from the stabilator spindle attach point.

Private Delisle's professionalism, alertness, and quick reactions revealed the anomaly before flight, thus preventing a possible serious accident. Without his initiative, the stabilator could have failed in flight, with disastrous consequences. For his initiative, Private Delisle deserves this Flight Safety award. ◆

Private Delisle is an Aviation Technician working at 425 Tactical Fighter Squadron (TFS) first line maintenance (servicing) at 3 Wing Bagotville.

For Professionalism

CAPTAIN MAUREEN CRABB, CAPTAIN TARA LANGLEY, AND CORPORAL LU VAN GENT

On Saturday 8 November 2003 at approximately 2300hrs, Captain Crabb was the duty Tower Controller at 4 Wing Cold Lake. At that time, she encountered a civilian aircraft that was apparently lost. The pilot had requested tower extend his flight plan by 30 minutes. The pilot thought he was just north of Cold Lake (the actual lake). Captain Crabb viewed the Radar Situation Display (RSD) and correlated it with the Direction Finder (DF) and concluded the pilot was unsure of his actual location, as the information did not correspond with where the pilot thought he was. Captain Crabb contacted Cold Lake Terminal to see if they were receiving any raw radar returns, as the aircraft reported not having a transponder. Captain Langley, the duty Terminal Controller, scanned the radar scope and the only raw returns she saw were two weak returns approximately 21 miles south, travelling very slow. Captain Langley asked Captain Crabb to instruct the aircraft to climb in order to receive a better radar return. At this point, both controllers believed the aircraft was actually one of the radar returns to the south of Cold Lake. Also working at this time was Corporal Van Gent, a Precision Approach Radar (PAR) controller, who had also just received her civilian Visual Flight Rules (VFR) pilot's licence only hours prior. She informed Captain's Crabb and Langley that Frog Lake was in the vicinity of the raw return. She emphasized her belief that the pilot was mistaking Frog Lake for Cold Lake. Captain's Crabb and Langley worked together to issue the pilot a series of "suggested VFR headings" to positively identify the lost aircraft. Once identified, the controllers correlated all available information from the DF and RSD and issued a series of VFR headings towards the base. Captain Crabb turned on the runway lights and strobes to full strength to assist the pilot in visually identifying the location of 4 Wing. When the aircraft was approximately 6 miles south, the pilot reported the Cold Lake runways visual and continued to the Regional airport (approximately 4 miles north east of Cold Lake) without further incident.

When Captain Crabb realized that the position report given by the pilot did not coincide with the information given by the direction finder (DF), she quickly enlisted the assistance of the Terminal crew. Together, they were able to ascertain the true position of the lost aircraft and render the assistance required to get the lost pilot home. Combining the best attributes of teamwork by utilizing professional and personal knowledge and skills, Captain Crabb, Captain Langley and Corporal Van Gent are to be commended for preventing the situation from deteriorating to a potentially hazardous emergency. ◆

Captain Crabb, Captain Langley, and Corporal Van Gent are still serving with Wing Operations, 4 Wing Cold Lake.

Good Show

MASTER CORPORAL ARON LEHTINEN AND MASTER CORPORAL CHUCK MATHEWS

On Wednesday, 4 June 2003, Master Corporals Lehtinen and Mathews were standing outside the Quick Reaction Alert (QRA) facility in Comox. There was a fully loaded *Operation Noble Eagle* Hornet in each of the four hangar bays. An air sovereignty alert practice scramble start involving two aircraft was in progress when Master Corporal Lehtinen heard the auxiliary power unit (APU) on one jet cut out shortly after the number one engine began to turn over. He proceeded into the hangar and saw the technician in the 'man one' position signalling the pilot that there was a fire. Initially he suspected that the APU was 'torching', as is often the case in situations of early APU shutdown followed by a quick restart attempt; however, he soon noticed that the entire underside of the tail section was in flames. At this point, the pilot abandoned the aircraft and moved a safe distance outside of the hangar. Master Corporal Lehtinen and Master Corporal Mathews immediately rolled a portable fire extinguisher to the rear of the involved aircraft. Master Corporal Mathews energized the extinguisher and remained in position to ensure Master Corporal Lehtinen's safety. Master Corporal Lehtinen aggressively fought the fire, which was burning just behind two AIM-7 missiles, until it was extinguished. He then ran to and climbed the boarding ladder to the cockpit. Quickly he shut down the restarted APU and turned off the master power switch to ensure that there would be no re-ignition of the fire. By this time, base fire fighting units arrived and inspected the aircraft to ensure there were no internal fires and no chance of a flare-up.

