National Defence Défense nationale

Flight Comment

ISSUE 3, 2013

PERSONNEL CAUSE FACTORS

Canada

Photo: DND

Views on Flight Safety

By General T.J. Lawson, Chief of Defence Staff, Ottawa

Having proudly served a career that has spanned more than three decades and several flying tours on a variety of aircraft, I am convinced of the importance of the Canadian Armed Forces (CAF) Flight Safety (FS) Program to the well-being of our men and women in uniform, and their ability to conduct operations.

While the CAF has made great progress in recent years to advance the occupational health and safety of our members, tragic and avoidable accidents still happen. As safety infractions can result in the death and injury of CAF members, the loss of operational equipment and resources, and even the impairment of our ability to achieve mission success, I am writing to urge all members and leaders of the CAF team to fully embrace the FS Program as part of our culture and daily routine.

FS must be a concern of more than just our aircrews. In fact, occupational safety is a responsibility that we must all take seriously, regardless of rank or experience. Our cooks who prepare in-flight meals, for example, routinely come into contact with flammable substances, while our technicians, support trades and contractors operate heavy equipment, tooling and ammunition that can be dangerous if handled improperly. Even members of the Royal Canadian Navy and Canadian Army operate in proximity to air and aviation assets, for which a level of familiarity and caution must be exercised. In short, unlike any other federal government department, service in the CAF often requires our members to be exposed to risks and danger. For this reason, the FS Program relies heavily on prevention.

Accordingly, my expectations for the implementation of the FS Program are unambiguous. I expect all CAF members, regardless of rank, to intervene with a view to halting unsafe practices as soon as they are identified. Further, it is vitally important that occurrences and hazards get reported when they are discovered. Heinrich's pyramid theory indicates that for every accident, there were 30 reported incidents and up to 300 unreported occurrences. In practical terms, this means that there are often many missed opportunities to address hazards before they result in the loss of life, limb or operational equipment.

Our FS personnel must be professional, credible, and present their views and recommendations courageously and in a professional manner. Their suggestions should be practical, feasible and effective while limiting impacts to operations when possible. Similarly, it behooves CAF leaders to consider carefully the advice of FS personnel, and to assess and consider risks at an appropriate level.

When accidents do occur, FS investigations will be conducted expeditiously with a view to exposing useful preventive measures (PM) in order to avoid re-occurrences. Changing behaviors that may have led to an accident can be hard work. It takes diligence, innovative thinking and the buy-in of all members. I expect leaders at all levels to seriously assess FS recommendations and to implement accepted PMs in a punctual manner.

The CAF has earned the respect and admiration of Canadians for its ability to respond swiftly and decisively to emergencies in Canada and in support of our allies internationally. That credibility is largely founded on the professionalism of our men and women in uniform, and their ability to identify, manage and mitigate risks. Together, we will reinforce this success by avoiding complacency and remaining vigilant for threats to the health and safety of our members through a robust FS Program. ◆

Flight Comment

Photo: Cpl Vincent Carbonneau

Cover description:
The cover symbolizes different factors affecting the human being in general, in this case a F18 *Hornet* pilot. The maze represents the complexity of the brain with interconnecting stimulus or personnel cause factors that come into play during a FS occurrence. The light / dark colours of the helmet represent the left / right sides of the brain and their inherent strengths and weaknesses. They also represent cold temperature / extreme heat or other physical elements that affect the brain and the body.

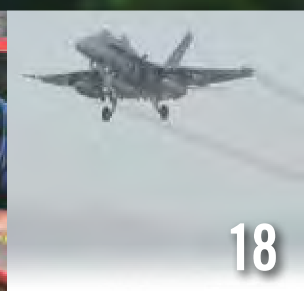


TABLE OF CONTENTS

Issue 3, 2013

Regular Columns

Dossiers

Lessons Learned

DIRECTORATE OF FLIGHT SAFETY

Director of Flight Safety
Colonel Steve Charpentier

Editor
Mr Jacques Michaud

Graphics and design
d2k Marketing Communications

Imagery Technician
Corporal Daisy Hiebert
Corporal Vincent Carbonneau

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. Contributions become the property of Flight Comment and may be edited for content, length or format.

Send submissions to:

National Defence Headquarters
Directorate of Flight Safety
Attn: Editor, *Flight Comment* (DFS 3-3)
101 Colonel By Drive
Ottawa, ON, Canada, K1A 0K2

Telephone: 613-992-0198
FAX: 613-992-5187
Email: dfs.dsv@forces.gc.ca

To contact DFS personnel on an **URGENT** flight safety issue, please call an investigator who is available 24 hours a day at 1-888-927-6337 (WARN-DFS).

The DFS web page at www.rcaf-arc.forces.gc.ca/en/flight-safety/index.page 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

Good Show

For Excellence in Flight Safety

Captain David Marsh

On 22 Oct 2012, Capt Marsh departed Whitehorse Yukon, for Cold Lake Alberta, on a routine night ferry flight in instrument meteorological conditions to return the aircraft to 409 Tactical Fighter Squadron. After levelling off at his enroute altitude, he engaged the altitude hold and navigation coupling systems to keep the aircraft level and flying towards the selected waypoint.

Just prior to crossing Watson Lake, Air Traffic Control (ATC) advised Capt Marsh that he would be out of communication range until reaching Fort Nelson. Suddenly, Capt Marsh noticed an auto pilot caution, then head-up display indications of a rapid left roll and a sudden descent, and lastly an attitude failure caution. Based on these indications, he immediately transitioned to the standby attitude indicator for reference. A few moments later the aircraft displayed inertial navigation system and air data computer failures, degraded navigation, and fluctuating altitude and heading information. Eventually, the altitude and heading stabilized, although any throttle movement caused the heading to vary up to 100 degrees. Capt Marsh then used the standby compass as a heading reference. He quickly identified a frequency on an enroute map and was subsequently able to re-establish ATC communications and request an altitude block to ease his difficulty with maintaining an accurate altitude on standby instruments.

Due to the inclement weather and lack of suitable airports along the route, Capt Marsh chose to continue his flight to Cold Lake. By this time, the aircraft indicated a lower than expected fuel quantity, nonetheless, he knew from planning that he had enough fuel to reach his destination. The weather was severe enough in Cold Lake that a precision instrument approach would be required to land, but not wanting to attempt an Instrument Landing System approach due to aircraft issues, Capt Marsh decided to conduct a Precision Approach Radar (PAR) approach; however, since it was after normal working hours, he knew that a PAR controller would likely not be on duty. Accordingly, he advised ATC in a timely manner so that a controller was able to be coordinated to meet Capt Marsh's arrival. Had Capt Marsh not made this call early enough, he likely would not have had sufficient fuel to orbit while waiting for a controller.

Photo: DND

Capt Marsh currently serves with 409 Tactical Fighter Squadron, 4 Wing, Cold Lake.

The investigation into the incident revealed that the aircraft's embedded GPS/inertial navigation system had unexpectedly failed. Capt Marsh's ability to not only fly, but to also navigate an aircraft on only standby instruments ensured that he safely returned his aircraft to Cold Lake. His initiative to find an ATC contact frequency, to request a block of altitude, and to ensure a PAR controller was called in, kept his aircraft and those around him safe. If not for his stellar actions in an extremely difficult situation, made more difficult by darkness and poor weather, it is very likely that this outcome would have been dramatically different. ◆

Good Show

For Excellence in Flight Safety

Captain Guillaume Paquet and Captain Brent Handy

On December 13, 2012, a formation of two 431 Air Demonstration Squadron *Tutors* were returning to 15 Wing Moose Jaw when one of the aircraft experienced a runaway engine. It was due to the formation's skill and precise coordination both in the air and with ground personnel that a safe engine-out landing was affected.

In consideration of the instrument meteorological conditions at the airfield, the pilots, Capt Handy, lead, and Capt Paquet, wing, decided to return to base with extra fuel after completing their third training mission of the day. Their successful ILS approach resulted in the formation breaking out of cloud around 700 feet above ground. About two miles from landing, Capt Paquet's aircraft suddenly broke formation and shot ahead of the Capt Handy's while at the same time gaining airspeed. Replying to Capt Handy's query, Capt Paquet informed him that his engine had suddenly run up to 104% RPM and that he was unable to control the power using throttle. Capt Handy immediately declared an emergency to ATC and dropped to trail position while Capt Paquet raised his landing gear and flaps to prevent an overspeed.

Without any airfield traffic, the formation was free to manoeuvre visually until a solution was determined. While Capt Paquet troubleshot the malfunction, Capt Handy provided his wingman with timely guidance and judicious advice, reminding him that fuel was not critical and that recovery time was not a factor. Capt Handy contacted 431 Sqn operations and arranged to speak with an avionics technician. The technician advised that the likely malfunction was the main fuel control unit and that the only way to reduce thrust would be to shut down the engine entirely using the engine master switch. The two pilots then discussed contingencies and the possible recovery profiles, which had to be significantly adjusted due to the low cloud ceiling. Capt Paquet then expertly manoeuvred his aircraft using high G turns and what little altitude he had available to reduce airspeed below the landing gear limit. Once the landing gear and flaps were selected, he then shut down the engine and glided the aircraft to a safe landing.

Photo: DND

Captains Paquet and Handy currently serve with 431 Air Demonstration Squadron, 15 Wing, Moose Jaw.

The skill, professionalism, and teamwork displayed by Capts Paquet and Handy preserved a valuable aircraft asset while avoiding a possibly life-threatening ejection. This makes them truly deserving of a Good Show Award! ◆

For Professionalism

For commendable performance in flight safety

Corporal Christian Gauthier

On 10 April 2012, avionics technician Cpl Gauthier conducted a daily inspection and before flight (DI/B) check on a CF188 prior to a post periodic inspection (PI) test flight. He discovered the aircraft control stick was incorrectly installed; the coupling ring which secures the control stick to the control stick adapter assembly was only partially tightened and not lock wired as required by the Canadian Forces Technical Orders. This condition was difficult to spot as a fully installed control stick may have only 1-2 threads showing. In this particular case, the control stick had 4 threads showing, a very small detail which was easily missed due to the location of the coupling ring in the lower section of the cockpit. This condition had gone unnoticed by PI Quality Assurance personnel and multiple checks carried out by various squadron technicians in the days prior.

Cpl Gauthier's keen attention to detail and professionalism enabled him to detect the faulty condition. Had the aircraft flown in this condition, the stick may have separated in flight causing a loss of control which would have led to a catastrophic result. Cpl Gauthier is clearly deserving of this For Professionalism award. ◆

Cpl Gauthier currently serves with Squadron, 3 Wing, Bagotville.

Photo: Cpl Pierre Habib

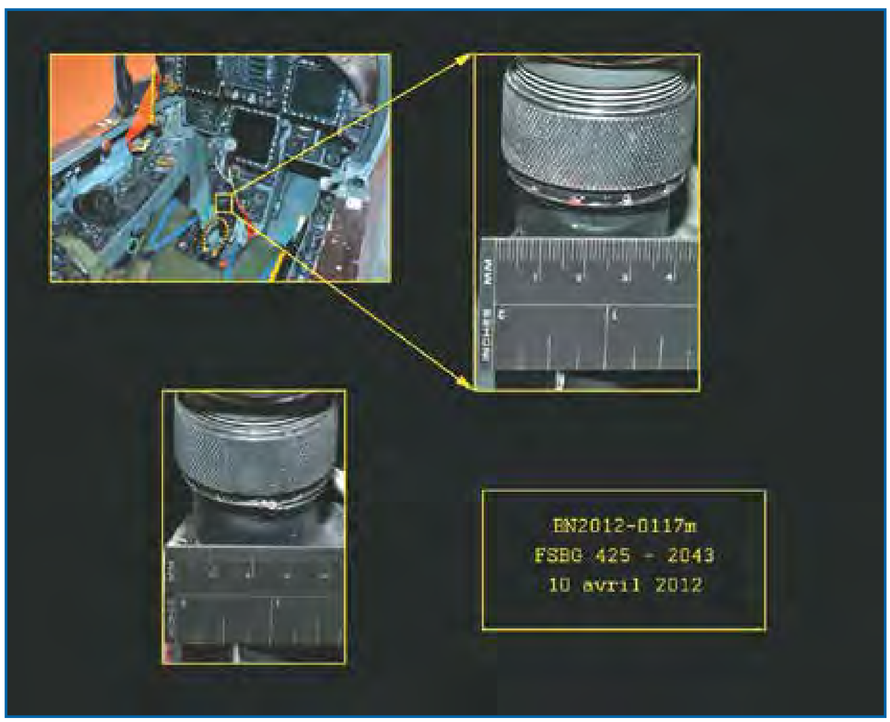


Photo: DND

Mr Eugene Stone

On 12 January 2012, Mr Stone, an IMP aviation technician with 103 Search and Rescue Squadron in Gander, was tasked to replace the gimbal bushings on # 3 engine on a CH 149 *Cormorant*. As part of the replacement procedure, the engine driveshaft is removed, and the engine torque tube remains installed on the engine. On completion of the gimbal bushing maintenance action, Mr Stone preceded to inspect the engine assembly, including areas not called for in the maintenance publications, as part of his final area close out. Looking inside and forward of the torque tube, he noticed that the engine fire shield was missing. The fire shield is located in a very awkward place to examine and is not visible during inspection with the engine driveshaft installed. The engine in question had been installed on this particular CH149 for the life of the aircraft, with over 3000 hours being flown by various squadrons. As well, the engine torque tube had been previously detached for maintenance on four separate occasions without the missing fire shield being detected.

As a result of Mr Stone's findings a fleet wide special inspection was ordered. Mr Stone is commended for his attention to detail, comprehensive knowledge of the engine configuration and dedication in carrying out the extra inspection to ensure the safety of the aircraft and personnel. In recognition of his professional actions, Mr Stone is awarded this For Professionalism award. ◆

Mr Stone works with the IMP Aerospace Division in Gander providing maintenance support to 103 Search and Rescue Squadron.

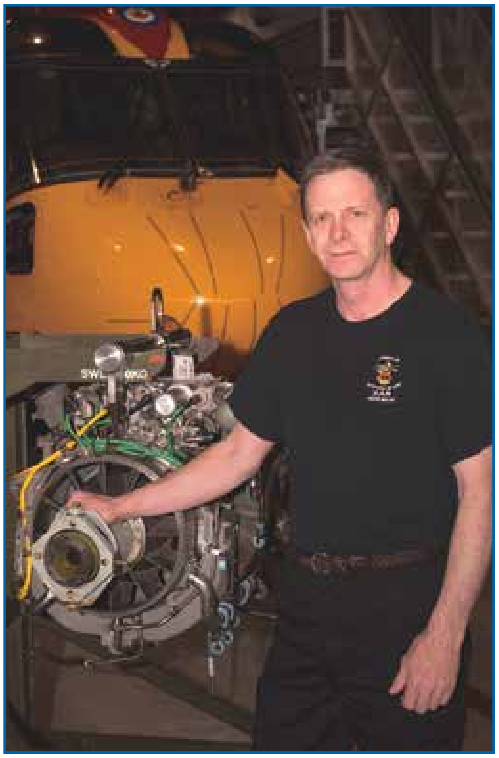


Photo: MCpl Sue Howell

Mr Rick Parent

On 25 May 2012, Mr Parent, a technician with IMP engaged in the maintenance of the CH149 *Cormorant* search and rescue helicopter at 19 Wing Comox, was tasked with refuelling one of the aircraft prior to its departure on a scheduled flight. When the refuelling tender arrived, Mr Parent inspected the tender nozzle prior to hooking it up to the aircraft and noticed a significant build-up of what appeared to be dirt or grime on the inside of the nozzle. Upon removing the residue with a rag he observed that the material was full of metal filings. Mr Parent notified the IMP Flight Safety Officer who immediately contacted the non-commissioned officer in charge of the refuelling section. Inspection of the remaining tenders revealed similar residue on all of the nozzles and subsequently all of the tenders on 19 Wing were placed under quarantine. Further investigation revealed that the refuelling tenders were new and had been delivered with a mount that, when the nozzle was stowed during transport, allowed metal filings to be deposited into the nozzle.

Mr Parent's professionalism, and attention to detail, kept the aircraft from having contaminated fuel, and lead to a fleet wide refuelling tender nozzle mount modification preventing similar incidents. He is most deserving of this For Professionalism Award. ◆

Mr Parent works with the IMP Aerospace Division supporting 19 Wing, Comox.


Photo: Cpl Pierre Létourneau

For Professionalism

For commendable performance in flight safety

Corporal John Sampson

On 6 December 2012, Cpl Sampson, an aircraft structures technician employed with 12 AMS, was assisting 423 (MH) Squadron in the preparation for a mobile repair party. Prior to leaving 423 (MH) Sqn's hangar, he approached the ACS technicians who were performing an approved non-standard repair (NSR) on a horizontal stabilizer on CH12421. He became concerned when he observed that aluminum bronze bushings had been manufactured and were being installed. Recognizing that aluminum bronze is a soft metal and prone to excessive wear he questioned the validity of the NSR. After careful examination of the NSR, CFTOs and the third line overhaul contractor's Maintenance Overhaul Technical Instructions he confirmed that the actual part number listed called for steel bushings, but the written directions stated aluminum bronze. With this critical information being confirmed he reported his findings to higher management.

Cpl Sampson's further investigation revealed that CH12435 had received an identical repair, with incorrect bushings, in September 2012, and as such, was immediately grounded. Cpl Sampson's perceptive recognition of the incorrect aluminum bronze bushing resulted in the NSR being clarified to reflect the installation of steel bushings.

Cpl Sampson's outstanding perseverance was instrumental in averting a potentially dangerous situation. A highly dedicated and meticulous technician, Cpl Sampson exhibited outstanding commitment towards airworthiness and flight safety. Cpl Sampson is most worthy of this For Professionalism Award. ◆

Photo: Cpl Nedia Coutinho

Cpl Sampson currently serves with 12 Air Maintenance Squadron, 12 Wing, Shearwater.

Master Corporal James Wight

On 19 Sept 2012, MCpl Wight, an aviation technician with 409 Tactical Fighter Squadron was tasked with leading a three person crew, and an AERE Phase Training 2nd year (APT 2) officer, in conducting functional testing of the nose landing gear system on a CF188 *Hornet*.

MCpl Wight briefed his crew and gave clear instructions to the APT 2, specifying the task, where to stand, and all associated dangers prior to commencing with the functionals. MCpl Wight manned the hydraulic test stand; Man One was located in the cockpit of the jacked aircraft, while Man Two was to conduct the inspection with the APT 2 watching. With everyone in place, Man One moved the landing gear handle to the retract position; MCpl Wight applied hydraulic pressure, and pressure began to build. Once the hydraulic pressure reaches 2000 PSI, the gear will retract suddenly and very forcefully. As the hydraulic pressure was slowly building, the APT 2 walked under the aircraft to try and get a better view of the wheel well and positioned himself in the retracting path of the nose landing gear. MCpl Wight observed the APT 2 in a life threatening situation and immediately depressed the emergency hydraulic cut off switch and secured the area.

The nose landing gear was only seconds from retracting when MCpl Wight's vigilance and quick decision saved the APT 2 from a potentially lethal injury. In recognition of his professional actions, MCpl Wight is most deserving of this For Professionalism award. ◆

Photo: DND

MCpl Wight currently serves with 409 Tactical Fighter Squadron, 4 Wing, Cold Lake.

Sergeant Alain Belzile

On 6 November 2012, aviation technician, Sgt Belzile, was conducting an independent check on a CH146 *Griffon* aircraft when he observed that the retaining plate for the aircraft's fuel control unit's inlet fuel line had been installed improperly. Instantly recognizing and understanding the critical nature of this error, he immediately performed visual inspections of other squadron aircraft; noting similar discrepancies. As an urgent outcome of his discovery, a special inspection was ordered and a CF-wide *Flash* bulletin was promptly issued by DFS. The subsequent inspections revealed similar anomalies across the CH146 fleet. Had this fault been allowed to continue undetected, it is very likely that the inlet fuel line would have become detached over time, resulting in either a sudden and unexpected engine failure or an engine compartment fire; both of which have catastrophic accident potential.

Sgt Belzile's meticulous attention to detail, initiative and dedication to task during routine checks, have unquestionably prevented the loss of aircraft and personnel. His concern in the identification and rectification of this major vulnerability has directly contributed to flight safety across the CF. Sgt Belzile is truly deserving of this For Professionalism award. ◆

Sgt Belzile currently serves with 438 Tactical Helicopter Squadron in Saint-Hubert.

Captain Pierre Guay

On 29 September 2011, 430 Squadron's Chief Maintenance Test Pilot, Capt Guay, was conducting a routine ground run prior to test flight, following a reduction gearbox change. Upon experiencing stronger than normal vibrations, he shut down the aircraft and began to troubleshoot the cause. Capt Guay's comprehensive knowledge and thorough understanding of maintenance actions carried out during a reduction gear box change led him to investigate the rotor blades. This included a meticulous review of the aircraft maintenance record set. It was at this time he discovered that the serial numbers of the blades mounted on the aircraft did not match those that were supposed to be installed. Further exploration located the correct blades in an adjacent hangar. Rotor blade life is tracked to ensure specific fatigue limitations are not exceeded and blades are balanced to each position on a specific aircraft. It is an integral part of the CF airworthiness program. By installing the incorrect rotor blades on Capt Guay's aircraft, the life cycle management program was unintentionally circumvented, dramatically increasing the risk to flight safety.

Capt Guay's complete examination and intense attention to detail uncovered a serious situation. The manner in which he achieved this outcome is clearly indicative of a superior professional attitude and demonstrated outstanding skill and knowledge; which were directly responsible for the resolution of a significant hazard to flight safety. He is most deserving of this For Professionalism award. ◆

Photo: DND

Capt Guay currently serves with 430 Tactical Helicopter Squadron in Valcartier.

For *Professionalism*

For commendable performance in flight safety

Corporal Sylvain Di Paolo

On 5 February 2012, while deployed on Exercise Faucon Gele, Cpl Di Paolo was tasked to move a CH146 *Griffon* helicopter as a member of a tow crew. The aircraft had been temporarily parked on a runway access ramp at the Thetford Mines airport. As the taxiway was significantly constrained, limited space remained for taxiing aircraft to proceed to the runway safely. An approaching ultralight, committed to taxiing past the *Griffon*, did not have sufficient room to do so safely. The tow crew members, realizing that the pilot had no intention of waiting for the helicopter to be moved out of the way, repositioned themselves strategically to monitor and guide the ultralight past. From his vantage point, Cpl Di Paolo recognized that the right wing of the ultralight was closing dangerously with the rear door of the *Griffon* and in his estimation, contact was unavoidable. The pilot of the ultralight failed to stop, despite several attempts to inform him of the immanent collision. Instinctively, just prior to impact, Cpl Di Paolo grabbed the wing of the ultralight and vigorously pushed it, preventing damage to either aircraft.

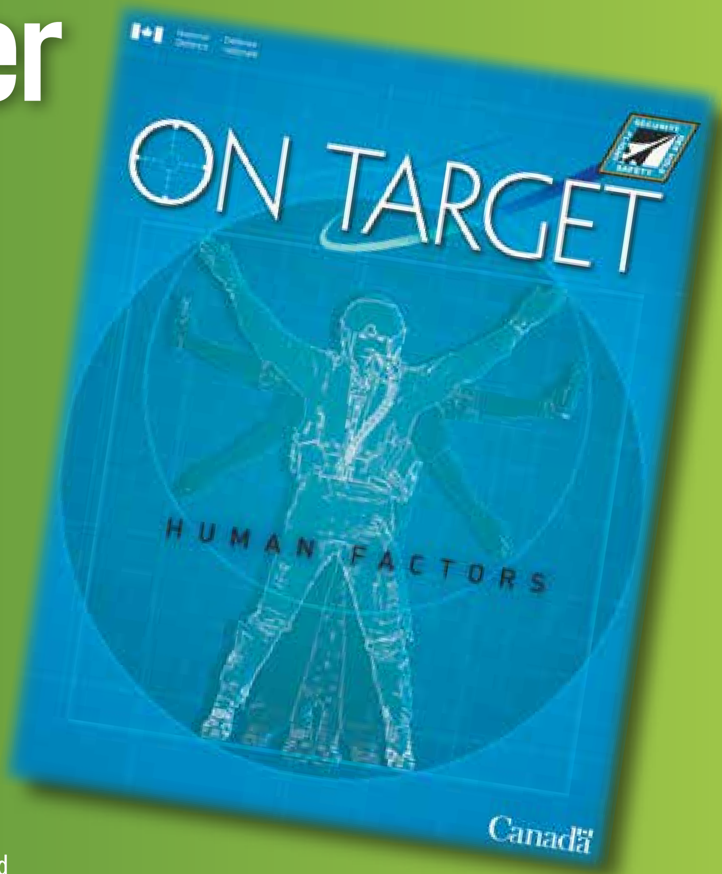
Cpl Di Paolo's vigilance, situational awareness, quick thinking and rapid intervention were directly responsible in averting a serious incident. His exceptional diligence and decisive actions are commendable and fully deserving of this For Professionalism award. ◆

Cpl Di Paolo currently serves with 430 Tactical Helicopter Squadron in Valcartier.

Photo: Cpl François Charest

The Editor's Corner

The Chief of the Defence Staff has indicated his strong views on Flight Safety (FS): "Our FS personnel must be professional, credible, and present their views and recommendations courageously and in a professional manner. Their suggestions should be practical, feasible and effective while limiting impacts to operations when possible. Similarly, it behooves CAF leaders to consider carefully the advice of FS personnel, and to assess and consider risks at an appropriate level." The importance that he gives to the contribution of personnel is critical to the success of the Flight Safety program.



Hopefully you have figured this edition has the theme 'Personnel Cause Factor'. Not only is it written in contrasting colours on the cover but the image speaks for itself. We had to go through numerous sketches before settling on this representation of what could affect an individual in the course of a day's work. Our Image Technician, MCpl Vince Carbonneau who by the way just got promoted and is posted with the office of the Governor General, has done an excellent job to render the concept of human factors with a simple image that is definitely worth a thousand words.

Mentioning a thousand words, LCol Paul Dittmann our Chief Investigator, has used exactly 1834 words to explain the improved CF Human Factor Analysis Classification System (CF-HFACS). This is the third version of CF-HFACS (V3.0) and represents the culmination of 28 months of work within the Directorate. Some will recall the FS seminar held in March 2011 where the problems of the current model were discussed and possible solutions put forward. The minutes of that meeting (under)stated that finding a solution would be complex. LCol Helen Wright, then Maj and Medical Advisor at DFS, did the literature review and put together an excellent first draft of the revised CF-HFACS. After several reviews, the model was simplified, with definitions and examples provided for each cause factor listed. The aim has been to develop a practical and simple document usable by all investigators.

When the FS Program did a review of CF-HFACS in 2009, it was felt that the model would be simpler to use. We published an *On Target* magazine on the topic (Encadre). Hopefully, the revised HFACS will work better. I am confident but the fix applied looks awfully similar to the 2009 solution. Will the results be the same? Of note, Maj Cybanski's article describe how some NATO Allies deal with personnel cause factors and if they use HFACS or not.

Understandably, all the lessons learned articles in this edition are based on human factors. The current Medical Advisor in DFS, Maj Steven Cooper, has written a humorous but compelling article on human factors titled 'The Human Error'. It explains how some innocuous factors, menial if considered individually, can come into play when combined together. As a challenge, you may want individually to try to classify each one of these occurrences and check your answers with a peer. If your answers are in the same ball park, the model will prove its worth. If not, read the 'Check Six' article titled 'Human Error in WW II'. It was published in *Flight Comment*, Edition 4 1977 and shows how some basic errors have influenced the course of the war.