In disregard of their own safety, Master Corporal's Lehtinen and Mathews' instinctive response in a critical situation prevented the possible destruction of one or more CF-188 aircraft as well as the potential loss of life or serious injury of the fifteen other personnel manning the QRA. These two individuals are commended for their outstanding display of bravery, quick thinking and decisive action. ◆

Master Corporal Aron Lehtinen and Master Corporal Chuck Mathews serve with 441 Tactical Fighter Squadron, 4 Wing Cold Lake.

Good Show

MASTER CORPORAL DANIEL HOWITT

Master Corporal Howitt, an Aviation Technician working in 8 Air Maintenance Squadron, was passing through 5 Bay, 10 Hangar, when he noticed what could have been a potential problem. He observed vehicles parked around an aircraft with open fuel tanks. As he approached the aircraft to pass on his safety concerns, he noticed that a non-fuel "Tiger" vacuum, stencilled with "NOT FOR FUEL USE" was in place to possibly de-puddle the aircraft. The non-fuel "Tiger" vacuum had a plastic hose attached and not the approved and grounded fuel "Tiger" vacuum hose. The non-fuel vacuum, which was configured for vacuuming dust, was missing vital safety attachments, such as grounding cables and static dissipation screens.

Realizing that he had come across a potential explosive situation, through the use of an unauthorized vacuum to de-puddle the tank, he immediately ordered all fuel cell maintenance to cease on the aircraft and notified his supervisor. If this had gone unnoticed and the maintenance crew used the vacuum to de-puddle the tanks, the results would have been catastrophic.

Master Corporal Howitt's keen sense of responsibility and immediate action prevented a possible serious flight safety incident. ◆

Master Corporal Howitt is still serving with 8 Air Maintenance Squadron, 8 Wing Trenton.

The Editor's Corner

MYSELF

Hello — As I embark on this new endeavour let me begin with a quick introduction. My name is Rob Burt and I'm the newly minted editor. I am an Aerospace Controller with work experience in both air traffic and air weapons control. Prior to this posting, I spent four years in Goose Bay, Newfoundland and Labrador, and, for three of those years, I was the Wing Flight Safety Officer. There were nine crashes while I was there, five were military and four were civilian. I believed I had relevant flight safety experience to take on this position, but it is now apparent that little has prepared me for the job of editor of a magazine. So I guess I'm asking you to cut me a little slack until I get my feet in under me (how about two issues?).

MY PREDECESSOR

I would like to thank Mr. Jacques Michaud for stepping in as editor for the last two issues, following the departure of Captain Tammy Newman. It's no small feat to put together a publication such as this and continue to do your "day job" at the same time. Kudos!

MY PLEA

The creation of the magazine is a collaborative and interactive process so I invite you to comment on anything that appears herein. I would appreciate any articles or photographs that you believe might further flight safety in the CF. Of course not everything gets published, but everything does get a fair read.

OUR APOLOGIES

Finally I would like to apologize to Master Corporal Aron Lehtinen and Master Corporal Chuck Mathews for an error in the summer issue. Their incredible act was displayed as a *For Pro* when it was obviously a *Good Show*. Their heroic deed is correctly reprinted in this issue.

Fly safe! ◆