You can anticipate receiving in August a fair amount of correspondence on this issue and a formal amendment for Chapter 10 of the A-GA-135-001/AA-001 *Flight Safety for the Canadian Forces*. The modification will primarily focussed on Chapter 10 that explain the categorization of cause factors as part of the FS investigations. Of note, the other cause factors have not been modified significantly, if only to emulate the format used for the Personnel/HFACS cause factors. Concurrently, the Flight Safety Course material will be updated to integrate the new model in the September serial.

Have a smooth flight!
Jacques Michaud

Maintenance in FOCUS

ROTATING MAINTENANCE

By Sergeant Andrew Elliott, 14 Air Maintenance Squadron, 14 Wing, Greenwood

Photo: MCpl Shilo Adamson

I would like to start by putting things in perspective. The CH149 *Cormorant* helicopters had just been removed from 424 Sqn Trenton for operational reasons and replaced with the CH146 *Griffons*. In order to maintain these *Griffons*, Op *Starfish* had been created; it consisted of one crew of maintainers taken from a 1 Wing unit, and one crew made up from the 3 Combat Support Squadrons, who would deploy to Trenton for 1 month at a time. This led to a high op tempo. There was an ever changing crew dynamic with one crew or the other handing over every 2 weeks, and personally I had done 6 rotations in an 18-month period.

The incident I am writing about actually happened over a period of three of my rotations to Op *Starfish*. During the first rotation in question there was a stiff throttle snag on one of the helicopters. This is a very common problem on the CH146 due to the throttle's design. As the tech assigned to the task, I did the normal troubleshooting and repair. The sector gears and flex shafts on the co-pilot side were inspected. I cleaned everything up nice, reassembled it, did the functionals and everything was fine. About three months later while on another rotation, but with a different crew, the same AC came in for a stiff throttle. I mentioned to the crew chief that it was the same aircraft, but

Photo: MCpl Tom Trainor

I was not selected to investigate it. I thought it was because the crew chief was unfamiliar with me, and under pressure from Ops to put the aircraft back into service.

Another technician was assigned to the repair and after the same usual cleaning, that I had done before, the AC was returned to service. Move ahead another three months and I was back in Trenton with yet another crew. Low and behold, in came the same AC snagged for stiff throttles. The plan was to do the same fix we had already done. I looked into the maintenance records and confirmed that it was the same AC, so I went to the crew chief with this information. This crew chief happened to be very familiar with me, as he was also my crew chief at my home unit, and he gave me the go ahead to investigate further. During the initial fault finding the #2 throttle seized completely about half way between idle and full throttle. Both collective sticks were removed and disassembled. FOD was found in the Co-Pilot's throttle area that had jammed between the #2 grip retaining pin and the cam opening of the stick, which caused the seizing. The sticks were cleaned, re-assembled, installed and functioned serviceable.

The fortunate outcome of this was that the throttle system was repaired while safely inside a hanger, rather than jamming in the middle of a flight, possibly at a critical point. The main thing I learned was to trust my instincts. During the second occurrence of the snag, I should have been more forceful even though I was dealing with a crew chief I had not worked with before, and who also had more experience on the AC than I did. The other thing I have learned and applied in my role now as a crew chief is that, while Ops plays a major role in maintenance decisions, it cannot dictate maintenance. There are some times when the maintenance section has to just step up and say "Stop". ◆

Photo: Cpl Roxanne Shewchuk

From the

Flight Surgeon

The HUMAN Error

By Major Stephen Cooper, DFS 2-6 Medical Advisor, Directorate of Flight Safety, Ottawa

You are the most high tech, modern and complex part of the technology we use in the RCAF. You represent, as human beings, over 80% of the cause factors for aviation occurrences in the world, yet you are one of the least monitored and least understood parts of the machinery.

The new Human Factors Analysis and Classification system (CF-HFACS) helps to organize many of the important factors that will enhance how you perform your job. We are often unaware of the laws of biology, physiology, chemistry and physics that allow us to safely and effectively interact with our environment.

We only become aware of these laws when there is an extreme and immediate feed back of pleasure or pain.

For instance, the laws of physics become immediately obvious when we are on our step ladder fixing our roof in the winter. We lean over that extra inch and suddenly the force vector of gravity has been shifted over just enough to overcome the friction that was keeping the ladder stationary on the ground. Earth's gravitational pull (which has been constant for millennium) acts on the mass of our body until our body rapidly decelerates against the icy ground. Our arm instinctually reaches out to protect our vital organs and the deceleration force is loaded onto our arm bones until they overcome the strength of the bone and you hear the "crack" of the bone breaking and feel the pain.

The laws of physics also apply in more subtle ways. . .and when combined with other factors. . .can add up to a similar disaster. For instance:

- A sprained ankle is getting better after a few weeks.
- You are up and down the ladder several times as you work to repair the aircraft engine.
- Your dog woke you up several times last night.
- You forgot your water bottle, you skipped breakfast to get out of the house to avoid a family conflict.
- Your head cold is getting better with lots of over the counter medications.
- You are working into your lunch hour in order to leave work early.

As you subconsciously raise your foot to get on the last rung of the ladder, your toe drops just a few degrees, your thigh flexes just a few degrees less, your toe catches, your bad ankle twists slightly and gravity takes you the 5 feet to the concrete floor below for a sudden and catastrophic rapid deceleration.

Humans do not come with gauges, lights, and other objective measures to detect when our performance is degraded. We rely on a set of rules and regulations to guide us in safe practice. Each one of these rules and regulations was usually learned the hard way and at the expense of another individual.

Working within these rules provides us with an envelope of safety; however, this involves high level thinking processes to understand and abide to these rules. Once you are affected by fatigue, illness, hypoxia, dehydration, hunger, and stress; decision making rapidly declines. We are unable to follow checklists, recall information, detect danger, and interact with other humans. The most dangerous thing is that we are not aware that our abilities have been dangerously degraded. No alarm sounds, no light flashes, no gauge goes yellow or red.

Each of these factors act on a continuum. For instance loss of pressurization at high altitude will cause a loss of oxygen and immediate incapacitation and probably a fatal aircraft accident. The same outcome may occur if a technician is flown up to a high mountain with lots of pollution while she has a head cold and tasked to work long hours. The resulting hypoxia and fatigue can lead to a mistake in a safety sensitive task and result in the loss of an aircraft as well.

Our "insight" is one of the first things that become impaired, and it is our insight that is required to recognize and remove us from an unsafe situation. Our loved ones are often the first to notice degradation in our performance. They observe our difficulty in doing routine tasks, coping with simple stressors and interacting with other people. Ironically the degradation in our performance prevents us from accepting their advice and correcting the problem. We may lash out or even blame our loved ones

Photo: DND

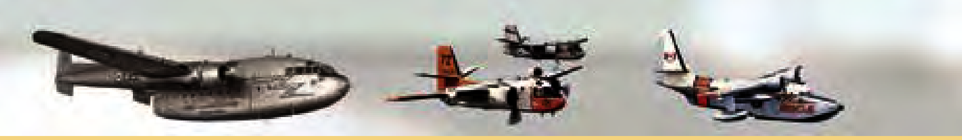
who are simply providing you feed back about degradation, much like a gauge or a warning light does.

"Often our friends, supervisors and co-workers will be the next to notice the degradation in our performance. They will often delay their warning because they are embarrassed to mention their observations. If they detect something, they will offer support such as "lets go for a coffee", "you need a vacation", "let me take you out for a drink". By this time your performance may have already dropped to a dangerous level.

Seeking advice from health professionals will often provide you with a much more objective measure of your performance, both with tests as well as their ability to detect subtle changes that may not be normal and suggest ways to improve your performance.

Reviewing the actual human factors in the HFACS flow chart will also provide you with insight about specific things that have caused accidents in the past and that will continue to contribute to accidents. You can even try giving your partner and children a blank copy of a PER and ask them to complete one on you and then debrief you. (Don't do this unless you are truly interested in personnel growth and improvement!).

We are all subject to the laws of nature and to all the factors that degrade human performance. Once our performance starts to degrade, we are unable to detect this degradation and take corrective action because "insight" is often one of the first things lost. You can use the CF-HFACS flow chart to do some self reflection of factors affecting your human performance. You also need to become aware of our "gauges and warning lights": family, co-workers and health providers, to provide you with effective feedback to optimize your human performance. You may have decreased performance right now, but your impaired "insight" is preventing you from recognizing this dangerous situation. ◆



HUMAN FACTORS in WWII

Flight Comment, Edition 4 1977

By Robert Rickerd – Airdigest

Photo: DND

When man had sufficiently mastered his new found wings to be able to fly beyond sight of his home field, navigation suddenly became an important part of this new art. Though not possessed of the uncanny homing instincts of his feathered fellow travellers, the WWI aviator did have the advantage of the experience of several centuries of mariners to assist him and quickly adapted their skills and instruments to his use.

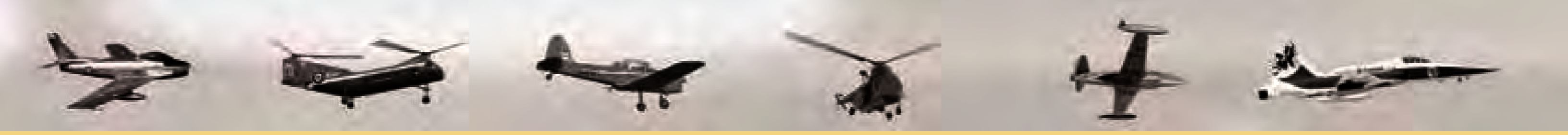
Between the wars many remarkable feats of aerial navigation were recorded, and with them some equally famous failures. Over-the-water flights tempted many pilots fatally. Attempts at Atlantic crossings became the vogue in the 1919-1939 period and cost the lives of 36 pilots and crew in aircraft lost over the ocean, some of them undoubtedly due to faulty navigation compounded by foul weather and fuel shortages. But the most humorous event in the Atlantic crossing craze was the "accidental" flight of Douglas "Wrong Way" Corrigan who parlayed the beginner's error of flying a reciprocal course into fame in 1938.

Amelia Earhart, who had become a member of the select group of successful Atlantic pilots six years earlier, was not satisfied that she had successfully proven women's equality. In 1935, she completed another "first solo" flight for a female, this time between Hawaii and California. Then in 1937 in an effort to emulate Wiley Post's 1933 feat, she set out on a round-the-world flight which was to be her last. Even with the help of Captain Fred Nooman, one of the most skilled navigators in America, who had successfully directed her course for 22,000 miles, she somehow missed an island airstrip in the Pacific and was never seen again.

Amelia Earhart's disappearance was accompanied by a rumor that after becoming lost, her Electra had strayed too close to secret Japanese military installations and had been shot down. This theory went unproved, but if true, the episode could be the first of many military actions involving the Second World War.

"Wrong Way Corrigans" can have serious consequences during hostilities – both to themselves and to the overall effort. One of the first of these, a Luftwaffe Flight Sergeant who had gained experience with the Condor Legion in Spain, and who should have known better, got himself lost over France on November 22 1939. By turning over the latest model Messerschmidt 109 to the Allies at a time when they desperately needed to know the strengths and weaknesses of Germany's number one flighter aircraft, he probably saved a good many Allied pilot's lives.

Later, in June 1942, at a point in time when British Intelligence was planning a Commando raid on the Continent in a desperate attempt to obtain an example of the new Focke Wulf 190 which was sweeping their Spitfire V's from the sky, a Luffwaffe Flying officer presented one intact. After following Spitfires out across the Channel, the pilot became disoriented, flew a reciprocal course and landed near Swansea, not realizing his mistake until the RAF base Duty Pilot jumped on the Focke Wulf's wing and pressed a Very pistol to his temple! Later, when the young Officer realized the significance of his gift, he perhaps understandably attempted suicide!



Further windfalls were to arrive at British airfields via navigational error as the war progressed. One of the most important being a Junkers 88G-1. Early in 1944, German night fighters were slaughtering RAF bombers with the help of new search devices. The new model JU88 was equipped with a radar which operated on a frequency unaffected by the aluminum foil "Window" strips which were being dropped by the RAF to confuse the night fighters. In addition, the aircraft had a receiver which allowed it to home on the tail warning radar of the Lancasters from as far away as forty-five miles.

On July 13th 1944, the secret which had helped the Germans to inflict losses of over ten per cent on the RAF were revealed when a German pilot returning from a patrol over the North Sea flew a reciprocal course into the arms of RAF experts.

Nor was hardware the only valuable item delivered into Allied hands via human error. On January 10, 1940, Hitler ordered that the attack in the West through Belgium and Holland commence on the seventeenth. On the same day Hitler issued his directive, a German staff officer was captured by the Belgians complete with detailed plans of the offensive, when his pilot, another Major, became lost and was forced to land on a flight from Munster to Cologne.

The German plans had to be changed, and the two little countries gained four months grace, while Hitler turned his attention to Denmark and Norway.

On the same day Belgium and Holland were attacked, May 10, 1940, German Heinkel bombers made the first of many tragic errors in navigation which were to unintentionally snuff out the lives of unsuspecting and innocent civilians. Briefed to attack a French airfield, three of nine aircraft became separated and lost their way in cloud. Mistaking the German town of Freiburg for the French target, the bombers missed the airfield and dropped most of their bombs inside the city limits in broad daylight. Of the fifty-seven victims, thirteen were women and twenty-two were children.

There were many other fatal instances of disorientation in World War II, some of them quite well known. The "Lady Be Good" was one of these. Returning from a mission against Naples harbor in 1943, the American Liberator overflew its base and followed a reciprocal course four hundred miles into the Libyan Desert. The wreckage and bodies of the crew were not discovered until sixteen years later. In 1942, the Duke of Kent and all but one of the crew of a Sunderland flying boat were killed when the aircraft drifted off course, hit high ground and crashed in Scotland.

The exact fate of the legendary band leader Glenn Miller was never discovered. He disappeared on a flight from England to Paris in December 1944. They all could have used some of "Wrong Way" Corrigan's luck. ◆

Photo: DND

Photo: DND

Photo: DND

Pressitis

By Major Wilfred Henson, 4 Wing Operations, 4 Wing, Cold Lake

My CF188 *Hornet* squadron was tasked to do a motivation exercise and fly a long range mass attack on the Moose Jaw airfield from Cold Lake. This represented very good opportunity for a multiple aircraft lead upgrade, to put on a display of force for the new pilots and then have a few drinks at the mess thereafter.

The day of the mission, however, provided less than ideal weather. The consensus between the crews is that it was just good enough. The transit plan was simple, depart in instrument meteorological conditions (IMC) radar trail until the descent to visual flight rules (VFR), marshal and then carry out the attack followed by a fly past and recovery. The weather contingency plan was GO until the NO GO would be called.

As I approached the marshal point on the "B" model CF188, I had the luxury of discussing the situation with my back-seater pilot. At minimum safe altitude (MSA), we anticipated the NO GO call anytime as we were in a milk bowl with no horizon and only occasional glimpses of earth through the haze. To our surprise, Lead radioed Terminal he was VMC, cancelled IFR and called pressing with the attack. On the radar, I saw the jets in front of me descending and turning. I waited for my jet to break out of the weather, and then waited some more. I told my back-seater that I couldn't cancel IFR and he immediately concurred. With that support I advised Lead I was IMC and unable to cancel IFR. Immediately after, one of the other jets that had just let down made a sudden alert call to avoid a tower he had just seen in the haze. With those two calls still hanging in the air, the Mission Monitor called the NO GO.

For this mission, the weather represented our greatest threat with the ceiling hovering right at MSA and visibility on the limits. In Lead's opinion the weather at MSA had met his VMC criteria to continue with the mission and from then on he completely re-focused his attention in getting the attack on target and on time. Once Lead had made the decision to press onwards, the elements of the formation simply went with him. The Mission Monitor had been so busy trying to stay in formation with Lead that he hadn't been able to absorb that the weather wasn't suitable for the attack, that is until the two radio calls forced him to refocus. I had broken the chain largely because I had a crewmember with me to discuss what was happening and share assessments with, which gave me the extra confidence of knowing it wasn't just me and my perceptions making the decision. There were some unhappy faces at the bar that night, but most importantly everyone was there to discuss the incident, and the lessons could be taken back home. ◆

The COVER-UP

By Chief Warrant Officer Pat Hort, 1 Canadian Air Division Flight Safety, Winnipeg

I was working VIP transport snags in 412 Squadron Ottawa, in the early nineties. A CC109 *Cosmopolitan* had just ground aborted from a VIP tasking. I was the MCpl in-charge (IC) of a small communication / radar crew. We quickly found what we thought was the fault with the aircraft, a wiring snag within the navigation system, and estimated it would take an hour or two to fix. Here lies part of the problem: our crew was going off shift after just completing seven days on shift. We were due for three days off., and so completed our aircraft records set paperwork, turned in our tool kits, carried out our handover to the oncoming crew and went on days off.

A little more background with regards to 412 Sqn Ops will help frame the events that followed. 412 Squadron's primary mission was VIP transport. It was a 24 hour / 365 day operation. There were three maintenance crews working day and night shifts. Serviceable aircraft availability was almost always less then the VIP taskings. When an aircraft was not available due to snags, the nature of the problem was always reported to very high levels within CAF senior management.

After three days off work, my crew reported for duty. To our surprise the CC 109 was still unserviceable. We took the handover from the crew going off duty and reviewed the aircraft record set. We checked the night book, as six other shifts had worked on the aircraft since my crew had first seen it. The snag that we had narrowed down to an hour or two fix now involved almost every communication and navigation system on the aircraft. The CF349s now numbered over 20.

I directed my crew to put the aircraft back into the state it was in when we had done the handover three days earlier. While returning the aircraft to this state, I found a section of lock wire in the base plug of one of the navigation computers. The lock wire had a nice little pig tail on it, as it had been used to extend a meter lead in the fault finding of the navigation system. The lock wire was now shorting many pins together in the base plug causing circuit breakers to blow and systems to fail throughout the aircraft. We knew that this wire had not been placed there by our crew as we hadn't worked on this system prior to going off shift. I showed the crew desk Sgt what we had found and told him we would fix the snag in no time and clean up the paperwork. When we removed the lock wire, reinstalled the other systems and reset the circuit breakers we were back to the original snag.

Photo: DND

We returned the aircraft to a serviceable state very quickly IAW with all CFTOs with no shortcuts taken.

Now we had to figure out what to do with the over 20 CF349s that were in the aircraft record set. As the aircraft record set was a mess, I elected to transcribe the original snag on to a new 349, to open support work entries for the work that we had performed and to destroy the other 20 plus 349s. We didn't report the lock wire that we found. The aircraft was returned to a serviceable state and flew the next day without incident.

As my crew was on night shift, we missed the events that took place the next morning. When senior management found out at the morning OPS briefing that they had lost an aircraft for three days for such a minor snag they were quite displeased. This displeasure moved down the food chain. The crew on shift did not know about the lockwire, and tried to deflect blame to my crew by pointing out that we had destroyed over 20 CF349s, "official records" in violation of the PO4. When my crew came back on shift, I was called to account for my actions. The whole story came out that my crew was covering for the other crews by not reporting the lock wire and by destroying the aircraft records.

It also came out that transcribing CF 349s was a common practice within our unit. All this was confirmed by the desk Sgt. To say that my Sgt and I were in the dog house would be an understatement.

Failure to report or covering up for others is never an option regardless of how well meaning your intentions are. My destruction of official records and not reporting the lock wire crossed the line. Remember that rules are in place to keep us out of trouble; under no circumstance is there a good reason for not following them. ◆

Photo: Sgt Jean-Francois Lauzé

Little Rock or Bust

By Captain Andrew "Hazno" Faith, Unit Flight Safety Officer, 419 Tactical Fighter Training Squadron, Cold Lake

It's the timeless story of pilot versus weather. For generations aviators have been faced with difficult decisions regarding weather and the completion of a mission. I recently faced a situation concerning weather that forced me and another pilot to make a decision weighing flight safety considerations and completing the mission.

We were tasked with flying the CT-155 *Hawk* from Cold Lake to Little Rock Arkansas for a static air show tasking. After discussing the tasking with the air show manager in Little Rock, he needed our aircraft chocked by 1800 hours on Friday. 419 Squadron operations needed the aircraft for the first wave on Friday, so we were forced to depart Cold Lake in the second wave. This was going to make our timings tight in Little Rock, but not impossible, if we did a quick turnaround at our gas stop.

I flight planned the mission and called customs to arrange our fuelling/customs in Casper, Wyoming. I knew the customs officer there and his quick and painless customs procedures were just what we needed to make our chock timing in Little Rock. An uneventful flight from Cold Lake to Casper put us on time and looking good for Little Rock. All I needed to do was check the weather, file, and we would be on our way.

However, a check of the weather showed a massive line of thunderstorms that spanned all the way from Dallas Texas to Omaha Nebraska, with cloud tops up to 40,000 feet. There were also reports of embedded funnel clouds over central Kansas. Since our flight routing had us passing over Salina Kansas, this was not a good sign. Our Little Rock destination was also forecasting a chance of thunderstorms at our estimated time of arrival. We didn't have the gas to go around the weather, we didn't have a suitable 'out' airfield to divert to airborne, and after consulting with the air show manager, still needed to be chocked by 1800 hours.

Looking back at the situation, the decision not to try to fly to Little Rock should have been an easy one; however, all other kinds of pressures were clouding our judgement. There was the operational pressure to get the mission done. There were also personal pressures affecting our judgement. Neither I nor the other *Hawk* pilot had ever been to Little Rock before and were looking forward to the new adventure. In addition, I got word that the CF188 Demo jet was going to be performing in Little Rock, and I was looking forward to visiting an old friend, Captain Pat Gobeil. Lastly, there is the dreaded phone call back to 419 Squadron that neither one of us wanted to make informing the boss that we wouldn't be able to make our tasking.

After some sober reflection and a visit to the Casper terminal building for a more in depth look at how the civilian traffic was funnelling around the storm at flight level 430+, we decided to cancel our attempt at Little Rock. I made the dreaded call to the CO of 419 Squadron to inform him of our decision and the reasons why. We asked to reposition to Denver for the weekend for some IF proficiency flying. He was very supportive of our revised plan and commended our flight safety decision.

So, it's another boring story about a pilot who decides not to go flying because of the weather. However, I learned a few important points about myself and my squadron. First and most importantly, I learned that the Squadron CO believes in flight safety and

> "I made the dreaded call to the CO of 419 Squadron to inform him of our decision and the reasons why."

will support me in flight safety decisions. There was no pressure to "accomplish the mission at all costs." Second, I learned that time and personal pressures will not force me into a making a dangerous decision.

Sometimes it's the boring stories that we learn the most from. ◆

Photo: MCpl Pierre Thériault

Safe and EFFICIENT

By Mr Collin Fraser

Mr Fraser has flown for over 35 years in many aircraft types, at all levels of civil aviation, across Canada and abroad. He is currently flying jets for a major airline.

Successful flight operations require that we continuously check and balance our mission priorities versus the range of hazards a situation can present. On the ground, we can plan and then repent, I mean debrief, at length and leisure. When we are in the airplane, however, the relentless pace of flight imposes time limits on evaluation. Is there a simple tool we can use to help us keep perspective both in the office and while piloting the aircraft?

Many years ago, as a guest of the Instrument Check Pilot School, I learned the phrase 'Safe and Effective'. The terms were used as a double filter. Any flight plan had to fit both parameters. It was as handy a tool in the airplane as in the pilot room. Later, I learned to broaden the latter term to 'Efficient', which seemed more suitable in all cases except emergency.

So we have our mantra: Safe and Efficient. Let's take our academic concept for a test flight.

I was inbound to Boston (KBOS), Captain of a Q400, call sign. . . let's say, 'Dasher 519'. We had a good cabin load that evening. At Flight Level 250, the big Dash 8 was muscling its' way through icing conditions at 360 knots. I was new to the airplane, and my airline was new to Boston. On our side was the fact that I had operated extensively into KBOS, with a different airline, during the previous century.

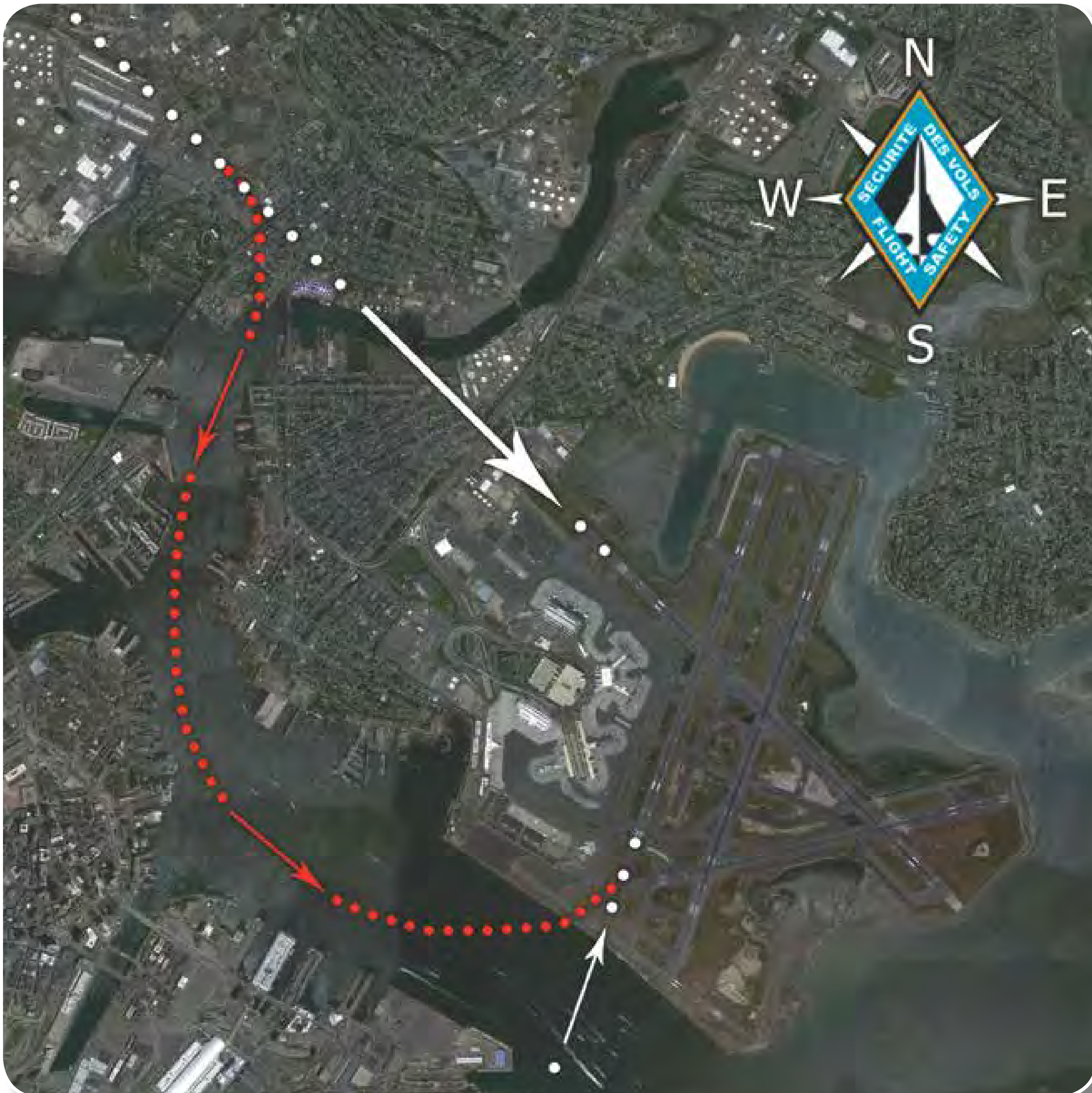


Figure 1

My First Officer (F/O) partner handed me the ATIS printout. It was fairly interesting: weather 1500 overcast, 5 miles visibility, rain, temperature 5, dewpoint 4, and wind northeast off the Atlantic at 15 knots. So, we would have brisk maritime conditions, in the dark.

The approach in use was ILS 04R. Good. Secondary approach was ILS 15R VA04L. That last group of characters tells quite a story. It starts with an instrument approach (ILS 15R) intersecting the main landing and departing stream at midfield. Above minimums, one levels off while breaking sharply right, then navigates visually (VA) along a harbor waterway. At least 120 degrees of left turn is required to align with the landing runway (04L), which is closely spaced with parallel traffic touching down from the primary approach on 04R. Vertical guidance becomes available from PAPI only once on centerline. *(see Figure 1)*

I knew all that from actually having flown the approach in the past. However, my airplane at the time was the original model of Dash 8, half the weight of today's flying machine. I had only ever known the visual approach to be assigned to smaller, slower aircraft types. I wondered if KBOS had much experience handling the Q400. My guess was that, with our speed, we would be directed into the main landing flow. We set up for ILS04R.

As soon as we were handed off from Center to Approach, the controller told us to "…expect ILS 15 Right, visual 4 Left."

Snap decision time. *I am not required to accept an approach I feel is unsuitable. From this direction of arrival, the more tricky procedure saves many track miles. KBOS controllers are serious professionals: this clearance must have been issued because it's routine practice. The weather is just workable. We have fuel for another approach. This aircraft is easily capable of flying the profile I have in mind, with plenty of margin.* "OK", I said.

The F/O was Pilot Flying, so I reprogrammed the nav system and commenced a briefing. We quickly discussed the factors above, with emphasis on not crossing our own runway centerline toward other landing traffic. I noted that the long left turn to final would be difficult to accomplish from the right seat, so I would take control for the visual segment.

Our VNAV displayed a steeper profile for transition to the new approach course. PF reduced power and in we went.

Once established on the localizer 15R we were cleared by Approach Control for the "ILS 15R, contact Tower". Before switching, I expressed my uncertainty as to what the missed approach procedure might be. The response that "Tower will issue headings if you get into trouble," was less than totally satisfactory.

On the glideslope, we were still in cloud. The rain was sheeting off the windshields, but at least the ice was gone.

I called KBOS Tower. His first words were "Dasher, have you flown this approach before?" He was audibly worried, hesitant. "Yes, but that was fourteen years ago", was my reply. A short silence ensued. "Well, the buildings are still on your right. Call 4 Left in sight." He sounded a bit relieved, but not relaxed.

We had nothing in sight. Our weather report was getting old, and the narrow temperature/dewpoint spread was pulling the ceiling down. My hunch was the visibility would be less than advertised as well. At 800 feet we emerged from an indefinite layer. It was a black night; the world outside presenting mostly as dots of light smeared on wet glass.

Soon, we picked out the threshold/PAPI installation of 15R. My visual search of the field beyond revealed an extensive and confusing array of lights. Isolating our desired runway under these conditions was clearly impossible. Still, I knew where the threshold was, and how to get there. I used about a mile of flight path to transition my partner and myself to our main visual cues, the harbor channel and the city core. I radioed, "runway in sight." "Cleared to land 4 Left", from KBOS tower; his tone was flat.

"I have control. Autopilot disengage," I called the flight mode change. Over a landmark I remembered, I banked right, headed down the harbor, set power and trimmed altitude to the nearest hundred mark. We flew an easy left curve along a dark water channel, the business district high-rises close on our right. I was focused largely on the developing left side view. We were circling the edge of the sea island holding KBOS airport.

I distinguished the approach lights on 4 Right, our no go zone. We were arrowing in perpendicular. One heartbeat, then I pulled power, eased the nose down and rolled left to intercept final.

Figure 2

The F/O, now the Pilot Monitoring (PM), surveyed his flight instruments, but couldn't see where we were going. As our turn progressed, the lights of Runway 09 came into view and rotated across PM's windshield. 09 was in use for departures and its threshold was proximate to our own target. It was a very compelling picture, and just what he was expecting: landing position over a runway different from that one over there, after a turn away.

I was cueing on our heading, and kept turning. I could see my partner's situational awareness dissolve as his head tracked the departure runway. "Watch our speed, please", brought PM back inside.

> "That was sweet, Dasher", said Tower. He had a full New England drawl now, "Exit left, contact Ground, point seven."

I held bank angle until nearing our runway heading, mindful of that parallel traffic. Rolling out, I picked out the PAPI lights for 4 Left. Three white. Good for now. Runway lights . . . near centerline. "4 Left in sight, landing," I said. Check speed, power. Back out the window. Drift, OK. "Fifty", from the Radio Altimeter; rudder the nose to the runway, flare, idle.

The mighty Q likes a wet runway. The main wheels skimmed on, and discing provided a reassuring deceleration while I set the nose down. The airplane slowed nicely, and I began scanning for a taxiway.

"That was sweet, Dasher", said Tower. He had a full New England drawl now, "Exit left, contact Ground, point seven."

We set our parking brake ten minutes early. Our passengers had experienced a smooth flight and friendly service. We cleared Customs through the Crew line, and marched back to the gate. After prepping the aircraft, we loaded up for the return flight, our fourth of the day.

The next morning at home, I sat in a sunny armchair and drank a cup of coffee while I considered the previous evening in KBOS. Certainly, everything had gone well. Even so, I felt uncomfortable about the cumulative lack of precision in a challenging approach. I thought an organized review would be useful. Out came the good old metrics, 'Safe and Efficient'. I decided to take them in reverse.

Our approach had saved a lot of obvious flying miles, plus who knows how many more prior to joining the primary landing stream. We had saved airframe time, fuel, and money, money. We can measure those factors. Score maximum for efficiency.

Discussions about safety are rarely black or white. It's more a judgment business. I looked at the approach one step at a time.

We had time to change the approach programming and brief the new exercise. The key procedure was not shown on any chart, but relied heavily on 'local knowledge', which I had. The lack of clear missed approach instructions left the first move up to me, in the event. Not what I was hoping for, but very well, if you insist. The deteriorating weather was much as expected, and remained adequate. In terms of obstacles, while we were guiding ourselves along the harbor, some of the downtown buildings might have exceeded our height. The procedure was a visual, and the towers were lit, so fair enough.

Level flight below 1000 feet is actively avoided in most heavy aircraft. My airplane had once again demonstrated that it was both capable and comfortable. But, during the last turn to final, the physics of inertia and my angle of attack display both told me that we were close to those margins I mentioned earlier. The approach track rapidly closes on other landing traffic at low altitude. A late and sharp turn away is required. I had to admit that the necessarily precise final turn must be initiated purely on instinct. Effective guidance is available too late for significant corrections. You nail it or go around.

My partner was not familiar with the exercise, and was waylaid by distraction. I began to feel that, while I had understood and mitigated the factors affecting the approach, nearly all of those constraints had been stretched near their limits. I wondered how repeatable my results would be.

Then I pondered the fact that I might be the only pilot in my airline that had flown that approach before last night. How would I feel about tossing an inexperienced crew into a similar dark corner and letting them find their own way out?

I decided to send a report to my Standards people recommending our company not accept that particular non-precision approach. I listed the items we have examined. Highlights were the potential for traffic conflict, and the occluded view from the right seat during a critical low altitude turn. In my opinion, there was insufficient margin for variation or error. I would not accept that clearance again.

> Discussions about safety are rarely black or white. It's more a judgment business. I looked at the approach one step at a time.

It's always nice to have a simple point on which to rest an argument. In this case, I refer to another worthy guideline. Due to the late turn to final, even if we were on speed and vertical profile, we were arguably not 'stabilized below 500 feet'. While the approach I flew might have been marvelously efficient, our analysis reveals that it was not safe enough to remain a viable option.

Our use of 'Safe and Efficient' as an evaluation tool has made quick work of examining a complex flight. If you keep the tool handy on the flight deck, it can serve equally well. ◆

Photo: Senior Airman Amanda Grabiec, U.S. Air Force

Crew Resource Management

By Warrant Officer Joel Langley, 1 Canadian Air Division, Winnipeg

During my four year Airborne Warning and Control System (AWACS) posting with the US Air Force (USAF), flight safety was paramount. The USAF, like the RCAF, reviews all of their incidents and develops programs from lessons learned. One such program introduced in the USAF was crew resource management (CRM). It was assessed that individuals were not communicating well among the aircrews, and that a vast majority of incidents could have been prevented if only the crew talked to one another. CRM is a very simple concept; if you see or feel something is not quite right, it is your responsibility to voice your concern among your crew. Basically it is a gut check. Simple enough!

Well, not really! Sometimes you question yourself about what you have seen, heard or observed, and don't bring things up to your crew for fear of embarrassment, thinking you might have been mistaken. I was faced with this type of situation while flying in Alaska on board a USAF AWACS during transition, a period of flight during a training sortie when the flight deck crew flies different types of approaches around airport or terminal areas. Examples include VFR and IFR approaches followed by touch and goes or low approaches. This could take up to two hours, depending on the pilots training requirements.

Transition gets boring and you tire very fast. Most of the time the mission crew sleeps through it. As a member of the mission crew, I have the luxury to listen to ATC and our flight deck on one of my many radios available to me at my seat location, anticipating the next call such as "request runway 06 for a full stop". During one mission in the spring of 2008, we were on station for over six hours, and finally we were on our way back to Elmendorf AFB. Over the internal net, the aircraft commander advised the crew of the time overhead Elmendorf, and also the dreaded word "transition"! As we came into the Anchorage airspace the mission crew prepared themselves for the possible upcoming two hours of boredom. As an aerospace control operator, with a background in ATC, I find transitions interesting, so I turned up the ATC radios to listen in and mentally visualize where our aircraft was in the airspace, since there are no windows in the mission crew area. Over and over during transition I would hear "request RADAR vectors to Elmendorf runway 06, and vectors back to RADAR." As we got closer the tower, ATC would respond "cleared for the option" and the flight deck would mix it up flying VFR for a while in Elmendorf's airspace. Finally 90 minutes later, I heard the flight deck on the intercom state that the next pass would be for a full stop, but I didn't hear the request go out on the radio to ATC. I was questioning myself that maybe I missed the radio call, as the aircraft commander would never land without clearance. I could hear a flight of F15s requesting their clearance for a landing, and maybe I misheard and we, in fact, had clearance for the landing. Four miles back from the threshold, I expected the pilot to advise Tower that the landing gear was down and state his intentions of a full stop on runway 06, as was done numerous times in the past 90 minutes. Again the radio was silent. Again, maybe I misheard. I would verify my inattention when I heard the tower controller give the winds and the altimeter setting, with the words "clear to land runway 06" to our aircraft. Again nothing! I struggled in my mind, am I missing something? I was debating on asking the flight deck on the internal net to verify if they had received the clearance. Then I thought, I could have been wrong and not heard their communications with ATC, plus if I was wrong and brought up the subject, I could embarrass myself. So I sat silent. Finally, I heard a radio call from ATC as I felt the wheels touched the pavement. It wasn't a typical call advising our pilots on their upcoming exit and to switch to the ground control frequency. It was more severe, and of an urgent nature. At this point I knew the gravity of the situation, and I also knew I was mistaken! Our crew was lucky that we didn't have a major mishap with the F15s in the circuit or other aircraft taxing that day. The aircraft commander was disciplined for the error.

During flight training, we train and certified on CRM to prevent such things. At the end of the day, I was uncomfortable with what I should have done; I would have been a lot more uncomfortable if our aircraft collided with another aircraft. This was a big learning curve in my flying career. ◆

A Mid-Life Upgrade for HFACS

By LCol Paul Dittmann, DFS 2, Chief Investigator, Ottawa

LCol Paul Dittmann has flown the CH124 *Sea King* on three Operational tours and one OTU tour. He has also instructed on the CH139 *Outlaw* while serving as the Commandant of 3 CFFTS. A former investigator, he is now the Chief Investigator in DFS.

Human Factors?

With a variety of interesting flight safety occurrences, December 2012 was a typical month in the RCAF: five live smoke markers were found loaded on a hangared Sea King; a Harvard oversped its landing gear and flaps at 180 knots while on descent; and a Loadmaster noticed undeclared dangerous cargo on a J Model Hercules post-flight. So what did these and the majority of December's other 147 occurrences have in common? They were all the result of human factors (HF).

"Human factors," you ask? That's right. Human factors play a role in most of the CF's 3,100 annual flight safety occurrences! You know that colourful poster with all the boxes on it that may hang on your flight safety promotion board? Well, that's a visual representation of the CF's Human Factors Analysis Classification System (HFACS), which we've used for about a decade….and it has just received a major "mid-life upgrade!"

How We Got to HFACS

In essence, a human factor is an act of omission or commission by an individual(s) or an organization that led to a flight safety occurrence. These HF play a part in the errors we make in the air and on the ground, and there are many ways to define them. Prior to 2003, the CF's Flight Safety Program used a different taxonomy for the assignment of personnel cause factors. Following revolutionary research done by behavioural psychologists at the US Navy Safety Center, on 1 January 2003 the CF adopted its own unique HFACS to document personnel cause factors. By 2007, DFS evolved HFACS V1.0 into V2.0 in order to provide a better understanding of causality, to target preventative measures (PM) that focus on unsafe acts and latent conditions, and to provide data for trending and research. Since then, however, we've found that HF needs to continue to evolve to remain useful and relevant to CF operations.

Back in 2001, DFS (Col Ron Harder) introduced the concept HFACS in Flight Comment, Issue 1, by saying that,

> "…an accident does not happen to an individual, but to the organization – every layer of that organization has somehow contributed. In fact, the individual who was the direct cause is only the last (and least manageable) failure in a chain of events."

Col Harder's comments continue to hold true today just as they did then. That's why we've dedicated a lot of time and effort to maturing HFACS V2.0 from where we left it in 2007. So now you're probably wondering, "What was wrong with V2.0?"

After working with it for four years, it became apparent to the whole Flight Safety Team that HFACS V2.0 wasn't working well. It was a complex classification tool that didn't provide consistent occurrence analysis. The reality was that investigations didn't always fit the HFACS model, which had a taxonomy that wasn't at all times consistent and clear. It demanded too much effort, while drilling down to the smallest subset of an HF did not necessarily yield a better PM. As well, the deviations structure didn't sufficiently address all the situations that investigators encountered. And last, the amount of training needed to effectively use V2.0 was in excess of what could reasonably be provided. So you can see that we needed to revamp HFACS if we wanted a workable HF tool while at the same time remaining a flight safety leader with our allies and industry.

Limitations of Any HF Classification Tool

Before explaining what's new with HFACS V3.0, it's important to understand the capabilities of any HF classification system. Over the last three years, DFS extensively studied the current literature on HF modeling, reviewed other working systems, and consulted our WFS teams. The most significant observation from this undertaking was that **EVERY** HF model is based on subjective classifications. As they rely on investigator opinion and their familiarity with the system, these classifications are not consistent when evaluated by different investigators. Consequently, upon re-examination, it is easy for investigators to reach differing conclusions about a particular occurrence. Because of this inconsistency, statistical mining of **ANY** HF system will not yield scientifically sound data; therefore, conclusive and objective predictions about the next occurrence still remain Flight Safety's elusive "holy grail." As a result, you may ask, "What good then is HFACS?!"

A well-built HF classification model should provide a general understanding of the HF involved in our air and ground operations. It should provide a consistent taxonomy that broadly identifies and analyzes the human elements of an occurrence, helping us to shape our PMs and occurrence prevention efforts. This endeavour, with all its inherent uncertainty, is naturally more art than science. The important point to all this is not to identify with absolute certainty those HF at play in an occurrence, but rather to identify elements in the HFACS model that will aid in determining appropriate PMs.

So, What's New?

Now that the background is out of the way, we can get to V3.0! The new HFACS has numerous changes in both theme and content.

The thematic changes addressed the flaws inherent in any HF system and targeted analysis that substantiates, above all, PM determination. We used a consistent layout and paragraph format while eliminating wordiness. By removing all adjectives in headers and eliminating any emphasis on "failure" and other negative verbiage, we better reflected our "just culture" and left it up to the investigator to determine whether a HF had a positive or negative impact. As there could be many unsafe acts, emphasis on the "last unsafe act" was deleted. This also prompted a slight modification to our interpretation of Reason's "swiss cheese" model that we use to describe how an occurrence happens. Additionally, we acknowledged that there could be several PMs for each cause. Last of all, we increased the use of "note" boxes to focus investigator attention on key elements or hints for consideration while investigating.

Regarding the content changes, there were too many modifications to mention them all here. What follows is an overview of the significant changes, which highlight the reduced complexity of V3.0, though some of the more subtle changes are better illustrated in the four picture panels at the article's end.

Personnel cause factors were broken into a logical taxonomy of groups, categories, and sub-categories based on intent. This makes it easier to drill down to a general yet focussed level of analysis but still allows relevant PMs to be generated. Additionally, we simplified the granularity of the analysis by eliminating

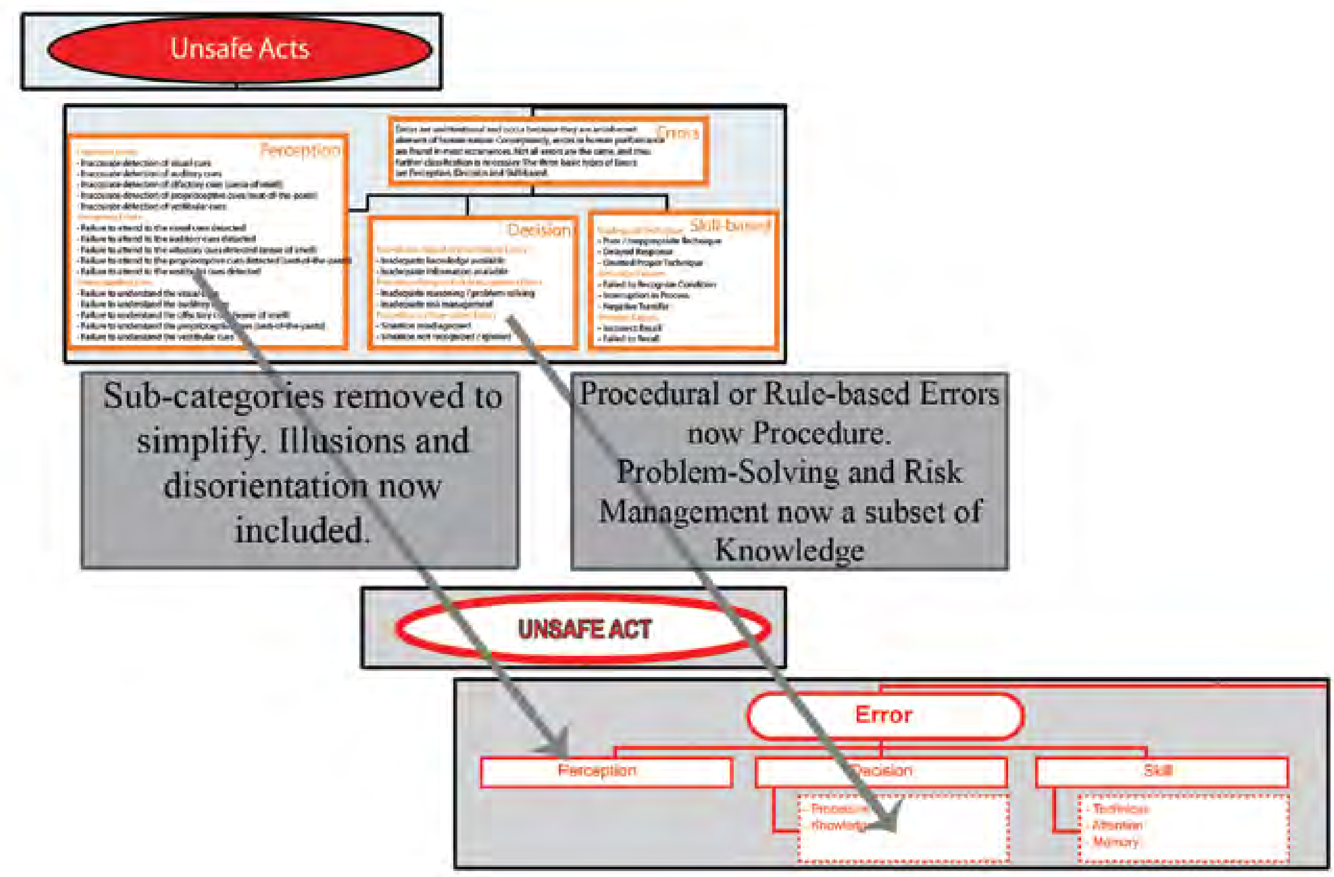


Figure 1

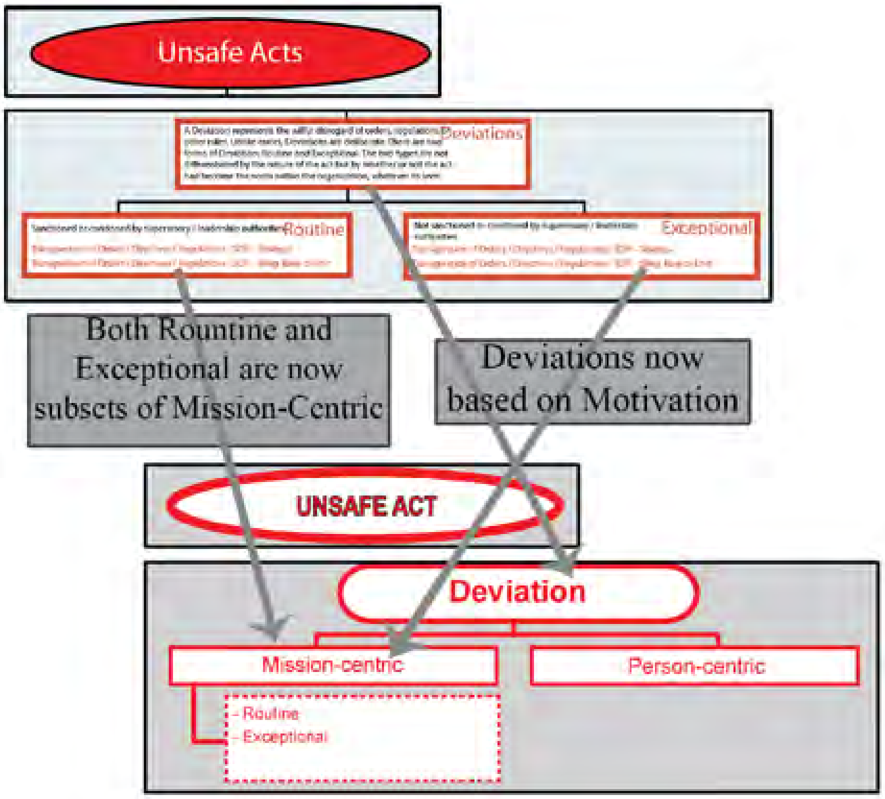


Figure 2

sub-sub-sub-categories, which were too detailed and rigid, and replaced them with a free-text box for investigators to provide further details, if needed. This then prompted the removal of the "other" sub-sub-sub-category as it became redundant. Detailed examples were also included to aid the investigator in identifying the correct HF category.

During our analysis of V2.0, we noted duplication of HF in several areas, and these were eliminated it to simplify classification. For example, Attention was retained in Unsafe Act/Error/Skill/Attention while it was deleted from Preconditions for Unsafe Acts/Conditions of Personnel/Mental States/Attention Deficiencies. Similarly, the element of Perception was consolidated in Unsafe Act/Perception and deleted from Preconditions for Unsafe Acts/Conditions of Personnel/Physiological States/Vestibular, Visual Illusions, and Spatial Disorientation.

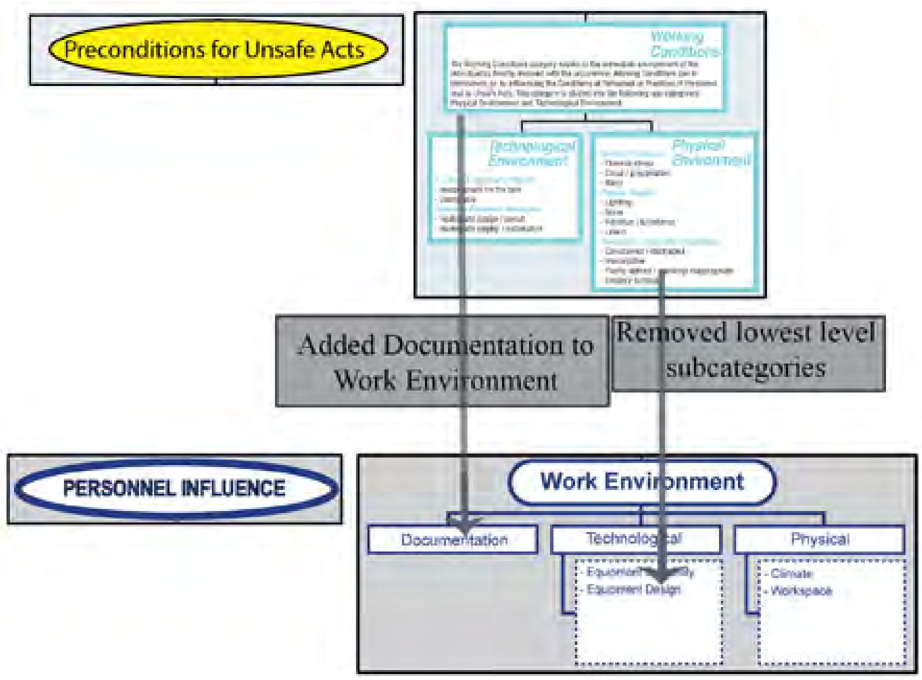


Figure 3

In response to feedback from the whole flight safety team, the Deviation category is now based on the motivation behind the deviation. Consistent with our just culture concept, we interpreted deviations to be a result of mission-centric or person-centric attitudes. Understanding that "getting the mission done" was the intent of the vast majority of CF members, our just culture allows us to accept that sometimes we err in order to succeed. The result was a Mission-Centric Deviation that retains the Routine and Exceptional Deviations that you are already familiar with. On the other hand, on very rare occasions, we encounter an individual who's selfish, and compromises rules and best practices for personal gain. This defines a Person-Centric Deviation. . . and is a matter for the Chain of Command!

And finally, we also put a lot of time and consideration into revising our HFACS poster. It has become a de facto tool to aid the investigator (after becoming familiar with the theory in the Chapter 10. . .of course!) and so it's essential that it be clear, uncluttered, and easy to read. And yes, we have included the poster in this edition of *Flight Comment*!

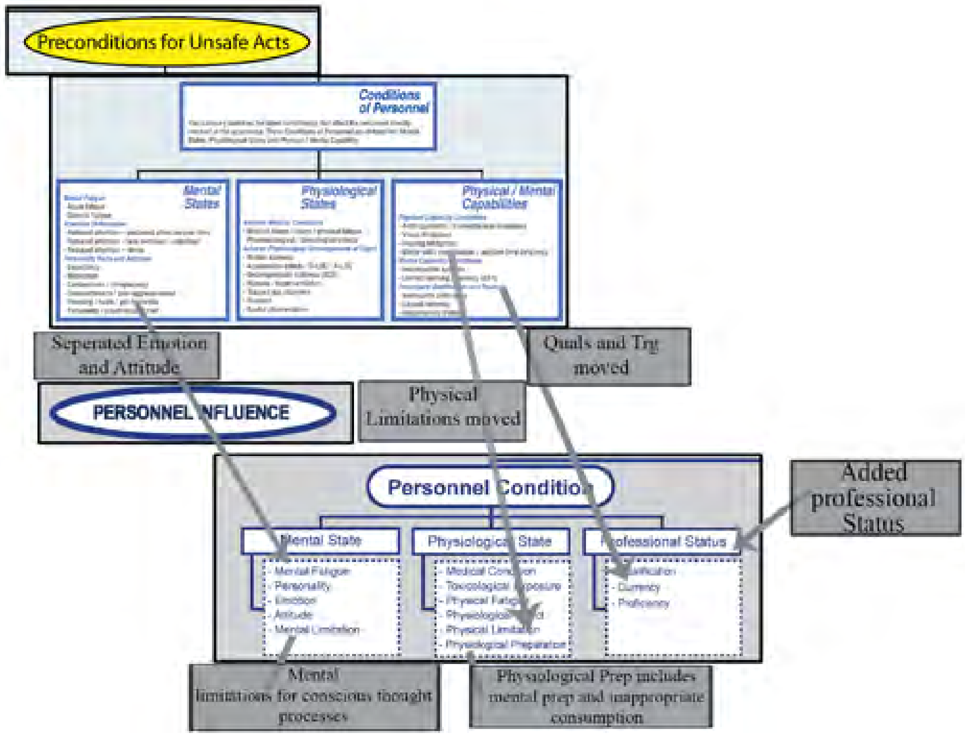


Figure 4

So, What's Left to Do?

"So what's next for HFACS V3.0?" First of all, it will be fully incorporated into the Flight Safety Investigation Management System (FSIMS), replacing the current Flight Safety Occurrence Management System (FSOMS) in autumn 2014, we hope. We also intend to start using V3.0 in a limited capacity in FSOMS on 1 October 2013.

The draft version of HFACS has already been distributed to the entire team for review. Translation and modification of the A-GA-135-001/AA001 Flight Safety for the Canadian Forces is underway and plans are being made to teach HFACS V3.0 on the Flight Safety Course this fall. A V2.0-to-V3.0 mapping matrix will be rolled out to allow users to use V3.0 with the current FSOMS architecture until FSIMS implementation next year. The mapping matrix will also enable data migration from the old to the new system so that future researchers will be able to incorporate past years of occurrence data. Case studies and analysis tools are also possible. Last of all, once we've worked with V3.0 for a year, we'll revisit its efficacy and make any improvements in response to the flight safety team's feedback.

Conclusion (Whew… Finally!)

HFACS' "mid-life upgrade" hasn't been a trivial undertaking, but rather a long and detailed process. We started with a system that we thought worked for us, layered on principles from the most current academic literature, and applied an operator sensibility. The end result, we think, is a simple and understandable systems-approach tool that gives us a sufficient, but not absolute, understanding of HF to drive effective and timely PM generation, with PMs being our number one goal. ◆

HFACS V3.0, can be found in Chapter 10 of the A-GA-135-001/AA001 Flight Safety for the Canadian Armed Forces, Change 7, and will be posted, along with all our current key FS information, on the DFS internet site, http://www.rcaf-arc.forces.gc.ca/dfs-dsv/index-eng.asp. Change 7 will be released in Nov 13.

Impact of Personal Privacy Devices on Global Navigation Satellite System

By Lieutenant-Colonel (Ret'd) Sean Murphy, former DG Space Requirements – GNSS/NAVWAR, NDHQ Ottawa

LCol Murphy joined the RCAF in 1973. During his 40 year career, he served as a tactical helicopter pilot with 427 Sqn Petawawa, 444 Sqn Lahr Germany, and 408 Sqn Edmonton flying both the CH135 and 136 helicopters. He also held various staff positions with the Royal Canadian Air Force (RCAF) and strategic staff with notable tours as A3 Contingency Ops Staff at AirCom HQ Winnipeg, Career Manager, ISR domain manager for the CAF, and most recently as the Navigation Warfare Program Director for the RCAF. LCol Murphy retired from the RCAF on 2 June 2013.

Advancements in Global Navigation Satellite System (GNSS) technologies continue to drive new and evolving GNSS applications. These applications are proliferating exponentially as the technologies are further integrated into mass-market consumer products. For the public sector, significant benefits are being realized thanks to the capacity of GNSS to support vital terrestrial operations in aviation, tracking, timing, geomatics, navigation and search and rescue, to name just a few. The international community, including the United Nations, recognizes the ubiquity of GNSS and the vast implications to society, economics and development globally. To date, the world has mainly relied on the Global Positioning System (GPS). It has been estimated the direct economic benefits of GPS technology in Canada to be in the $6-7 billion range and possibly as much as 6-7% of Canada's GDP may be dependent on GPS (approximately $95 billion).[1] Other nations have or soon will be fielding their own GNSS systems. Unfortunately, GNSS is deemed vulnerable due the availability of inexpensive hardware capable of jamming incoming GNSS signals.

Militarily, GPS has become critical to all aspects of modern CF military operations (PGMs, navigation, precise timing). To protect US/Allied access to GPS and prevent adversary use of GPS, while minimizing the impact outside the areas of operations, the U.S. DoD initiated the Navigation Warfare (NAVWAR) program in 1996. The Canadian NAVWAR Program Office was established in 2002 to be the focal point within DND and the CAF to coordinate, administer and oversee the Canadian NAVWAR activities. The NAVWAR program's main objectives are to evaluate and mitigate vulnerabilities to CAF operational platforms and systems, which include fully understanding the implications of intentional or unintentional disruption of the military and civil use of the GNSS signals, specifically the GPS signal.

"The illegal use of GPS jammers, often referred to as Personal Privacy Devices (PPDs) or Radio Jamming Devices (RJDs) that interfere with the GPS signal, is growing in Canada and throughout the world."

The civil aviation sector is increasingly moving towards a reliance on GNSS technology in order to facilitate the flow of air traffic and to reduce the costs of maintaining land-based infrastructure. Additionally, the air transportation industry is continuously evaluating risk and mitigation strategies of GNSS technology to make the aviation sector as safe as possible. The strategies include the following:

- Three WAAS satellites provide a high level of redundancy over most of Canada.
- Appropriate levels of ground-based navigation aids are being maintained to support flight operations.
- A useable approach completely independent of GPS at either the destination or alternate airport is required.
- Simulation exercises are held to assess the increase in controller workload resulting from a widespread GPS outage, and to train ATC personnel to handle such outages.
- NOTAM alerting of WAAS and/or GPS outages is provided.
- FAWP crossing altitudes are published on approach plates so that pilots can validate the vertical guidance.
- GPS and WAAS performance is continuously monitored.
- Procedures are checked for GPS/WAAS satellite masking and flight checking of GPS/WAAS approaches is conducted before publication.

The illegal use of GPS jammers, often referred to as Personal Privacy Devices (PPDs) or Radio Jamming Devices (RJDs) that interfere with the GPS signal, is growing in Canada and throughout the world. The typical PPD device is usually poorly designed and constructed with the result that they impact a much greater area than intended (most jammers have a range of 100 m to 1 km, however, some may have an effective range up to 10 km). The proliferation of these inexpensive devices has the very real potential to interfere with RNAV approaches at airports.

There have been a number of incidents in Canada and other countries involving PPDs that have caused disruption to the use of GNSS in aviation. Here are a few examples:

- **Newark Airport.** In late 2009, engineers noticed that satellite-positioning receivers for a new navigation aid at Newark Liberty International Airport in New Jersey were suffering brief daily breaks in GPS reception. Over a period of several weeks, sporadic outages of the GPS Ground-Based Augmentation System (GBAS), located at the airport to provide precision approach services, occurred due to radio-frequency (RF) interference from unknown sources. Analysis showed that certain vehicles on a nearby freeway were the likely culprit(s), and using advanced interference detection equipment and multiple surveillance cameras, an offending truck driver was caught and arrested. In his possession was a widely available $33 GPS jammer.[2]
- **Chibougamau Leg Bracelet.** Periodic GPS interference problems were affecting aviation operations at the Chibougamau/Chapais Airport, located approximately 20 km southwest of Chibougamau, Quebec. With the assistance of Industry Canada's Spectrum, Information Technologies and Telecommunications (SITT) Sector radio-communications interference detection technology, and after several weeks of investigation, the source was identified. An offender, who was wearing a GPS ankle monitor as part of court-imposed movement restrictions, was jamming it in order to visit his girlfriend who lived outside his prescribed area of movement. Coincidentally, his travel route brought him into close proximity of the airport.[3]
- **Edmonton Airport.** On 6 and 7 December 2012 and at approximately the same geographic point, GPS signals were reportedly lost by separate aircraft conducting the RNAV runway 20 approach at CYEG. The pilot, who was the same in both incidents, experienced the signal losses flying different aircraft each night. The first night, the signal was lost on both the Universal FMS and the Garmin 400 GPS.

The Universal reported "Position uncertain" and the Garmin simultaneously reported "Poor GPS coverage." The next night at about the same point on the approach, the FMS went haywire and reported "Position uncertain," reacquiring position a minute or two later just before reaching the airport. The fact that it happened in two different aircraft, with three different GPS units made it fairly certain that was not an equipment problem. Also, a Learjet conducting the approach was observed to be off course on final approach but landed without incident. When queried, after landing, the Learjet pilot confirmed he had done the RNAV approach and had lost GPS signal during the approach. Industry Canada investigated and was able to geo-locate the interference to a strip mall close to the approach path. While interviewing persons at the mall, the signal stopped transmitting.[4]
- **Industry Canada Trials.** Industry Canada has been conducting trials since November 2012 to determine the extent of the problem of GPS signal interference by PPDs near Canadian airports. Over the course of 13 days, they had 51 jamming instances. The lengths of these occurrences were short, suggesting that they were being used by transiting vehicles. Not all signals detected were strong enough to impact the GPS approach to the airport, but some were powerful enough to interfere with the signal.[5]

"Although jammers are illegal to own or operate in Canada, Canadian Border Services Agency (CBSA) reports an increased volume of these devices being imported."

In the military, we have the advantage that we carry (for most airframes) military GPS receivers that provide quite a bit of signal protection as long as the receivers are keyed; an un-keyed military receiver provides no added protection. Additionally, most of our aircraft equipped with military GPS receivers, have or will soon have GPS anti-jam antennae systems, adding additional capability protection. Unfortunately, for the most part, the military receivers used by the RCAF are not yet authorized for use when operating in Canadian civilian airspace, which means the installed civilian GPS receivers must be used, making them vulnerable to interference from PPDs.

Both Industry Canada and the Department of Justice are looking at updating both the Radiocommunications Act and the Criminal Code of Canada to address PPDs and other interference devices. In the meantime, aircrew must remain vigilant to this very real vulnerability and avoid complacency as GNSS use becomes more pervasive in our daily lives and impacts our economy. Don't be caught unaware, follow the established procedures that deal with the loss of satellite reception when conducting RNAV approaches and always have a back-up approach dialled up and ready to go. ◆

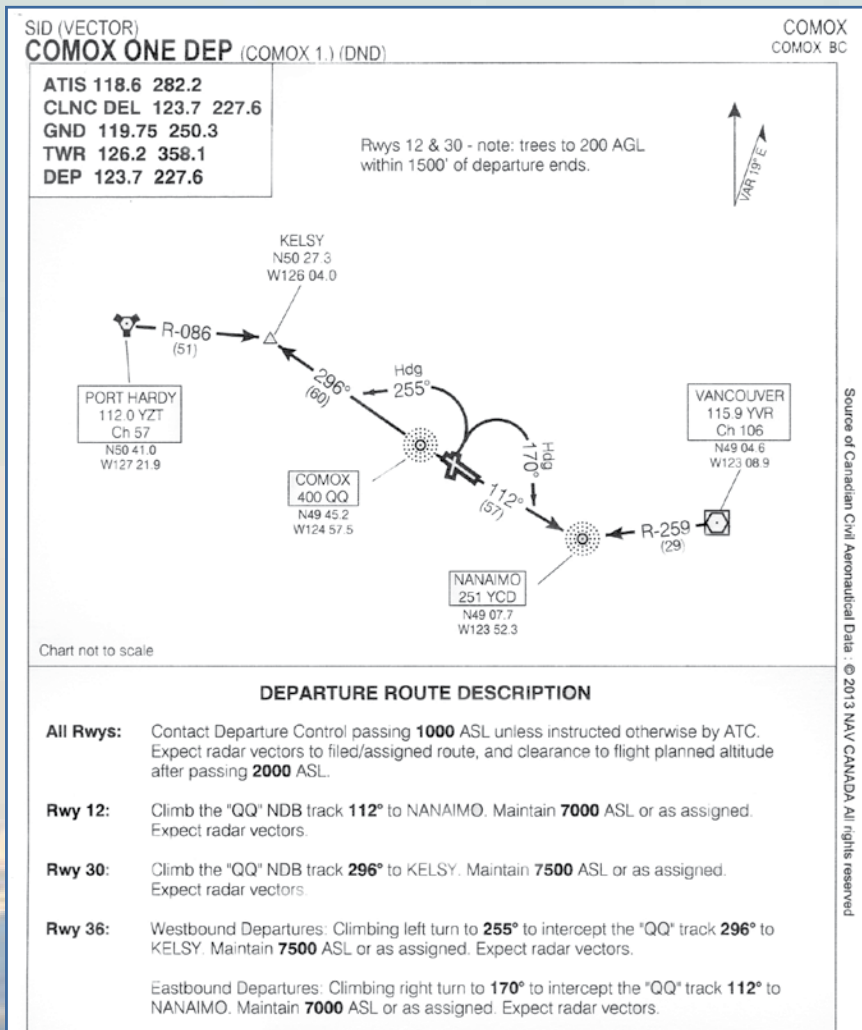
References:

1. Assessment on Canadian Infrastructure and Use of Global Navigation Satellite System, April 2011.
2. ibid.
3. ibid.
4. Report from USCG Navigation Center to Canada GNSS Coordination Office, 10 Dec 12.
5. GNSS Coordination Working Group Meeting, 22 March 13.

On Track

IFR QUESTIONS ANSWERED BY THE RCAF ICP SCHOOL

By Capt Cameron Pow, ICP School Flight Commander, 17 Wing, Winnipeg



DEPARTURE ROUTE DESCRIPTION

All Rwys: Contact Departure Control passing **1000** ASL unless instructed otherwise by ATC. Expect radar vectors to filed/assigned route, and clearance to flight planned altitude after passing **2000** ASL.

Rwy 12: Climb the "QQ" NDB track **112°** to NANAIMO. Maintain **7000** ASL or as assigned. Expect radar vectors.

Rwy 30: Climb the "QQ" NDB track **296°** to KELSY. Maintain **7500** ASL or as assigned. Expect radar vectors.

Rwy 36: Westbound Departures: Climbing left turn to **255°** to intercept the "QQ" track **296°** to KELSY. Maintain **7500** ASL or as assigned. Expect radar vectors.

Eastbound Departures: Climbing right turn to **170°** to intercept the "QQ" track **112°** to NANAIMO. Maintain **7000** ASL or as assigned. Expect radar vectors.

This article is the next instalment of a continuous *Flight Comment* contribution from the RCAF Instrument Check Pilot School. With each *"On Track"* article, an ICP School instructor will reply to a question that the school received from students or from other aviation professionals in the RCAF. If you would like your question featured in a future *"On Track"* article, please contact the ICP School at: +AF_Stds_APF@AFStds@Winnipeg.

Photo: Cpl Pierre Habib

This edition's question is asked on numerous ICP Courses: When air traffic control (ATC) clears an aircraft for a Standard Instrument Departure (SID) that has a routing with a turn, when do you commence the turn?

Every RCAF pilot can answer the big three items that are required for a diverse departure or a "½" departure. They can all recite "35 feet at the departure end of the runway, no turns below 400 feet above aerodrome elevation (AAE) and maintain a climb gradient of 200 feet per nautical mile up to the minimum enroute IFR altitude".

But what happens when you check the aerodrome chart and it says refer to the SID? Most SIDs strive to satisfy the requirements of a diverse departure, thus enabling aircraft with power restrictions to depart safely. So a SID might meet the requirements of the "½" designation even though it directs the pilot to fly a particular routing. This is the basis for this question: If you have to fly a routing that demands a turn, when can you turn?

At what point should the pilot turn to intercept the outbound routing?

On a simple SID, the designer will make it easy for the operator and publish an altitude at which to turn. But what if there is no turn altitude published? For example, look at the *Comox One Departure* and focus on RWY 36. If we look at this SID, the published routing directs the pilot to conduct a climbing left or right turn to intercept a track. At what point should the pilot turn to intercept the outbound routing?

The correct answer for the question is to commence the turn at 484 MSL (400'AAE). However, occasionally we find that VFR procedures get mixed up with IFR requirements and some pilots may delay the turn because, under VFR, they wouldn't turn until 1000' Above Ground Level (AGL).

The problem with this combining of IFR and VFR is that the IFR procedure designer only works with Terminal Instrument Procedures (TERPS) criteria. Every departure procedure has an initial zone in which aircraft climb straight ahead for 400 vertical feet. If a turn is published after the initial zone, the expectation is that the pilot will commence a turn immediately. The safety margins for the procedure change direction to follow the turn, so delaying the turn may bring the aircraft near the lateral limits for safety.

Bottom line: If a SID requires a turn on departure and there is no turn altitude published, the pilot shall commence the turn at 400 AAE. ◆

Photo: Cpl Pierre Habib

Military Use of HFACS

By Major Adam Cybanski, Directorate of Flight Safety, Ottawa

Major Cybanski is a tactical helicopter pilot with over 20 years and 2500 hours on fixed and rotary wing aircraft including the CT114 *Tutor,* CH139 *Jet Ranger,* CH135 *Twin Huey and* CH146 *Griffon. He completed a tour in Haiti as Night Vision Goggle Specialist and Maintenance Test Pilot, and has managed the* CH146 *Griffon Full Flight Simulator. He is a graduate of the Aerospace Systems Course and holds a BSc in Computer Mathematics from Carleton University.*

The Human Factor Analysis Classification System (HFACS) is used by many military nations. Although the system has only been around for ten years, it has emerged as a worldwide standard for classifying human factors (HF). In a recent survey conducted with our military Allies, it was found that each nation takes a different approach to the analysis of HF in aircraft accidents, some sticking with the basics of personnel, material or environment cause factors, while others are working on next-generation systems evolved from HFACS or similar models.

HFACS has an interesting history. In 2003, the US Secretary of Defence challenged the military to reduce the number of mishaps and accident rates by at least 50% in the next two years. An Aviation Safety Improvement Task Force was implemented, which established an HF Working Group (HFWG) with a charter to identify data-driven, benefit-focused, human-factor and human-performance safety strategies designed to identify hazards, mitigate risk and reduce aviation mishaps. The HFWG was directed, among other things, to promote a common human factors classification system for DoD-wide implementation. The HFACS framework was subsequently developed by behavioural scientists from the United States Navy, Dr. Scott Shappell and Dr. Douglas Wiegmann.

The Royal Canadian Air Force (RCAF) has significant experience with HFACS. The RCAF has the unique status of being one of the first organizations to officially integrate HFACS into their safety program. On 1 January 2004, the CF adopted CF HFACS V1.0 to document personnel cause factors. The model was similar to the Shappell/Wiegman model, but integrated changes to categorize maintenance events. Subsequently, V2.0 was implemented in 2007, which added nanocodes and changes to some terminology, such as violations to deviations. This year, the Directorate is making additional changes to better meet operational requirements and improve usability.

HF analysis can be done in different ways. Some countries employ special analysts to code each and every accident, like the US Navy Safety Center. This leads to excellent consistency, as a small number of well-trained personnel can analyze in a very consistent and repeatable manner. Others nations such as Canada, train **all** their flight safety personnel to code occurrences using HFACS. This large pool of analysts is required in order to code all incidents as well as accidents. The reason for this universal approach is that contrary to large forces such as the US Navy, Air Force and Army who can collect enough information strictly from accident analysis, the relatively small number of accidents in the RCAF would not yield statistically significant data without also including incident analysis. The end result of RCAF incident analysis is the collection of a very large amount of HF data. The trade-off is a lack of consistency between investigators, leading to an increased requirement for quality control.

Some HFACS Numbers

Number of respondents to survey: 15 nations

Respondents: Belgium, Canada, Croatia, Czech Republic, Denmark, Finland, Ireland, Netherlands, Poland, Portugal, Romania, Spain, Sweden, Switzerland, United Kingdom

Nations that use HFACS without modification: 6

Nations that use modified HFACS: 4

Nations that do not use HFACS: 5

Number of nations that are planning to improve their system: 7

"We are using the standard HFACS model, but limit it to occurrences that have previously been identified as an event that occurred solely due to human factors."

– Ireland

Many organizations use HFACS as originally developed. The initial developers of the system, the US DoD still employ the original system in their individual branches as explained above. The Belgium Air Force uses the HFACS system to guide their HF investigations, while the Croatian Air Force conducts investigations in accordance with HFACS philosophy, and intends to fully implement the HFACS model. The Polish Air Force employs HFACS for accidents and serious incidents in its annual safety report. They are looking at expanding the use of HFACS with nanocodes and perhaps by modifying the classification system. The Irish Air Corps uses HFACS, only for occurrences attributable to personnel cause factors, but not for any others such as material or environment.

Some countries do not use HFACS at all. The Finnish Air Force uses their own model to classify personnel cause factors, although it bears some similarities to HFACS. The Dutch Air Force does not use HFACS or any other model. Instead they employ the aid of a psychologist when required. The Portuguese Air force breaks down their occurrences into HF categories of crew/operator failure, maintenance failure, and organizational failure.

"There is no specific model used – the investigation team may use whatever seems practical or helps the investigation (shell, 5M, etc.). For statistical purposes we don't go deeper into different types of human error. . . maybe we should."

– Switzerland

The Swedish Air force uses a system with limited HF analysis capability that includes a few HFACS codes. The Romanian Air force is closely examining the US, Canadian, and French HFACS systems in order to adopt an HF classification system in the near future. The Czech Republic Forces does not use HFACS, but is looking into establishing the original or modified system.

Other countries have made significant changes to the original HFACS design. The UK RAF used the original model for a period, but then modified it to apply to Maintenance, and intend to update the model. The Royal Danish Air Force uses a modified version of HFACS and have added a category called Team Factors to capture CRM issues.

"The RDAF uses a modified version of the UK classification system. The system is structured to systematically captivate a description of both the direct circumstances of an occurrence and the underlying contributory factors."

– Denmark

It is clear that the playfield is not level when it comes to military use of HFACS. Most military nations canvassed agree that it is a comprehensive tool that can be used for accident analysis, but many have indicated that it could use some refining to better meet operational needs and improve usability. The key to improving this capability for all nations lies in sharing our experiences and innovations in this field. ◆

Epilogue

TYPE: SAR Tech – "C" Category
LOCATION: Cloud Lake, Greenwood, NS
DATE: 09 January 2013

The accident occurred during a daytime training mission when a Search and Rescue Technician (SAR Tech) received serious injuries upon landing in a confined area following a CC130 aircraft static line parachute jump.

The SAR Tech exited cleanly from the aircraft and commenced flying to the confined area under a normal parachute canopy. He completed his control and manoeuvring check, disconnected his reserve static line snap shackle and completed three sequential spiral turns. He subsequently completed a penetration check and another spiral turn while continuing to descend. Next, at low altitude, he conducted an aggressive 180 degree left turn to enter the confined area via a gap in the trees along the shoreline.

One second after completing the turn, the SAR Tech impacted the ground with considerable forward speed. Two other SAR Techs, who were already in the confined area, ran to the injured SAR Tech to provide medical aid. He was then flown to the Shearwater aerodrome in a CH149 helicopter and transported by ambulance to the Queen Elizabeth II Hospital in Halifax. He sustained "C" category injuries.

The investigation determined that the parachute was serviceable and that the operation of the CC130 aircraft did not contribute to the accident. The investigation is focussed on parachute training, training documentation and the individual actions of the injured SAR Tech. ◆

Epilogue

TYPE: ***Griffon* CH146**

LOCATION: **Kandahar Airfield, Afghanistan**

DATE: **2009 - 2010 Period**

This investigation examined exceedances of aircraft Inlet Turbine Temperature (ITT), Speed Never Exceed (VNE), Main Rotor Revolutions Per Minute (Nr) droop, and Angle of Bank, discovered over a period of several months mostly through the monitoring of aircraft Health Usage Maintenance Monitoring System (HUMMS) data. Several issues in these investigations were also present in CH146434's accident, 6 July, 2009 as follows:

- **ITT:** From December 2008 to November 2009, HUMMS recorded 1,120 ITT exceedences between 810ºC and 940ºC for more than five seconds.

- **VNE:** On CH147 Chinook escort missions, VNE was exceeded to remain in a position to provide close protection. Crews believed the exceedences were justified by their mission to protect the Chinooks at all costs. In one extreme case, a crew flew at 135 knots for an extended period of time despite environmental conditions having reduced VNE by 40 knots to 95 knots.

- **Nr Droop:** Although it was determined to be a frequent occurrence, only one crew reported a droop below the normal operating range. In this case the helicopter was thought to droop to 90% while taking-off from a forward operating base in a dust ball.

- **Angle of Bank:** Flight data analysis discovered 14.7% of all deployed CH146 turns were in excess of 50 degrees of bank. Several were above 60 degrees and, in some cases, up to 88 degrees.

Cause Factors included crews intentionally exceeding limitations and operating the aircraft beyond its capabilities. Ineffective communication between the chain of command and maintenance and air crews also allowed for exceedances to go unnoticed.

Inadequate guidance was provided to tactical level crews to carry out their missions, allowing them to drift away from expected cultural, procedural, and operational norms. Finally, the operational deployment placed pressures on personnel and motivated crews to exceed limits in the belief that it was justified due to nature of their missions.

Safety actions included re-emphasis of limitations and amendments to training and manuals to improve performance calculations. Recommendations included clarification of helicopter pitch and roll limits, improvement of information contained within aircrew manuals, and education on the Power Assurance Check. Improvements to aircraft gauges and modifying the Attitude Indicator to include a mark at the 50 degree limit were also recommended in addition to amending the Commanding Officer's and the Flying Supervisor's courses to deal with deviations from limits, orders and regulations; understand operational and technical authority levels; and identify the challenges between training, domestic and deployed operations. Lastly, it was recommended to implement a military flight operations quality assurance program for all CF aircraft. ◆

Photo: Cpl Andrew Saunders

THE BACK PAGE

Did you know the following Flight Safety activities took place in 2012?

- In 2012, the Airworthiness Investigative Authority (AIA) initiated eight investigations and closed 12. The DFS investigations were for seven CF accidents (one category "A", two category "B", and four category "C") and one Air Cadet accident (category "B") involving two aircraft.
- DFS presented 41 annual briefings (33 English and eight French) at 26 locations across Canada and at the Canadian Contingent at Geilenkirchen, CDLS (London) and SHAPE HQ Belgium. The briefings were attended by approximately 7400 personnel.
- A total of 25 FS award submissions for individuals or groups were considered, resulting in the granting of three Good Show and 19 For Professionalism awards and five recommendations for a commander's commendation.
- A total of five Flight Safety courses (FSC) were conducted by 1 Cdn Air Div FS staff. They qualified 162 personnel, including Air Cadet staff members, civilian contracted service providers, army personnel and DND firefighters.
- Personnel reported 3,236 occurrences, of which 54.9% were classified as air occurrences. When compared to 2011, the reporting rate increased significantly to a 10 year high of 247.2.
- Last year, the FS Program saw a large number of overdue occurrence reports (509 of 3149).
- The air accident rate for the CF also decreased significantly to 0.43 and is below the 10-year mean of 0.64. This was attributable to one category "A" (CC130 *Hercules*), one category "B" (CH146 *Griffon*) and two category "C" (one CH146 *Griffon*, one CC138 *Twin Otter*) accidents.
- DFS conducted three FS surveys at contracted service provider sites (Magellan Aerospace (Orenda) in Mississauga, ON; Vector Aerospace in Richmond, BC; and IMP Cormorant Support Center in Halifax and Greenwood, NS) as part of the DFS' contracted service provider visit program. The FS staff at 1 Cdn Air Div conducted surveys of 8, 9, 12, 14, 16, 17, and 19 Wing, 443 Sqn, and 3CFFTS. A FS staff assistance visit to 1 Wing was also completed.

If you want to read more about the FS Program performance in 2012, read the *2012 Annual Report on Flight Safety* available on the DFS site of the Defence Wide Area Network at http://airforce.mil.ca/caf/fltsafety/index-eng.asp